GLOBAL POTATO CONFERENCE - 2008

SOUVENIR

Global Potato Conference 2008

Opportunities and Challenges in the New Millennium

9-12 December, 2008

Organizers

International Year of the POTATO 2008

HIDDEN TREASURE

Indian Potato Association
Shimla

CPRI

Central Potato Research Institute
Shimla

Indian Council of Agricultural Research
New Delhi

GLOBAL POTATO CONFERENCE - 2008

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SOUVENIR

GLOBAL POTATO CONFERENCE – 2008

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International Year of the POTATO 2008

HIDDEN TREASURE

Organizers

Indian Potato Association
Shimla

Central Potato Research Institute
Shimla

Indian Council of Agricultural Research
New Delhi

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Preface

The potato, which originated in the Peru-Bolivian region about 8000 years ago, has come a long way to become the most favourite culinary item of billions of people of the world. The Spanish conquerors, in search of gold, took the potato from Peru to Europe during the later half of 16th century. Soon the British, Portuguese, Spanish, French, Dutch and Belgian colonialists carried the potato to Asia, Africa and the South Pacific. Colonial officials, soldiers, missionaries and explorers introduced potato growing to their foreign outposts. Initially faced with much opposition by the inhabitants wherever it was introduced, potato acquired the status of 'bread of life' for the people in both developed and developing world. It supported the people across diverse cultures during war and peace, and also helped in reducing the calamities of famine.

Potato is the world's fourth major food crop after wheat, rice and maize because of its yield potential and high nutritive value. With an annual global production of about 320 million tonnes, potato is an economically important staple food in both developed and developing countries. It is a highly nutritious, easily digestible and wholesome food, and offers vast potential for ensuring food security for billions of people of the world. It has the physiological potential to produce 120 tonnes food per hectare with net dry matter yield of 24 tonnes/ha. The current turmoil in world food supply and demand, and rising inflation of food prices have posed a great challenge to feed the burgeoning population, especially in developing countries. In this context, potato offers a potential alternative to serve the mankind as a food security crop. It has been identified by the Food and Agriculture Organization as the 'food for the future'.

The permanent representative of Peru proposed a resolution, co-sponsored by the Latin American and Caribbean group of countries, at the 33rd Session of the FAO Conference in November, 2005 to focus world attention on the importance of potato in providing food security and alleviating poverty. The 68th Session of the UN's General Assembly accepted the resolution in December, 2005 and declared the year 2008 as International Year of Potato (IYP). It invited FAO to facilitate and coordinate the implementation of IYP 2008 all over the world. The IYP is being celebrated throughout the globe by way of organizing hundreds of seminars, symposia, conferences, *etc.* with the aim to create awareness about the role that this wonder crop can play in world food security. The Global Potato Conference being organized during 9-12 December, 2008 at New Delhi could be perhaps the concluding part of this great celebration.

Indian attachment with potato is not a historical one since it was introduced in the country only in early 17th century. However, India has become self-sufficient in production of table, seed and processing potatoes (mainly from sub-tropical plains) due to the development of indigenous varieties, production and processing technologies and the establishment of National Potato Seed Production Programme. The transformation of potato, from its temperate nature to sub-tropical one through indigenous research, has helped in intensifying agriculture in the north Indian plains and ensuring food security of the country. The impact of potato research on agricultural development and social welfare in India has been enormous with the annual potato production touching around 25 million tonnes.

An attempt has been made in this Souvenir to present a holistic picture of potato right from its origin to research and development, and impact in India. The blessings from high dignitaries of India and abroad in the form of Messages for the Global Potato Conference 2008, will serve as a guiding force for successful organization of this maga event. We are indebted to all former Directors and senior officers, once associated with the Central Potato Research Institute, for reinventing the Institute through their reminiscences. We place on record our appreciation to all the Heads of Divisions and Stations and other staff of CPRI for their valuable contribution in this Souvenir. Special appreciation goes to our sponsors who have contributed liberally for organizing this Conference.

On behalf of the Indian Potato Association, I take this opportunity to thank the executive of IPA, and the chairman and members of advisory and various organizing committees who shared with me the responsibility of organising the Conference in a befitting manner. I hope that this Conference would evolve suitable strategies for the expansion of potato production, processing and utilization in the world in order to meet the challenges of food security of the new millennium.

I wish the participants of GPC 2008 a very happy stay and fruitful experience during the Conference.

SK Pandey
President, IPA

Shimla: December, 2008

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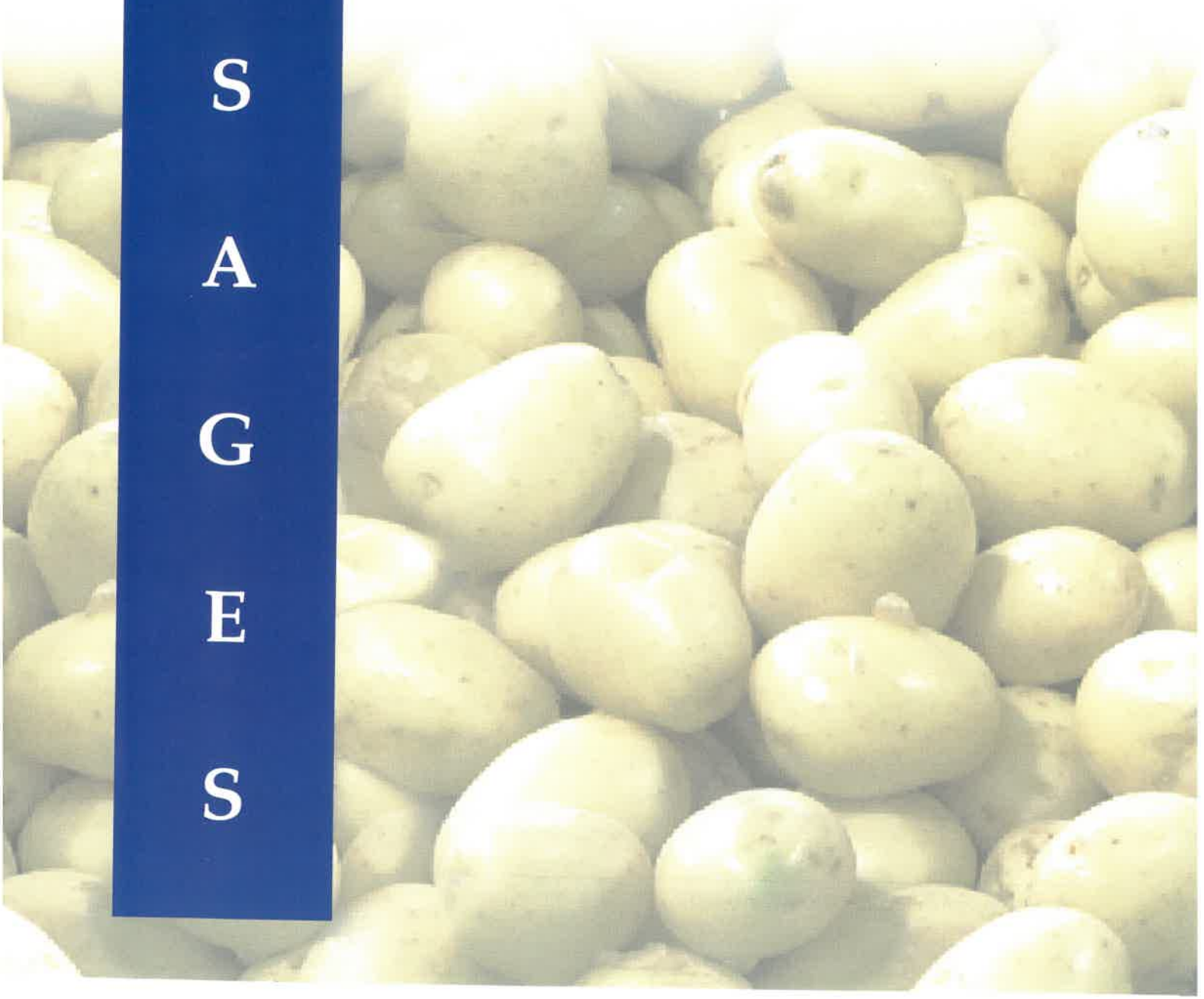

अर्चना दत्ता (मुखोपाध्याय)
विशेष कार्याधिकारी (जन सम्पर्क)
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Officer on Special Duty (Public Relations)

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राष्ट्रपति भवन,
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President's Secretariat,
Rashtrapati Bhavan,
New Delhi - 110004

Smt. Pratibha Devisingh Patil
President of India

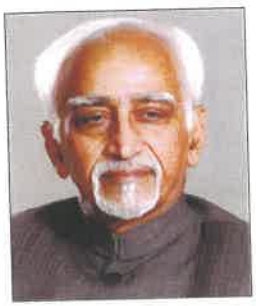
MESSAGE

The President of India, Smt. Pratibha Devisingh Patil, is happy to know that the Indian Potato Association along with the Central Potato Research Institute, Shimla and the Indian Council of Agricultural Research, New Delhi are jointly organising the Global Potato Conference – 2008 from December 9-12, 2008 at New Delhi.

The President extends her warm greetings and felicitations to the organisers and the participants and wishes the Conference every success.

A. Datta

Officer on Special Duty (PR)



Md. Hamid Ansari
Vice-President of India

भारत के उप-राष्ट्रपति के विशेष कार्य अधिकारी
OFFICER ON SPECIAL DUTY
TO THE VICE PRESIDENT OF INDIA
नई दिल्ली/NEW DELHI - 110011
TEL.: 23016422 / 23016344 FAX : 23012645

MESSAGE

Hon'ble Vice President of India is happy to know that the Indian Potato Association in association with Central Potato Research Institute, Shimla and Indian Council of Agricultural Research is organizing the Global Potato Conference 2008 during December 9 – 12, 2008 in New Delhi.

Vice President of India extends his good wishes to the organizers and participants and wishes the Conference all success.

(P. HARISH)

New Delhi
11th November, 2008

शरद पवार
SHARAD PAWAR

सत्यमेव जयते

कृषि, उपभोक्ता मामले, खाद्य और
सार्वजनिक वितरण मंत्री
भारत सरकार
MINISTER OF AGRICULTURE
& CONSUMER AFFAIRS
FOOD AND PUBLIC DISTRIBUTION
GOVERNMENT OF INDIA

8 October, 2008

MESSAGE

It gives me immense pleasure to know that the International Year of Potato declared by the Food and Agriculture Organization of the United Nations is being celebrated in India by organizing a Global Potato Conference from 9-12 December, 2008 at New Delhi. I congratulate the Indian Potato Association for organizing this important event jointly with Central Potato Research Institute, Shimla; Indian Council of Agricultural Research, New Delhi and a group of public and private institutions.

The year 2008 is a landmark year for Indian agriculture as the foodgrain production registered an all-time record of 231 million metric tons. I take this opportunity to thank my farmer friends for achieving this stupendous task. Potato, which is the fourth important food crop in India, also registered a record production in the year 2008. Potato is a highly productive crop that can be fitted with many prevailing cropping systems. The nutritional property of potato tuber is well acclaimed. Therefore, potato can be the best choice for crop diversification without compromising farm profitability. Potato has the physiological potential to produce 120 tonnes/ha vis-à-vis 35 tonnes/ha of present-day commercial potato cultivars. It is, therefore, necessary to intensify basic and applied research to harness the potential of this wonder crop. With global population expected to cross 9.3 billion by 2050, high productive crop like potato will play a crucial role in ensuring global food and nutritional security.

I am happy to learn that during 4 days of the conference, a group of more than 400 national and international agricultural scientists will be discussing present status of potato research in the fields of genetic resource management, potato genomics and biotechnology, seed production and management, resource management for sustainable production, potato health management, post-harvest management, potato trade and industry, etc. I sincerely hope the conference will come out with fruitful recommendations for enhancing productivity of this crop in a sustainable manner.

I wish the Global Potato Conference a grand success.

(SHARAD PAWAR)

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MINISTER OF RURAL DEVELOPMENT
GOVERNMENT OF INDIA
KRISHI BHAWAN, NEW DELHI-110 114

डा. रघुवंश प्रसाद सिंह
Dr. Raghuvansh Prasad Singh

MESSAGE

I am very happy to know that an International Conference on potato is being organized jointly by Indian Potato Association; Central Potato Research Institute, Shimla, and Indian Council of Agricultural Research, New Delhi from 9-12 December, 2008 at New Delhi. I learn that this Conference is India's contribution to the year-long celebration of the International Year of Potato declared by the Food and Agriculture Organizations (FAO) of the United Nations.

Potato has been identified as the food for future by FAO. It is a highly productive crop with ideal nutritional composition. Popularity of potato as a vegetables complement and snack food is increasing rapidly in India. Feeding more of potato to our rural population would go a long way to reduce the wide spread malnutrition prevalent among the poor. Potato is a labour intensive crop, and creates of rural employment opportunities to a considerable extent. Cultivation of potato invites many small and marginal industries to the village. A large number of Self- Helps Groups belonging to BPL families also sustain their livelihood on potato based home industries/products. Thus, I am sure, intensification of potato cultivation will supplement rural development.

I understand a group of more than 400 national and international agricultural scientists will be deliberating on issues related to potato production, improvement, storage, marketing and utilization during the 4 days of the conference. I hope the conference will come out with recommendation for enhancing productivity and profitability of this crop in order to improve the economy of our villages.

I wish the Global Potato Conference a grand success.

(Raghuvansh Prasad Singh)

उपाध्यक्ष
योजना आयोग
भारत
DEPUTY CHAIRMAN
PLANNING COMMISSION
INDIA

एम. एस. आहलुवालिया
MONTEK SINGH AHLUWALIA

MESSAGE

I am happy to know that the Indian Potato Association along with the Central Potato Research Institute, and the Indian Council of Agricultural Research, is organizing an International Conference on Potato in New Delhi from 9th – 12th December, 2008 on the occasion of International Year of Potato.

Potato is an important vegetable crop in India and accounts for 28.8 per cent of the total vegetable production. It is grown in almost all the States under diverse agro-climatic conditions. The Food and Agriculture Organisation of the United Nations encourages the production and consumption of potato in order to reduce the consumption of food grains. The average productivity of potato in our country is 18 MT per ha which is low in comparison to countries like Netherlands, France & Germany where productivity is more than 45 MT per hectare. Even though India produces high quality potatoes, with a short growing season of 90-100 days, ample opportunities exist to improve domestic consumption, storage, processing and export.

In this context, the theme of the conference related to potato improvement, bio-technology, production, protection, storage, post harvest processing, transfer of technology and marketing is very relevant. I hope that the Conference will come up with ideas and recommendations which can be translated into policies to increase potato productivity, result in value addition and enlarge the market for the benefit of both the farmers and the consumers.

I wish the International Conference all success.

(Montek Singh Ahluwalia)

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Prabha Rau
Governor, Himachal Pradesh

Raj Bhavan
Shimla-171 002

MESSAGE

I am glad to know that the Indian Potato Association and Central Potato Research Institute is organizing a Global Potato Conference during 9-12 December, 2008 at New Delhi as a part of the celebrations of International Potato Year 2008 declared by the United Nations.

The Institute can justifiably celebrate the potato year with great satisfaction due to the success achieved in potato production in the country as result of sustained research and development work. The green revolution in the country led to self-sufficiency in foodgrains. However, in the recent years the stagnating growth rate in food production has become a major challenge to feed our growing population. In this context potato can play major role in providing food security not only to India but also to the whole world.

I am aware of the excellent role that the Central Potato Research Institute has played in the past six decades for well being of the potato growers of the country. I am sure that the conference will open up new vistas of research and development in potato for the well being of the future generations.

I extend my good wishes for the success of this mega event.

P.A. Rau.

(Prabha Rau)

Prem Kumar Dhumal
Chief Minister, Himachal Pradesh

Ellerslie
Shimla-171 002

MESSAGE

I am extremely happy to know that Indian Potato Association in collaboration with Central Potato Research Institute, Shimla; Indian Council of Agricultural Research, New Delhi; and a group of public and private stakeholders, are jointly organizing the "Global Potato Conference 2008" from 9-12 December, 2008 in New Delhi to celebrate the International Year of Potato, declared by the Food and Agriculture Organization of the United Nations.

The State of Himachal Pradesh is historically associated with potato cultivation. Captain Mundi, a British military officer, popularized potato cultivation in and around Shimla hills by 1828. The first organized potato breeding process in India also started at Shimla in the year 1935. The country's first "Potato Seed Certification Unit" was also established at high altitude of Kufri (Near Shimla) at the same time. Potatoes produced by this State are accepted as high quality seed potato throughout the country. Even the table potato variety is also treated as a speciality product and named as "Pahari Alu" that always fetches producers premium price. Of late, the Kangra region of the State is emerging as an important belt for production of processing grade potato during off season. The establishment of Central Potato Research Institute, a world famous research institute on potato in the State, reflects its contribution towards development of potato sector in the country. Scientists of the institute need to come out with technologies for high yield varieties and increased productivity of this crop in the State, which is still below the national average.

I hope the Conference will usher into innovative ways and means to improve productivity and profitability of potato cultivation in the country including Himachal Pradesh and provide growers source to generate remunerative income.

I wish the Global Potato Conference a grand success.

(Prem Kumar Dhumal)

सुबोध कांत सहाय
SUBODH KANT SAHAI

राज्य मंत्री
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MINISTER OF STATE FOR
FOOD PROCESSING INDUSTRIES
(INDEPENDENT CHARGE)
GOVERNMENT OF INDIA
PANCHSHEEL BHAWAN, AUGUST KRANTI MARG
NEW DELHI-110 049

9th October, 2008

MESSAGE

I am pleased to know that Indian Potato Association alongwith Central Potato Research Institute, Shimla, and Indian Council of Agricultural Research, New Delhi is organizing the "Global Potato Conference 2008" from 9-12 December, 2008 at New Delhi to celebrate the International Year of Potato declared by the Food and Agriculture Organization of the United Nations. Potato is the second crop after rice that has been given this special status by FAO.

Potato is indeed a special crop that has the potential to satisfy ever increasing global food demand. It produces almost 4 times more food per unit area compared to major cereals. Moreover, potato tuber is an ideal food supplying sufficient energy, proteins, minerals, vitamin C, a number of B group vitamins, and high quality dietary fiber. Though India is now the third largest producer of potato, its per capita consumption is meagre as compared to developed nations. There are plenty of opportunities to increase potato utilization in India that will automatically increase its production. In that context, potato processing and value addition become very important. It is satisfying that nearly 4-5% of total potato produce is now being processed in India. However, most of it is being processed as high priced chips and related products that are out of reach of common people. There is an urgent necessity to develop cheaper processed product acceptable to common Indian household that will increase consumption of this highly nutritious food.

I am happy to know that a group of national and international agricultural scientists are deliberating for three days on different aspects of potato science and technology including post harvest management and value addition. I hope effective recommendation will come out of this deliberation that will improve consumption and utilization of this prized food.

I convey my heartiest congratulations to the Indian Potato Association and wish a great success for the Global Potato Conference 2008.

(SUBODH KANT SAHAI)

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सत्यमेव जयते

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डा. मंगला राय
सचिव एवं महानिदेशक
DR. MANGALA RAI
SECRETARY & DIRECTOR-GENERAL

MESSAGE

It gives me pleasure to know that Indian Potato Association jointly with Central Potato Research Institute, Shimla; Indian Council of Agricultural Research, New Delhi and several other public and private institutions is organizing the Global Potato Conference from 9-12 December, 2008 at New Delhi. The year 2008 is recognized by the FAO as the International Year of the Potato. It is the second crop after rice to have received unique recognition on account of its enormous potential as food.

In India, potato can play a major role in crop diversification, rural poverty alleviation, and food & nutritional security. The true potential of this crop was realized only in the post-independent India and the country with a production of nearly 24 million tonnes emerged as the third largest potato producer as a result of devoted research and development efforts. Today, India produces one of the best quality potatoes in the world. However, ample opportunities exist to improve domestic consumption, storage, processing and export. It is, therefore, necessary to critically analyze the technologies for potato production, protection, storage and utilization in the light of global status.

I am happy to learn that a group of national and international agricultural scientists will be deliberating on wide range of issues pertaining to potato improvement, genomics, biotechnology, production, protection, storage, post-harvest processing, and marketing. Besides, an exhibition will also be arranged at the conference venue to showcase the strength of technologies and inputs in facilitating sustainable agriculture with special emphasis on potato. I hope the conference will come out with effective recommendations for accelerating potato productivity keeping in view imminent climate change and non-renewable natural resources.

I wish the Potato Global Conference a grand success.

(Mangala Rai)

Date: 13th October, 2008
New Delhi

डा. चारू दत्त मायी
अध्यक्ष
DR. C. D. MAYEE
CHAIRMAN

कृषि वैज्ञानिक चयन मंडल
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Message

I am happy to know that the International Year of Potato declared by Food and Agriculture Organization of the United Nations is being celebrated in India by organizing the Global Potato Conference from 9 – 12 December, 2008 at New Delhi. I congratulate the Indian Potato Association, Shimla for organizing this important event jointly with Central Potato Research Institute, Shimla, Indian Council of Agricultural Research, New Delhi and a group of public and private institutions.

Potato played a pivotal role in global food and nutritional security and is being projected as the food for future particularly in food insecure developing countries. Potato is a carbohydrate rich but low-fat food possessing adequate amount of vitamin C, B1, B2 (riboflavin), B3, B6, folate, pantothenic acid and minerals such as iron, potassium, phosphorus and magnesium, dietary antioxidants, and fibres. In India, potato can play a major role in crop diversification, rural poverty alleviation, and food & nutritional security. Potato research also played important role in development of several disciplines. Every school children must have used potato to learn the mechanism of osmosis in living cell. Potato late blight during the Irish potato famine (1845) gave birth to the discipline of Plant Pathology. It also played a vital role in the development of plant molecular biology and biotechnology in recent years.

I am happy to learn that a group of national and international agricultural scientists will be deliberating on key issues pertaining to potato improvement, genomics, biotechnology, production, protection, storage, post-harvest processing, and marketing. I hope the conference will come out with effective recommendations for accelerating potato productivity in the country.

I wish the Potato Global Conference a grand success.

(C.D. Mayee)

टी० नन्द कुमार, आई०ए०एस
सचिव, भारत सरकार
T. Nanda Kumar, I.A.S
Secretary
Government of India

भारत सरकार
कृषि मंत्रालय
कृषि एवं सहकारिता विभाग
Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation

MESSAGE

I am delighted to learn that the Indian Potato Association and Central Potato Research Institute, Shimla are organizing a Global Potato Conference during 9 - 12 December, 2008 at New Delhi. The timing of the Conference acquires special significance because United Nations have declared the year 2008 as 'International Year of Potato'.

Grown for its edible tuber, potato is considered as an energy food. It is rich in vitamin C and contains magnesium, phosphorus and potassium. In the post-green revolution India, with a large population to feed and the recent increase in prices of food grains, potato holds the promise to supplement the efforts for providing food security to vulnerable groups in society.

In order to exploit the full potential of this crop we must work together towards increasing its productivity. Also, potato rots very quickly with increase in atmospheric temperature. Therefore, providing controlled temperature conditions for its storage is very crucial. Current marketing system of potato leaves a disproportionately large ieverage with the middlemen at the cost of growers and consumers. This disequilibrium must also be corrected.

I am sure that this Conference will address all the issues and evolve a comprehensive strategy for sustainable potato production to ensure food security. I extend my best wishes for the success of the Conference.

(T. Nanda Kumar)

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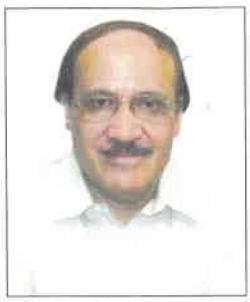

डा. एम. के. भान
DR. M.K. BHAN

सचिव
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MINISTRY OF
SCIENCE & TECHNOLOGY

MESSAGE

I am glad to learn that the Indian Potato Association along with Central Potato Research Institute and ICAR is organizing an International Conference on Potato at New Delhi from December 9-12, 2008 as India's contribution towards the celebration of **"International Year of the Potato".**

Today, potato is the fourth most important food crop in the world, with annual production approaching 300 million tons. More than one-third of the global potato output now comes from developing countries, up from just 11 percent in the early 1960s. CPRI & other International agencies like CIP has played an important role in this shift A single medium-sized potato contains about half the daily adult requirement of vitamin C while other staples such as rice and wheat have none. India is the third largest producer of potato in the world with a production of about 23.12 million tones from about 1.30 million hectares with 18.00-19.00 t/ha productivity during the last 2-3 years. A number of new Hybrids have been released recently by ICAR to benefit processing industry & hilly areas.

The potato research community has recently seen the rapid development of extensive genomic resources and tools. The development of large potato EST collection and microarray platform has led to wealth of gene sequence data for Solanaceace research community. Currently, the advanced state of tuber biology, some new development notably expression and metabolic profiling has started to give a deep impact on our understanding of potato biology. I hope the deliberations of three day conference related to the latest areas of potato improvement biotechnology, protection, production, storage and post-harvest storage would make it interesting to all participants and delegates. I convey my best wishes for the success of the conference. Also, I congratulate the Indian Potato Association, CPRI and ICAR for bringing out the souvenir on this occasion.

(M. K. Bhan)

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सदस्य
योजना आयोग
योजना भवन
नई दिल्ली–११० ००१
MEMBER
PLANNING COMMISSION
YOJANA BHAWAN
NEW DELHI-110 001

प्रो. वी. एल. चोपड़ा
PROF. V. L. CHOPRA

October 27, 2008

MESSAGE

I am very happy to know that Indian Potato Association jointly with Central Potato Research Institute, Shimla; Indian Council of Agricultural Research, New Delhi and a group of public and private institutions is organizing the Global Potato Conference from 9-12 December, 2008 at New Delhi to celebrate the International Year of Potato declared by Food and Agriculture Organization of the United Nations.

Potato is a major non-cereal food crop consumed by more than a billion people in the world. Potato tuber constitutes an ideal food rich in carbohydrate, vitamins, minerals, and dietary fibres. In India, potato can play a major role in crop diversification, rural poverty alleviation, and food & nutritional security. Intensive research and development for adaptation and improvement of this crop during last 50 years has ushered a potato revolution in India as reflected by 18-fold increase in production during this period. Yet, there is ample scope to further improve potato productivity by harnessing the power of modern science. For example, genetics of potato has not yet been understood quite thoroughly. It is necessary to use modern tools of genomics and biotechnology for gaining better understanding because potato is very amenable to most of the modern biotechnological tools. The power of modern science and technology should be rationally utilized to make advancement in potato productivity and quality.

I am pleased to learn that a group of national and international agricultural scientists are deliberating for three days on key issues relating to potato improvement, genomics, biotechnology, production, protection, storage, post-harvest processing, and marketing. I hope the conference will come out with effective recommendations for accelerating potato productivity in the country in a sustainable manner.

I wish the Potato Global Conference a grand success.

(V.L. Chopra)

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Joint Secretary
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S. K. Pattanayak
Mission Director (NHM)
and Joint Secretary

October 15, 2008

Message

The year 2008 is being celebrated as the "International Year of Potato" to promote development of sustainable potato-based systems for providing food security and eradication of poverty. India has domesticated the temperate potato crop by producing short duration potato varieties to fit into its sub-tropical short winter conditions. The development of seed plot technique has further revolutionized the seed potato availability in the country by making it possible to produce seed in the Indo-Gangetic plains. In the recent years, development of potato processing varieties like Kufri Chipsona-1, Kufri Chipsona-2, Kufri Chipsona-3 and Kufri Himsona has revolutionized and led to a major breakthrough in the production of quality potato products. The potato production in the country has increased from about 2 million tonnes in 1950-51 to about 25 million tonnes in 2006-07 thereby ensuring food security, remunerative income and employment to millions of farmers of this country. The current turmoil in the world regarding food supply and demand can be adequately addressed by resorting to potato production in a big way. Like other horticultural crops, production and productivity of potato in India can be considerably increased by adopting better techniques and marketing practices.

I am glad that the Indian Potato Association and Central Potato Research Institute, Shimla are jointly organizing the Global Potato Conference in December, 2008 at New Delhi. I hope that this noble endeavour will make use of the opportunities to face the challenges of food security in the new millennium by evolving suitable strategies for the emergence of potato as a crop of international significance.

(S.K. Pattanayak)

डा. एच. पी. सिंह
उप महानिदेशक (बागवानी)
DR. H. P. SINGH
DDG (Horticulture)

भारतीय कृषि अनुसंधान परिषद
कृषि अनुसंधान भवन-II
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INDIAN COUNCIL OF AGRICULTURAL RESEARCH
KRISHI ANUSANDHAN BHAVAN-II
PUSA, NEW DELHI 110 012

MESSAGE

Potato has emerged as a very important crop of Indian sub-tropical plains following its introduction in 16th century from temperate world, largely due to timely development of indigenous varieties, appropriate technologies for production system management and above all disease free seed production. Central Potato Research Institute, which was started in 1949 at Patna subsequently shifted to Shimla, Himachal Pradesh in the year 1956 has contributed uniquely on transforming this crop, from temperate to sub-tropical nature. The institute has carried out pioneering research and development work on potato during last 60 years that virtually triggered a potato revolution in the country. The institute also gave focused attention to production of disease free planting materials of potato that created an enabling environment for extending this crop in new area. In the process of development many new issues have emerged which require to be addressed. I am happy that scientists in Central Potato Research Institute have confidence to take new challenges. India is now the third largest potato producer in the world and its productivity is higher than many other countries when calculated on the basis of sunshine hour available per day during the short photoperiod growing season in the plains.

The year 2008 has been declared as the International Year of Potato by FAO, recognizing the potential of this crop as future food for the growing world population. It is a matter of satisfaction that a group of national and international agricultural scientists will be deliberating on key issues pertaining to potato improvement, genomics, biotechnology, production, protection, storage, post-harvest processing, and marketing. Besides, an exhibition will also be arranged at the conference venue to showcase the strength of technologies and inputs in facilitating sustainable agriculture with special emphasis on potato. I am also privileged to steer this global conference and hope the conference will come out with effective recommendations for accelerating potato productivity keeping in view imminent climate change and non renewable natural resources.

I wish the conference a grand success.

19/11

(H.P. SINGH)

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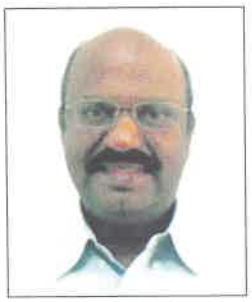

C.V. Ananda Bose

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सत्यमेव जयते

Additional Secretary
Government of India
Ministry of Agriculture
(Department of Agriculture
& Cooperation)
Krishi Bhawan, New Delhi-110114

MESSAGE

It is a matter of immense pleasure to learn that a Global Potato Conference is being organized in India in December, 2008 to mark the concluding function of International Year of Potato declared by the United Nations. The theme of the conference is to address the challenges and opportunities of food security in the new millennium. In the recent years much emphasis has been placed on improving agricultural productivity particularly that of horticultural crops. The horticultural crops like potato could be the best option for diversification in agriculture towards achieving food and nutritional security. Advances in potato research have led to impressive growth of potato production and productivity in India. However, in order to promote sustainable potato production, there is a strong need to promote technically sound, economically viable, environment friendly and socially acceptable technologies. Equally important are the post harvest issues like marketing, storage and processing so as to make potato cultivation a viable enterprise. An international conference like this would provide an opportunity to all those involved in this noble endeavor to make use of the achievements made so far in evolving fresh strategies. I am confident that the future goals for making potato a food security crop will be framed by the participants of this conference.

I earnestly hope that the participants of the conference will have successful deliberations and share rewarding experiences during the conference. The useful discussions and deliberations will lay the foundations for future work and interaction among all the stakeholders.

(C.V. ANANDA BOSE)

Manuel Picasso
Ambassador

EMBASSY OF PERU

New Delhi 29th September, 2008

MESSAGE

Let me congratulate the Indian Potato Association (IPA) along with the Central Potato Research Institute (CIPRI) and the Indian Council of Agricultural Research in organizing an International Conference on potato at New Delhi from 9 to 12 December 2008. Key issues pertaining to potato improvement, biotechnology, production, protection, storage, post-harvest processing and others will be deliberated at the conference, conceived as India's contribution towards the celebration of the International Year of the Potato, according to a decision adopted by the General Assembly of United Nations last year.

Originally from the Andean region, there are archeological evidences which are the earliest signs of cultivation of potato several *milenia* ago in the oldest Peruvian cultures.

Nowadays potato is called to play an important role in providing food security and eradication of poverty. The International Year of the Potato, then, should be seen as a departure point towards a process of permanent development of this product, so unique and versatile and so close to many economic activities, rituals, festivals and ancestral customs of my country.

The International Potato Center, with headquarters in Lima, hosted last March a world conference with the UN' s Food and Agriculture Organization that produced the "Cuzco Challenge" a rallying call to the global potato research to place potato science at the service of the poor in the world.

In India, there is an interest for knowing the Peruvian techniques regarding the cultivation of the potato as well as sweet potato (camote). Both countries (Peruvian Institute of Agricultural Research and the Indian Council of Agriculture Investigation) signed a Memorandum of Understanding establishing scholarships for scientist and students and it should be soon implemented. Peru is also open to exchange specialists of the Ministers of Agriculture of both countries to discuss and develop food security cooperation.

I really appreciate the brilliant idea of concluding the "International Year of the Potato" in New Delhi, capital of India, the 3rd largest producer of potato worldwide.

Manuel Picasso
Ambassador

REPUBLIC OF PERU
EMBASSY IN INDIA

Embassy
of the Federal Republic of Germany
New Delhi

Bernd Mutzelburg
Ambassador

New Delhi, October 15th, 2008

Message from Ambassador Bernd Mützelburg
for the Global Potato Conference 2008

The Government of the Federal Republic of Germany welcomes the initiative of organising the Global Potato Conference 2008 in India. The immense potential of the potato plant to assure food security has by far not been exhausted. Improved seed quality and new breeds, sophisticated cultivation and harvesting methods together with accurate post harvest treatment are important elements to be considered.

Today's research will be tomorrow's innovations. To effectively combat hunger and undernourishment, we need joint efforts and intensified cooperation. With the growing significance of the potato plant for global food security, it is essential to intensify our joint efforts and continue international cooperation in highly professional research institutions.

Better resistance against the most prevalent pests and diseases and a better adaptation to changing climatic conditions is key for new plant varieties. This cannot be achieved over night and requires enduring efforts. Therefore, a new plant variety being the result of these efforts requires effective legal protection. Granting the breeder the exclusive right to market and further reproduce the new variety is not only a matter of fairness but also a necessary tool to encourage the development of new varieties for the benefit of society.

Conformity of intellectual property rights for new varieties of plants is ensured by the International Union for the Protection of New Varieties of Plants (UPOV). The 65 UPOV-members agreed to grant the breeder his intellectual property rights in the territory of all UPOV-members. However, the so called breeder's exception allows all breeders to use protected varieties for their own breeding activities. Through this, all breeders in UPOV member states benefit from sharing the developments made by the whole breeding sector.

I fully trust that this conference, being a milestone in the International Year of Potato, will contribute to broaden awareness of the impressive potential of the potato plant.

I wish the organisers and all participants a lot of success.

B. Mützelburg

Bernd Mützelburg
German Ambassador in India

Bioversity International

Improving lives through biodiversity research

EMILE FRISON
Director General

9 October 2008

Dr. S.K. Pandey
Director
Central Potato Research Institute
Shimla 171 001 (H.P.)
India

Dear Dr. Pandey,

The Indian Potato Association is to be congratulated on organizing such an important conference to mark the International Year of the Potato. As the past year has shown, against a background of rising prices, locally important staples such as the potato can help to buffer the food security of communities. The Conference notes the importance of improving all aspects of potato cultivation to ensure that production is enhanced, and I am certain that the vital role of diversity in this effort will not be overlooked. Diversity is important not only to give breeders the raw materials they need, but also directly in farmers' fields to stabilize yields and to protect against epidemic outbreaks of pests and diseases. Potatoes can also be a vital component of on-farm diversification schemes, adding another string to the farmer's bow.

For all these reasons, I wish all those attending the Conference a productive and stimulating meeting that will move forward efforts to ensure food security in India and around the world.

Yours sincerely

Emile Frison
Director General

Bioversity International is the operating name of the International Plant Genetic Resources Institute (IPGRI).
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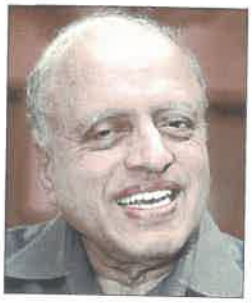
Dr. Joachim von Braun
Director General

Dear Participants of Global Potato Conference:

The potato is a global gift; more and more eaters, mostly marketed locally. The future of humankind will be even more potato-eaters because it makes economic, ecological, and nutritional sense. Science must enhance the smooth expansion of potato production, processing and utilization. Policy must facilitate these actions.

Best wishes to the international year of the potato.

Joachim von Braun
Director General



M.S. SWAMINATHAN
President

M.S. Swaminathan Research Foundation

Centre for Research on Sustainable Agriculture and Rural Development

MESSAGE

Within a short period after its introduction from South America, potato became an important staple in Europe as well as many other countries in the world. Infact there were statues in Germany in honour of Sir Walter Raleigh and Sir Francis Drake for their contributions for introducing into Europe this God's gift to mankind. I had the great privilege of starting my research career in 1949 with this wonderful crop. Fortunately, there was a large collection of tuber bearing *Solanum* species at the Commonwealth Potato collection i \n Cambridge, UK, conserved under the loving care of Dr J G Hawkes. I had an opportunity to build genetic stocks for resistance to the Golden Nematode, frost etc., The material developed by me by crossing *S. tuberosum* with *S. acaule* led subsequently to the breeding of the frost tolerant variety, Alaska Frostless. I was also associated with the setting up of an Inter-regional Potato Introduction Station at Sturgeon Bay, Wisconsin, USA. In our country the development of the seed plot technique of raising seed potatoes during the aphid free season by CPRI gave birth to a potato revolution.

The importance of potato both with reference to food security and farm income is considerable. We will face new challenges arising from changes in temperature as a result of global warming. We should therefore initiate a dynamic anticipatory research programme, including the development of excellent potato varieties both for home consumption and industrial processing through the True Potato Seed (TPS) methodology. The research challenges are great, but so are the opportunities opened up by biotechnology. For example, the work done at the Jawaharlal Nehru University on transferring genes for nutritive quality from Amaranthus to Potato is yielding promising results.

In recognition of the importance of potato to human diet and wellbeing, 2008 is being commemorated as the International Year of the Potato. I hope the Global Potato Conference will provide a roadmap for ensuring the availability of good quality potato for all and for ever.

M S Swaminathan

United States Department of Agriculture
Foreign Agricultural Service
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American Embassy
New Delhi - 110 021
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October 10, 2008

Dear Dr. Pandey:

With reference to your letter to Ambassador Mulford regarding the Global Potato Conference 2008, he has asked me to convey his very best wishes for the success of this Conference.

We wish you success for this event.

Sincerely,

for HH

Holly Higgins
Minister-Counselor for Agricultural Affairs

Dr. S.K. Pandey
Chairman - Organising Committee
Global Potato Conference 2008
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scri living technology

PJG/AP
15 October, 2008

MESSAGE

It is a great pleasure to write on behalf of SCRI to wish the International Potato Conference to be held in Delhi in December 2008 every success. The potato is a very important crop for the world and SCRI was pleased to organize a celebration of the UN International Year of the Potato in August in Dundee. As the Year draws to a conclusion it is fitting that India should be hosts to such an important meeting, and I know that SCRI staff are looking forward to participating in the conference.

I hope that the Conference celebrates the science and the contribution of the crop to food security.

Peter

Professor Peter Gregory
Chief Executive and Institute Director

POTATO FACTS

Highlights

- The Cultural Voyage of Potato
- Potato is a Nutritious Food with Industrial Uses
- Indian Potato Varieties
- Seed Plot Technique
- Changing Concepts in Potato Production Technologies
- Impact of Potato Research in India

The Cultural Voyage of Potato

SK Pandey and Anil Kumar
CPRI, Shimla

The English word 'Potato' comes from Spanish *patata* which is a compound word of Taino *batata* (sweet potato) and Peruvian *papa* (potato). The other European names of potato are German *kartoffel*, Latvian *kartupelis*, Estonian *kartul*, Romanian *cartof*, Russian *kartofel* and Italian *tartufoli*. Another common name is *pomme de terre* in French meaning 'ground fruit'. An analogous name is Finnish *peruna*, which comes from the old Swedish term *jordpäron* meaning 'earth pear'. In Polish, potato is called *ziemniaki* or in some regions *kartofle*, and in Slovak *zemiak*, from the word for 'ground'. In Persian, it is called *seeb-i-zameen* meaning 'ground apple'. In Hindi, Nepali and several other Indian languages the potato is called *alu* or *aloo*, while in Marathi and Gujarati, it is called *bataka* or *batata*.

Origin of Potato

Botanists are in general agreement that potato species originated in the Andes, from Colombia and Venezuela to Chile and northern Argentina. But genetic diversity, both in wild and cultivated species, is concentrated in the area of Peru. The botanists of Russia and Britain had reported that in Peru-Bolivia, there existed a large number of potato types under cultivation which differed very widely between themselves. Most of those varieties were the forms of *Solanum andigenum*. Others were either distinct species or hybrid forms between two speces. The high degree of variation and differentiation among different forms of potatoes in Peru-Bolivian region could be attributed to the variation in climatic and soil environment resulting from the diversity of depth and direction of the mountain valleys.

According to a series of genetic studies, experts consider that the potato *Solanum brevicaule*, located in Peru's portion of lake Titicaca, is the single ancestor of all potatoes in the world as it originated more than 8,000 years ago. In the ancient ruins of Peru and Chile, archaeologists have found potato remains that date back to 500 B.C. However, the origin of potato could be traced far back in the history upto 6000 B.C. based on other archaeological records. The Inca people grew and ate potatoes and also worshipped them in ancient times. They even buried potatoes with their dead relatives. According to some historians, potato found place in Inca's prayer as quoted below:

"O Creator! Thou who givest life
to all things and hast made men
that they may live, and multiply.
Multiply also the fruits of earth,
the potatoes and other food
that thou hast made,
that men may not suffer
from hunger and misery."

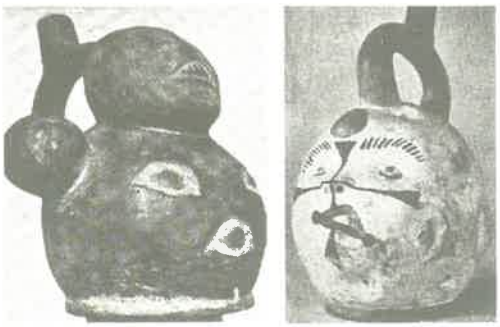
Archeological Evidences

The Incas were an upland tribe living near the shores of lake Titicaca who gradually dominated their neighbors, and eventually established themselves in and around the town of Cuzco. In the late Inca period, many of the local arts practiced by the subject peoples, such as Chimu and Nazca, persisted. It is in the pottery of the Proto-Nazca, Chimu and Inca cultural periods that we find the evidence of the existence of potato. These potteries could be divided into 3 groups which in one way or other portray the potato (Source: RN Salaman, 1985. *The History and Social Influence of the Potato*). The first group includes those pots in which there is no association with the human figures and the potato is depicted in a more or less realistic manner (Fig.1&2). The second group includes the pots in which potato is represented either as a human being, or in some close relation to a human being (Fig.3&4). The third group includes pots which present a design which is transitional between first and second groups (Fig.5&6).

Fig. 1: Tuber pot with deep 'eyes'

Fig. 2: Twin tuber pots linked by a bridge

Figs. 3&4: Pots with men built up of tubers



Figs. 5&6: Pots with human heads built up of tubers

Figs. 7&8: Tuber pots from which emerge human figures

Potatoes were also a part of supernatural beliefs of Incas and other communities of Andean civilization. In many of the potteries, human beings and animals have been depicted to sprout from the 'eyes' of potato (Fig.7&8). Such symbolic representations in potteries imply that potatoes had been a familiar article in the lives of those people for many generations before they sculptured them on their potteries. It formed the major staple diet of high Andean people as is today.

Potatoes in Andean culture

In view of Andean people's insecurity and the shortage of food at higher altitudes, the next step was to develop a method for the preservation of potato. Eventually, a dried product called *'chuno'* came in use by Andean people as early as 2000 years ago. This product was resistant to injuries by frost or cold. For the reparation of *chuno*, the potatoes were spread out on the ground and left there during the night to freeze. The next day women and children trampled the tubers with their bare feet in order to squeeze the water out of them. Then the tubers were left exposed to the sun. The whole process was used to be repeated on 4-5 consecutive days and at the end of the period, the ordinary *chuno* was dried off and stored. This product was used by Incas during war or famine and also during long journeys.

Fig.9: Harvesting of potatoes during Inca period
(Source: *Poma de Ayala and Felipe Guaman, 1613*)

The Incas took the Andean civilization to a new high during which potato became the principle diet in place of maize. They also developed several measurement systems based on potato. The time consumed for cooking of potatoes was considered as the unit of time. Similarly, the area of land required for producing potatoes for one family was considered as the unit of space. Several implements for potato cultivation were also developed (Fig.9). Potato also played important role in several religious and social rituals of Incas. The planting and other operations of potato themselves were accompanied by social ceremonies and rituals.

The Early Domesticated Potatoes

The work of Russian botanists revealed a large range of potato speces whose chromosome formulae fall into one or the other of the following series: 2n = 24; 2n = 36; 2n = 48; 2n = 60; and 2n = 72. Several distinct species of potatoes were cultivated by the natives of Andean civilization. However, preferential selection of the most palatable tubers led to an accumulation of *Solanum andigenum* varieties in Ecuador and Columbia. On the contrary, other potato species still played an important part in Peru-Bolivian regions where the distinction between cultivated and wild species was neither in the past nor is it today. In these regions, the potato varieties grown in a particular plot were frequently of mixed types. Even in the potato fields themselves, wild potatoes occur as weeds and these are often collected and eaten (Fig.10).

Fig.10: Wild and cultivated varieties of potato in Peru

In the far-distant past and to some extent today, new species and new varieties of potato have arisen without the direct intervention of man. This has been brought about by doubling of chromosome outfit during meiosis, by cross-pollination of species with different chromosome numbers or by mutation. It is believed that the evolution of potato and its various species occurred during Pleistocene time and the species *Solanum stenotomum* with chromosome formula 2n = 24 was the possible ancestral type cultivated throughout the Andes of Peru and Bolivia. By the doubling of its chromosomes, the 2n = 48 potatoes represented by the species *S. andigenum* came into existence. The Chilean potato area is separated from that of the Andean ones by snow-covered mountains and coastal desert. The botanists found considerable differences in habit and form between the Chilean and the Andean potatoes. The former closely resembled the European potato and hence, was given the name *Solanum tuberosum* (2n = 48), while the latter was given the name *S. andigenum.*

Spread of Potato in Europe

The introduction of potato in Europe proved to be one of the major events in man's history, for it came to this continent not as one whose appeal was based on the delight of the eye or the palate alone, but with the long-tried record of economic worth. It is generally believed that the Spanish conquistadors first encountered the potato when they arrived in Peru in 1532 in search of gold. Spanish explorer and conqueror, Gonzalo Jiminez de Quesada (1499-1579) took the potato to Spain in lieu of the gold he did not find (Source: Linda Stradley, 2004. *History of Potato*). The accounts of various historians suggest that potato was introduced into Spain between 1550 and 1570.

The Spanish in the beginning considered potatoes a kind of truffle and called them 'tartuffo'. Potatoes were soon a standard supply item on the Spanish ships since it was noticed that the sailors who ate potatoes did not suffer from scurvy. By 1565 potatoes were introduced into neighbouring Italy probably by Jerome Cardan, a physician and astrologer. According to Clusius, potato tuber was an established garden vegetable in certain parts of Italy by 1588.

Potato was introduced during 1585-86 in Great Britain and Ireland by Sir Walter Raleigh (1552-1618), a British explorer and historian. It is believed that one of the Raleigh's agent Thomas Hariot obtained the potatoes from the cook's store of Drake's ship. Raleigh planted the potatoes at his Irish estate at Youghal. He asked his gardener to bring him a dish of the new plant. The local gentry were invited to a royal banquet. Unfortunately, the cooks were uneducated in the matter of potatoes and a dish of bitter berries was presented. Raleigh then ordered his gardener to root them up and potatoes were banned from the court. However, soon people came to know that it was the tubers of potato plant that were eaten.

The potato was carried to Belgium and Germany by 1587, to Austria by about 1588 and to the United States of America by 1600. However, in US it was not widely grown for almost a century. Antoine Parmentier (1737-1813), a French military botanist is credited for introduction of potatoes to France. According to historical account, he was taken prisoner five times by the

The Andean potato *Solanum andigenum* was the first to be introduced to Europe and dominated European production for several decades. It was a fair-weather crop highly susceptible to frost and late blight. The Irish catastrophe led to concerted efforts to develop more productive and disease-resistant varieties. In the early 19th century, the Chilean *Solanum tuberosum*, adapted to long-day growing conditions, was introduced to Europe. It quickly replaced the Andean short-day variety. Breeders in Europe and North America, drawing on the new potato germplasm, produced many of the modern varieties that laid the foundation for massive potato production in both the regions.

Spread of Potato in Asia

With the beginning of Europe's Age of Discovery, the sailors also began to appreciate potato tubers as food during ocean voyages. And the European colonialism and emigration took potato to all corners of the globe. Colonial officials, soldiers, missionaries and explorers introduced potato growing to their foreign outposts. Thus, British, Portuguese, Spanish, French, Dutch and Belgian colonialists carried the potato to Asia, Africa and the South Pacific. In the Asian heartland, the potato tuber also moved along more ancient routes, finding its way from the Caucasus to Turkey, from Russia to western China, and from China to Korean peninsula.

In much of Asia, the local name for potato reflected the nationality of the colonial master. For example, in west Java, where the potato was introduced in 1794 by the Dutch, it was known as 'Dutch Potato'. In 1897 the potato reached Vietnam where people called it the 'French Tuber'. In the Himalayas, where potato reached via trade routes of British East India Company, the *Sherpas* called them 'English Potatoes'. In the Ottoman and Persian empires, where potato was introduced by Sir John Malcom of Britain, it was known as 'Malcom's Plum'.

Potato in India

It is believed that the Portuguese traders first took potato to India during late 16th to early 17th century. The first Portuguese voyage led by Vasco da Gama reached the Indian western coasts in 1498. After reaching the southern coastal city of Calicut, Vasco da Gama managed to get permission from the local king to trade in the territory. Subsequently, the Portuguese traders established a permanent base at Cochin, south of Calicut, under the leadership of their first Viceroy Francisco de Almeida during 1505-1508. In 1508, Almeida won the important sea battle of Diu, establishing the Portuguese as a major power in the region. Then there was continuous exchange of trade items between India and Portugal and probably potato reached Indian southern coast as food aboard Portuguese ship during the late 16th century.

Though the Portuguese introduced potato into India, it was the English who took the crop to the length and breadth of the country. The first written mention of potato in India occurs in Edward Terry's account of a lavish banquet hosted by Abdul Hassan Asaf Khan (elder brother of Nur Jahan and father of Mumtaz Mahal), who was the Governor of Punjab under the Mughal Emperor Jehangir, in honour of the British Ambassador Sir Thomas Roe in 1615 at Ajmer. Though potato was first introduced to the Southern coast of India, it was probably not cultivated by the farmers of the region. Instead, it established quickly in the gardens of Surat and Karnataka.

The first British Governor-general, Warren Hastings, promoted potato cultivation during his tenure from 1774 to 1785. Later on, agri-horticultural societies and the botanical gardens

took initiative in promoting its cultivation throughout India. The Royal Agri-Horticultural Society, founded by the great missionary scholar William Carrey in the year 1820 at Calcutta, was one such society that popularized potato cultivation in eastern India. In 1832, Captain Trichmond grew potatoes from a variety imported from England and distributed by the Royal Agri-Horticultural Society. He observed that the English potatoes were much superior to that of local varieties in size and weight. These new English potato varieties were introduced to hill stations like Nainital and Shillong.

Meanwhile, other army officers also took interest in extending and stabilizing potato cultivation in Indian hills. Its cultivation in the hills north of Dehradun was first started by Major Young and consolidated by Captain Townsend. Another military officer, Captain Mundi, initiated the efforts to introduce potato cultivation in the Simla hills in 1828. Potato in Nilgiri hills was introduced by Mr. Sullivan in the year 1830. Later on, the Government Botanic Garden established in the year 1848 at Ootacamund promoted potato cultivation in the entire Nilgiri hills. In the hills, the imported European potato varieties found a hospitable temperate climate and spread quickly in the entire region.

The early potato introductions in India were the varieties of *S. tuberosum* ssp. *andigenum* (earlier called *S. andigenum*), which were non-European varieties known as *desi* or indigenous varieties. Prominent among them were Phulwa (flowering in the plains), Gola (round potatoes), Satha (maturing in 60 days), Coonoor White, Coonoor Red and Darjeeling Red Round. These varieties are no more the mainstream varieties under cultivation in India, yet they still enjoy consumer preference in small pockets of the country. Besides these *desi* varieties, about 38 European varieties of *S. tuberosum* ssp. *tuberosum* (earlier called *S. tuberosum*) were also under cultivation in India before independence. These are referred to as exotic varieties which were long-day adapted and, therefore, their cultivation was restricted to the hills of the Indian sub-continent. Prominent among them were Craig's Defiance, Dunbar Cavalier, Great Scot, Italian White Round, Magnum Bonum, Majestic, President, Royal Kidney and Up-to-Date.

The exotic varieties introduced by the British were adapted to cultivation during the long summer days of Europe and proved unsuitable for cultivation in sub-tropical Indian plains having shorter winter days. Initial attempts to establish the potato in India were also challenged by storage during hot summers and fast degeneration of seed tubers mainly due to virus accumulation. Several attempts were made to acclimatize imported European varieties to the Indian conditions of hotter plains. But these attempts proved failure and led to the initiation of indigenous variety development programme in 1935 with the establishment of Potato Breeding Station at Shimla, Seed Certification Station at Kufri, and Potato Multiplication Station at Bhowali. Later on, these stations were merged with the Central Potato Research Institute established in August, 1949 at Patna. The headquarters of CPRI were subsequently shifted to Shimla in 1956 in order to facilitate hybridization work and better maintenance of seed health.

By 2008, CPRI had released 45 indigenous varieties for Indian hills and plains, contributing to an enormous expansion of potato production and productivity in the country. Most of these varieties are suitable for growing in sub-tropical plains where 90 per cent of Indian potatoes are now grown. As a result, the country recorded an increase in area under potato from 0.24 million hectares in 1950-51 to 1.4 million hectares in 2005-06 with the corresponding increase in production from 1.66 to 24.0 million tones. India now ranks 3rd in production and 4th in area of potato in the world. Thus, from its initial status of garden vegetable in India in early 17th century, potato established itself across diverse eco-zones in India over the next two and a half centuries and is now ruling the country as 'King of Vegetables'.

Potato and Modern World

The 20th century saw the potato finally emerge as a truly global food. The Soviet Union's annual potato harvest reached 100 million tonnes. In the years following the Second World War, huge areas of arable land in Germany and Britain were dedicated to potato, and countries like Belarus and Poland produced more potatoes than cereals. With the increasing industrialisation and urbanisation worldover, potato developed itself into a prominent snack food. The invention of mechanical potato peeler in 1920s helped make potato crisps America's top-selling snack. A restaurant chain founded by the McDonald brothers in the US in 1957 spent millions of dollars to perfect the French fries, a product abundantly consumed by French soldiers during the Second World War. A Canadian firm, McCain, that began making frozen French fries in 1957, expanded to open 55 production facilities in six continents and now supplies one third of all French fries produced internationally.

From the 1960s, cultivation of potato began expanding in the developing world. In India and China alone, total production rose from 16 million tonnes in 1960 to almost 100 million in 2006. In Bangladesh, potato has become a valuable winter cash crop, while potato farmers in southeast Asia have tapped into exploding demand from food industries. In sub-Saharan Africa, potato is a preferred food in many urban areas, and an important crop in the highlands of Cameroon, Kenya, Malawi and Rwanda. The potato has an extraordinarily rich past and a bright future. While production in Europe is declining, the potato has ample room for expansion in the developing world, where its consumption is less than quarter that of developed countries. Potato consumtion is also expanding very fast in the developing world where the potato's ease of cultivation and high energy content have made it a valuable cash crop for millions of farmers. The stagnating growth rate in food production in the recent years has become a major challenge to feed our burgeoning population. Potato is a highly recommended food security crop that can help ride the current turmoil in world food supply and demand.

Potato is a Nutritious Food with Industrial Uses

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The humble potato has travelled a long way from the Andes mountains in Peru, where the Incas cultivated it in 6000 B.C., to India via Europe. The potato was brought from Peru to Spain by the conquistadors in 16th century and is believed to have been introduced into India by the Portuguese in the 17th century. The potato is grown throughout the world in more countries than any other crop except maize. To the inhabitants of Peru and Bolivia, the potato was the "bread of life" for centuries and to the inhabitants of many countries in the world, even today, it is the "bread of life." The Russians called it the "second bread" and to the French it is "*Pomme de terre*" i.e. "Apple of the earth."

During 17th to 19th century, European peasants raised a large family on a nourishing diet of potatoes alone and the population explosion in Europe in 1800s was supported by potatoes. During this time in Ireland, on an average 4.5 kg of potatoes were consumed per day by each person. When the potato crop was destroyed by the deadly late blight disease caused by the fungus *Phytophthora infestans* during 1845-1851 resulting in the infamous potato famine, 2.5 million Irish died and more than one million migrated to North America. The potato sustained the war fought between the Prussians and the Austrians during 1778-79 (The war is known as "Potato war" because the armies fought as long as potatoes were available and once they ate up all the potatoes in Bohemia, the war was called off), as well as the industrial revolution during the eighteenth century in Europe. The potato took a long time to establish itself in Europe but once established, it changed the history of Europe.

Though the potato was introduced into India by the Portuguese, it was the English who took the crop to the length and breadth of the country and were responsible for its cultivation for the first time in the northern and southern hills. By the early 19th century, the potato established itself as a vegetable crop in the hills and the plains and has grown gradually in area. After four centuries, it has conquered the country like no other vegetable and remains the "King of vegetables" to this day. Recognizing the importance of this crop, the CPRI, supported by its seven regional research stations in different parts of the country has strived to increase the production and utilization of potatoes in the country.

Potato crop duration in the plains is 90-100 days and a good crop can produce 30 t/ha. About 20% of a potato tuber is dry matter and the rest is water. Even with 20% dry matter, potato produces more dry matter per unit area and time than the staple cereals. The dry matter production in potato is 47.6kg/ha/day, whereas in wheat and rice, it is 18.1 and 12.4 kg/ha/day, respectively. Similarly, potato produces 3 kg of edible protein per ha per day as compared to 2.5 and 1.0 kg in wheat and rice, respectively. The approximate contents of major tuber constituents are shown in Table-1.

Though potato is one of the few foods capable of nourishing the populations of this world, many people are unaware of its nutrient value. Many people think that potato is all starch and nothing else. This is the impression people have not only in developing countries like India but also in a developed country like U.K. as has been shown by a study in which housewives in U.K. were unaware of the vitamin and protein content in potatoes.

Table 1. Major constituents of potato tuber

Constituents	Content (%)
Water	75-80
Carbohydrates	16-20
Crude protein	2.5-3.0
Fibre	0.6
Fat	0.6
Minerals	1.0

Potato is a low energy food and 100g of boiled potatoes provide only 69 kcal. But it has been blamed of being a calorie rich food causing obesity. According to Indian Council of Medical Research, the recommended dietary allowance (RDA) of energy for a moderately active adult with a body weight of 60 kg is 2875 kcal/day. That means one has to eat more than 4.1 kg of potatoes per day to get obese. Now we all know that it is not at all possible for a person to consume so much of potatoes in a day. Then why blame potatoes of causing obesity? Another common misconception is that potatoes contain fat therefore, cause obesity. The fat content in potatoes is not more than 0.1% but they absorb considerable fat during frying. French fries have 19% fat content and provide energy of 220 k cal/100g whereas, potato chips have 38% fat content and provide energy of 513 k cal/100g. So the real culprit is not potato but the fat which it absorbs.

The potato is not an outstanding source of energy but it is a very good source of high quality protein. This is of considerable importance in a developing country like India where energy supplies are more readily available than protein supplies. Twenty one amino acids are present in the proteins of human body. Out of these eleven can be synthesized by the human body itself. The remaining ten amino acids which can not be synthesized by the human body are called essential amino acids. Human beings have to take these essential amino acids through their food to meet the body's requirements. When the essential amino acids are not taken in sufficient quantity, growth and development are retarded. The advantage that potato has over other cereal staples is its high lysine content (Fig.1). The lysine content in potatoes is similar to that in a typical animal protein. With its high lysine content, potato can supplement diets which are limiting in lysine. For example, rice with accompanying potatoes provides a better quality protein.

Potato protein has a very high biological value (98) because all amino acids are present in potato protein in comparatively large quantities and in harmonized quantitative ratios. It is one of the vegetable proteins comparable to valuable proteins of animal origin (Fig.2). A diet of potatoes and eggs is very nutritious because, the biological value of a mixture of egg and

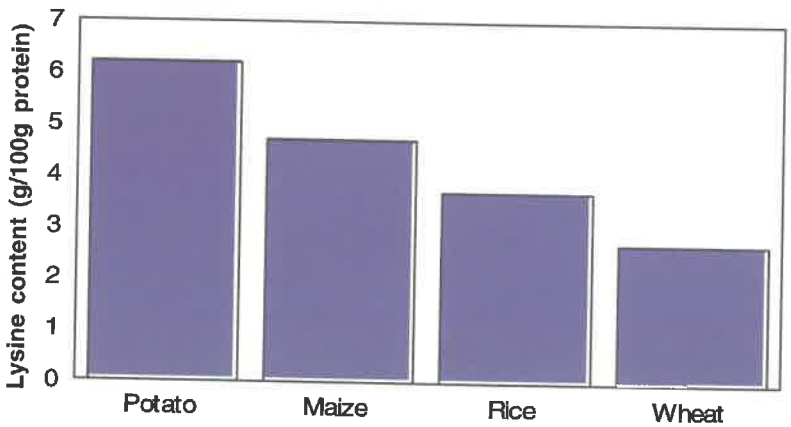

Fig. 1. The lysine content of potato is higher than the major cereals

potatoes (130) is higher than that of egg alone (100).

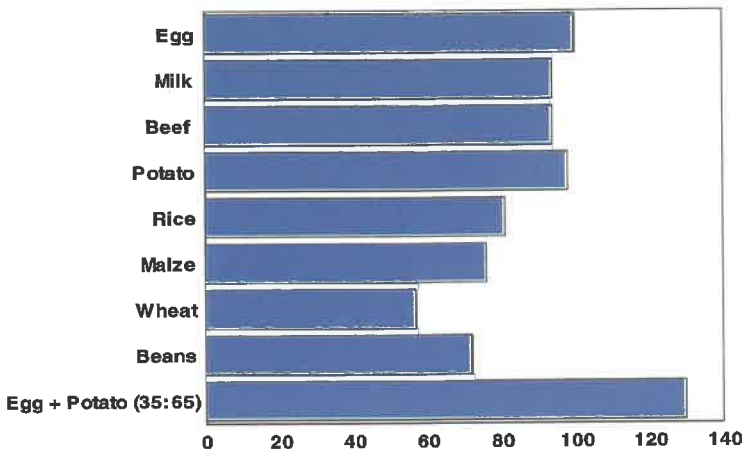

Fig. 2. Potato protein has a very high biological value

The potato is also a good source of vitamins. Potatoes contain 20-30 mg of vitamin C per 100g. Potatoes saved ancient sailors from scurvy, a disease characterized by bleeding gums and caused by vitamin C deficiency. As long as sailors had enough supply of potatoes in their ship, they were not affected by scurvy. Potatoes also contain good quantity of B vitamins and contribute substantially to the daily requirements of thiamin, niacin, folic acid and pantothenic acid.

Since potatoes are so nutritious, can a person live on a diet of potatoes alone? Yes. It is possible. A man in Scandinavia is reported to have lived healthily for 300 days on potatoes with a bit of margarine. We have our own man Mr. Satyanarayan Aggarwal, who lives in village Chandia of Madhya Pradesh. He is more than 90 years of age and has lived a healthy life by eating only potatoes since 1950.

When the potato was first introduced into Europe, it was cursed as an evil food. Its common nickname in Great Britain was "spud", an acronym for the Society for the Prevention of an Unwholesome Diet (A 19th century activist group in Britain). Diseases like leprosy and rickets were falsely attributed to potato consumption but later on, as it came to be accepted and became a staple food, people realized their mistake. Unfortunately, even today in India, potatoes are erroneously associated with several diseases. One such wrong notion is that potatoes can cause or worsen diabetes. On the contrary, research done in Europe has shown that potatoes are good for diabetics if eaten in right quantity as recommended by the physician. Potatoes are a good diet for patients suffering from other diseases as well. Potatoes are good for patients with high blood pressure because potatoes contain low level of sodium and do not absorb salt when cooked unpeeled. Potato fibre stimulates peristaltic movement and improves digestion. Earlier it was thought that potatoes are not good for patients with renal failure but recent studies have shown that a diet of potato and egg (300 g of potatoes + 30 g of whole egg) was good for patients with chronic renal failure. Even the peels of potatoes are medically useful. Work done by doctors at Wadia hospital, Mumbai has shown that when wounds/burns are covered with potato peels, healing is faster.

Besides being an excellent food, potatoes have other uses as well. Prices of petroleum products are increasing day by day and maintaining a car is becoming expensive for the middle class. In the decades to come, it would not be surprising if potatoes become the source of alcohol, which would be used to run automobiles. Research has shown that potatoes produced on one acre of land can yield 5,455 litres of ethyl alcohol. Efforts are also being made by scientists to produce biodegradable plastic from potatoes. Genetically transformed potatoes may also be used for the production of biopharmaceuticals.

While developing countries including India use mainly fresh potatoes, more than half the total quantity produced in developed countries is processed to produce French fries, potato

chips and other frozen or dehydrated products (Fig.3). Potato chips came into existence when in 1853, an American Indian cook in Saratoga springs, New York, prepared super thin slices and deep fried them for a customer who did not like the thick fried potatoes. Hence, they were originally known as "Saratoga chips." Since then the potato chips industry has grown into a multi billion-dollar industry. In India also potato chips are a favourite snack food for the children and teenagers and the industry is growing rapidly. However, the quantity of potatoes processed by the organized sector in India is not more than 1-2% of the total production in the country. Whereas, in U.S.A., about 60% of the potatoes produced is processed.

Fig. 3. Some popular processed potato products

If there is one processed product that is more popular than potato chips in the world, it is the French fries. French fries probably originated in France and were introduced into England in 1860s, and sold as an accompaniment to fried fish. This was the beginning of the famous "fish and chips" which became the most sustaining main meal of many families in U.K. Frozen French fries form more than 50% of the processed products from potatoes in many developed countries. Starch is another processed product from potatoes, which has both edible and industrial uses. Besides its use in food industry potato starch is used in paper, textile and pharmaceutical industries. It is also used to produce a number of other products like adhesives and dyes.

To quote McKay, "Nature has designed only a few foods that are capable of nourishing the great populations of the world. Of those, the white potato is one. Beneath its skin are liberal stores, not only of energy, but of high quality protein that will support health and growth". The potato has sustained civilizations for thousands of years and will continue to sustain the increasing population of this world. The day is not far when even in those countries where the potato is a vegetable, it will get its due place and importance as a staple food. Mankind will ever be grateful to God for the precious gift of potatoes.

Indian Potato Varieties

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The humble potato (*Solanum tuberosum* L.), that was unknown to the people outside its center of origin till 16th century, is a major world food crop today exceeded only by maize, rice and wheat. India has prominent place in potato production today though potato came with the European missionaries in the early 17th century only. This feat can be blissfully attributed to the robust Indian potato breeding programme which resulted in the development and release of 45 high yielding, disease resistant varieties during the last six decades. Consequently, India produces nearly 24-25 million tonnes of potato from an area of 1.4 million hectares every year, 90 per cent of which lies in the sub-tropical plains.

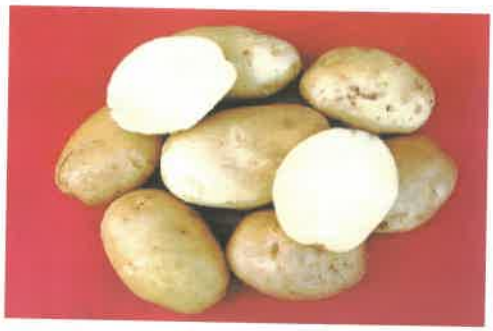
Potato originated in the temperate highlands of Peru and Bolivia having long days, hence it adapted easily to the similar agro-climatic conditions in Indian hills soon after its introduction in the country in early 17th century. However, introduced European varieties proved to be failure in the Indian plains having adverse sub-tropical agro-climate for potato production. Moreover, these varieties were bred for typical European summer season and long crop duration of up to 180 days. On the contrary, the Indian conditions provided only short crop duration of up to 90 days and short days during the winter season followed by very hot summer season unsuitable for post-harvest handling. Hence, it was a daunting task of adapting this temperate crop to Indian agro-climatic conditions.

The Indian potato breeding programme had many failures initially before it tasted success with the release of first batch of improved varieties in 1958-59. The major breakthrough in potato improvement programme came in 1963 with the development of "Seed Plot Technique", which made it possible to raise, evaluate, select and multiply breeding material under disease free conditions in plains. This led to development of a system, wherein crossing was attempted in the hills and raising of seedlings, evaluation and maintenance of segregating population was done in the plains. This approach yielded rich dividends both for potato improvement programme and potato seed production in the country. All varieties released by CPRI carry the prefix 'Kufri' as a memento to place of hybridization. After that the potato breeding programme was a huge success and resulted in sustained release of improved varieties – four varieties released during 2008, the international year of potato. These are Kufri Himsona, Kufri Girdhari, Kufri Sadabahar and Kufri Khyati (Fig. 1).

One of the major distinctions of the present day Indian varieties is that they are a class by themselves. It is for the first time in the world history that potato varieties in different maturity groups specifically suited for subtropical conditions are now available in such a large number. Among Indian potato varieties, 7 are early maturing, 26 are medium maturing and 12 are late maturing. Forty varieties possess white or yellow skin, whereas five varieties namely Kufri Red, Kufri Sindhuri, Kufri Lalima, Kufri Kanchan and Kufri Arun possess red skin. Twenty six varieties are suitable for growing in plains, 27 possess multiple resistances to different biotic and abiotic stresses and 7 are suitable for processing. The varieties Kufri

Chipsona-1, Kufri Chipsona-2, Kufri Chipsona-3 and Kufri Himsona (Fig. 2) have been specifically developed for processing. In addition, Kufri Jyoti, Kufri Chandramukhi and Kufri Lauvkar are also suitable for processing when grown in specific areas. Barring two varieties released during initial stages i.e. Kufri Safed and Kufri Red, which were clonal selections from the indigenous varieties, all other varieties are hybrids.

Kufri Girdhari-resistant to late blight



Kufri Sadabahr-early bulker, resistance to late blight

Kufri Himosona-processing variety for hills

Kufri Khyati-early bulker, moderately resistant to late blight

Fig. 1. New potato varieties released during 2008.

Presently 23 varieties, viz. Kufri Sindhuri, Kufri Chandramukhi, Kufri Jyoti, Kufri Lauvkar, Kufri Badshah, Kufri Bahar, Kufri Lalima, Kufri Swarna, Kufri Jawahar, Kufri Sutlej, Kufri Ashoka, Kufri Pukhraj, Kufri Giriraj, Kufri Anand, Kufri Chipsona-1, Kufri Chipsona-2, Kufri Kanchan, Kufri Pushkar, Kufri Arun, Kufri Shailja, Kufri Surya, Kufri Chipsona-3 and Kufri Himalini are under cultivation and occupy nearly 95% of the total potato area in India (Fig. 3). Prominent among them are Kufri Jyoti in the hills and state of West Bengal, Kufri Badshah in Gujarat and Kufri Bahar in Uttar Pradesh occupying 80-90 % areas under potato in respective states. Rapid degeneration of seed stock is a serious problem in sub-tropical plains of India. The popular varieties Kufri Jyoti, Kufri Bahar and Kufri Sindhuri have a low rate of degeneration.

The high yielding indigenous potato varieties and agro-techniques developed by CPRI have made tremendous impact on potato production in the country. India now ranks third both in potato area and production. If potato productivity is expressed as production/day/ha then

India ranks third, and if it is expressed as production/solar radiation hour/ha then India ranks 1st in productivity in the world. Compared to the production, area and average yield of 1949-50 (1.54 million tonnes from 0.234 million hectares with an average yield of 6.59 tonnes/ha) the year in which CPRI was established, the increase is 15.32, 5.63 and 2.72 times, respectively. Not withstanding the population growth (2.19%), the per capita potato production has increased from 4.37 kg in 1949-50 to 21.52 kg during 2004-05 indicating a growth rate of 3.41%.

Kufri Chipsona-1 | Kufri Chipsona-2 | Kufri Chipsona-3

Fig. 2. Varieties for processing.

Kufri Jyoti-wid adaptability | Kufri Bahar-early bulker | Kufri Pukhraj-early bulker

Kufri Swarna-resistant to | Kufri Kanchan-wart immune | Kufri Surya-heat tolerant

Fig. 3. Popular varieties for different agro-climatic regions.

Many Indian potato varieties have found favour with the farmers in the neighbouring countries also owing to the agro-climatic similarity with India. For example Kufri Chandramukhi in Afghanistan, Kufri Jyoti in Nepal and Bhutan and Kufri Sindhuri in Nepal and Bangladesh. Many Indian segregating clones have also been released as varieties in other countries. For example I-654 as CCM-69.1 in Mexico, I-822 as Krushi and I-1085 as Sita in Sri Lanka, I-1035 as Montanosa and I-1085 as BSUP-04 in Philippines, I-1035 as Mailaka in Madagascar, and I-1039 as India and Red skin in Bolivia and Vietnam, respectively (Fig. 4).

Figure 4. Indian potato varieties/hybrids adopted in foreign countries.

The future potato breeding efforts in India, aims at developing varieties with wider adaptability, better nutritional and keeping quality for diverse usage and resistance to major pests and diseases. Special efforts are being made to develop varieties for French fries, baby potatoes, and tolerance to cold induced sweetening. Efforts are also on to develop varieties tolerant to abiotic stresses, namely heat and drought, and having high nutrient use efficiency. Indian potato breeding programme have now been tuned to develop varieties for changing global climate for sustained, environment friendly and high quality potato production. Diverse gene base available in *Solanum tuberosum* ssp. *andigenum* and other related tuber bearing *Solanum* spp. is being exploited with the help of biotechnological techniques.

Seed Plot Technique to Meet the Challenges of Seed Production in the Indian Subtropical Plains

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Potato is a vegetatively propagated crop where potato tubers are generally used as seed. Potato is a good host to a large number of pests including viruses which are particularly important. Due to vegetative mode of propagation, any virus infection in the seed stock continues from generation to generation with increase in titre of the virus. Continuous use of virus infected seed potatoes for many years leads to a stage where tuber yield becomes uneconomical and such a seed stock is called 'degenerated'. Hence, vibrant potato industry requires continuous supply of healthy seed tubers in sufficient quantity.

India was meeting its seed potato requirements partly through import and partly by multiplication in the high hills devoid of vector pressure till 1939. Imports stopped in 1939 due to World War II. A potato seed supply system from hills to plains was used to address potato seed supply. Under this scheme, the seed stocks of important varieties were multiplied in the hills during summer and the produce transported to plains for late winter/spring planting in the plains. However, this plan proved unsatisfactory due to: (i) non-availability of varieties adapted to both long days of hills and short days of plains; (ii) dormancy of hill seed which was fit for planting during spring and degenerated very fast due to high vector pressure during spring and, (iii) limitation of land in the hills. These factors restrained expansion of potato cultivation and productivity in the country.

A need, therefore, was felt to have indigenous varieties and technologies suited to the sub-tropics to have a viable potato industry in India. As a result, Central Potato Research Institute came to existence in 1949 at Patna and later shifted to Shimla in 1956. Degeneration of seed stocks when grown during spring in the plains was established to be due to viruses which were mainly spread by the aphid *Myzus persicae*. A detailed survey of a number of locations in the plains during 1956-60 for the population dynamics of *M. persicae* during the crop period was undertaken (Pushkarnath, 1967). It was found that the vector population in the North Indian plains (Indo-Gangetic plains) remained either absent or very low during October to December which was sufficiently long a period to grow healthy seed crop in the plains (Fig.1). This information formed the basis of seed production in the plains through the technique called **'seed plot system of seed production'** during 1959. Initially, it comprised planting of seed crop during September end to mid October, planting at a close spacing on not too rich a soil to ensure large percentage of seed sized tubers, two inspections of the crop to remove off types and virus diseased plants, restriction of irrigation from mid December onwards and dehaulming the crop in the end of December or on *M. persicae* level crossing 22 aphids/100 compound leaves (critical aphid level). Incidence of various virus diseases in crop raised as per the above scheme at Jalandhar was less than 1.5% even after 3 to 4 years of propagation. Results of detailed surveys of different regions with respect to suitability for seed production are summarized in Table 1.

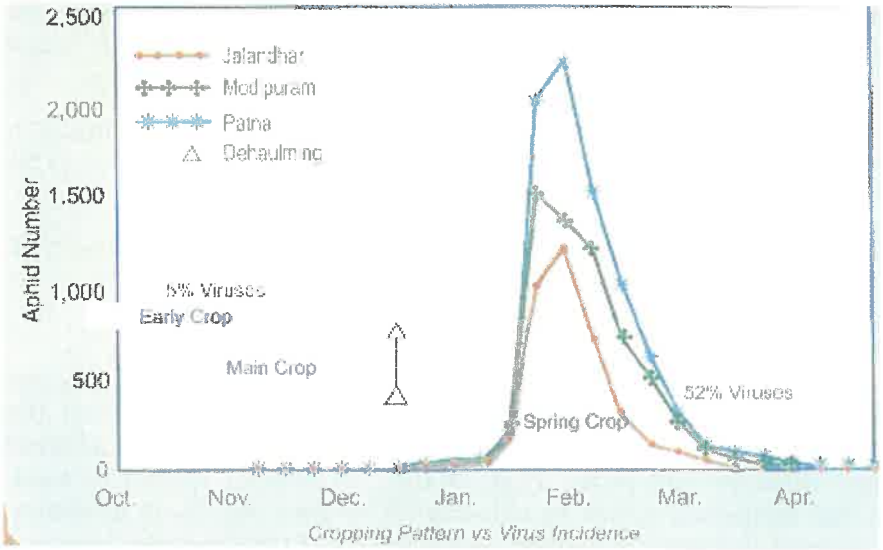

Fig.1: Aphid population curve in northern plains of India (average of ten years data)

Table 1: Identification of suitable seed producing areas in India

State	Zone	Suitability for type of seed	Reasons for suitability
Himachal Pradesh	Northern high hills	All categories of seed	Low vector pressure No serious soil borne pest
	Lahaul Spiti Valley	Foundation & certified	Higher vector pressure Some soil borne pests
Jammu & Kashmir	Northern high hills	Foundation & certified	Low vector pressure Soil borne diseases
	Plains	Foundation & certified	Higher vector pressure
Arunachal Pradesh, Sikkim, Meghalaya, Manipur, Nagaland, Mizoram, Tripura	North-eastern high & mid hills	Foundation, certified & quality seed (for regional use)	High vector pressure Presence of brown rot & wart.
Darjeeling hills	Quarantine area	Quality seed for local use	Wart disease
Punjab, Haryana, UP, Western MP, Bihar	Indo-gangetic plains	All categories of seed	Low vector pressure No serious soil borne pest
West Bengal, Orissa, eastern MP	North eastern plains	Foundation & certified seed (for local use)	High vector pressure Presence of brown rot
Maharashtra, Karnataka, Andhra Pradesh	Plains & plateau area	Quality seed (for local use)	Very high vector pressure Soil borne brown rot
Tamil Nadu	Nilgiri hills (Quarantine area)	Quality seed (For local use)	Presence of cyst nematode Presence of brown rot

Potato is grown in most of the states of India, However, areas suitable for seed production are limited to a few states in the north-west and northern Indo-Gangetic plains which meet the following requirements of certified seed production :

i. Existence of sufficiently long period of about 75-90 days virtually free from aphid vectors and suitable for crop growth and tuberization; this period is September end to last week of January.

ii. Freedom of soil from soil borne pests like cyst nematode, bacterial wilt, powdery scab, wart, ring rot and any other quarantine pest.

iii. Good productivity of the crop.

As a result of the development of "Seed Plot Technique" the major centre of disease free seed production shifted from the hills to the plains. The seed produced through seed plot technique in the plains not only gave 30-40% higher yields but also was free from many soil and tuber borne diseases and pests. This, in turn, prevented spread of seed and soil borne diseases from the temperate zones to sub-tropical plains. All these advantages led to rapid development of seed industry in Punjab and western Uttar Pradesh. Integration of seed plot technique with the advanced virus diagnostic techniques, plant protection measures and agronomic practices has laid the sound foundation of the Breeder Seed Production programme of the Institute. Refinements in the seed plot technique at CPRI include the following measures:

- Adoption of 2-3 years crop rotation to avoid build-up of soil-borne pathogens like black scurf and common scab in the soil;
- Isolation of minimum 25 meters of the seed crop from the ware potato crop;
- Use of disease free seed stocks selected by employing latest diagnostics like ELISA, RT-PCR, immuno electron microscopy and NASH;
- Use of correct physiological age cold stored seed;
- Planting of seed crop by 15th October in Punjab, by 25th in Haryana, Rajasthan, western Uttar Pradesh and first week of November in eastern UP and Bihar;
- Use of systemic granular insecticides such as Thimet 10-G at the time of planting and earthing up against sucking insects and white grubs;
- Use of pre-sprouted large sized healthy tubers (40-80 g) with multiple sprouts to ensure a large proportion of seed sized tubers. Pre-sprouting ensures quick and uniform emegence, early tuberization and maturity;
- Full earthing at planting and use of herbicides for control of weeds and prevent spread of contagious viruses;
- Inspection of seed crop 3 times at 50, 65 & 80 days during growing season to remove the off type and diseased plants;
- Protection of crop from late blight disease to prevent seed borne infection;
- Protection of crop from vectors towards the maturity of the crop;
- Withholding irrigation in the 3rd week of December i.e. 7-10 days before haulms killing in north-western plains and 1st week of January in north-eastern plains;
- Killing of haulms with Grammaxone @ 2.5-3.0 lit/ha or mechanically pulling them to kill;

- Harvesting of crop 15-20 days after haulm killing when the fields are in workable condition and tuber skin is hardened;
- Curing of produce by keeping in heaps in a cool shady place for about 15-20 days;
- Treatment of produce with commercial grade 3% boric acid to prevent surface borne diseases; and
- Drying of treated seed in shade and then filling in the bags, sealing, labelling, and cold storing.

A flow chart of the seed plot technique is presented in Fig. 2.

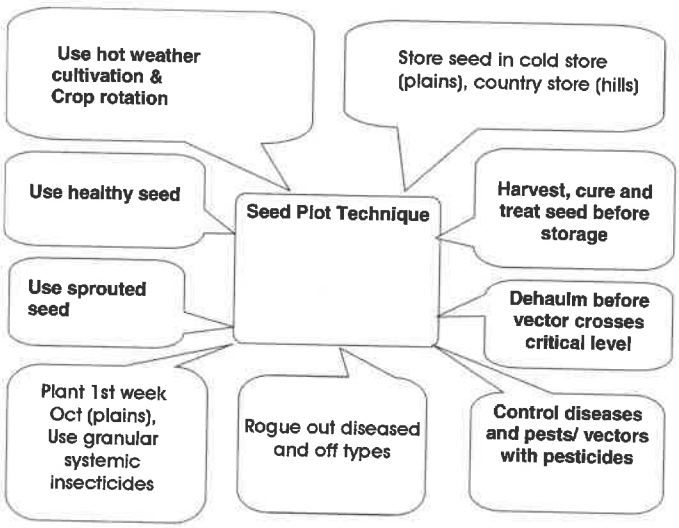

Fig. 2: Important components of seed plot technique

Recognition of the fact that seed potatoes could be produced in the subtropical plains on a sustainable basis by 1959 laid the foundation of what was called as "Seed-Plot System of Seed Production" by 1967(Pushkarnath,1967). Consequently, production of seed potatoes in the plains started from 1970 onward and movement of seed from hills to plains declined sharply . Today, whole of seed potato requirement of the subtropical plains is met from the seed grown there itself. Subtropical plains have also become the source of seed to other parts of India such as West Bengal, Orissa, Maharashtra, Gujarat and Karnataka. Adoption of the seed plot technique has resulted in phenomenal increase in area under potato from about 0.5 in 1970 to about 1.4 million hectares in 2007. The corresponding production has gone up from about 39 to 249 lakh metric tonnes during the period.

Suggested Reading:

1) Pushkarnath.1967. Seed potato production in the sub-tropical plains of India. *Potato J.* 44: 429-441.
2) Pushkarnath and KK Nirula. 1970. Aphid-warning for production of seed potato in subtropical plains of India. *Indian J. agric. Sci.* 40: 1061-70.
3) Pushkarnath.1959. Producing healthy seed potatoes in the plains: A new approach. *Potato J.* 1: 63-72.

Changing Concepts in Potato Production Technologies

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The agro-techniques followed during the specific period are mainly designed considering with the architecture of the plant, cropping systems, local problems, level of mechanization, technology build up and knowledge of related sciences available during that period. The concepts of crop production activities have been undergoing changes with time after the establishment of Central Potato Research Institute in 1949. Organized and collaborative efforts were directed not only on development of varieties but also to introduce and develop new package of practices in potato production. The indigenous technical knowledge of potato crop management has been improved with the integration of knowledge of the various disciplines of crop production. The main purpose of crop production is to regulate the physiological functioning of the potato plant by improving the efficiency of nutrients, water, light and other inputs to provide optimum conditions to each plant to express its genetic potential within the constraints of environment. All these have induced to conceptualize changes in the potato production technologies which are summarized below:

Tillage management

Conflicting concepts persist regarding tillage requirements of potato crop. Logically excessive tillage may destroy soil aggregates, but at the same time, some tillage is required to enable proper ridging to provide favourable soil conditions for the development of tubers. A fine textured soil with minimum clods is considered good for potato cultivation. This is achieved by ploughing to a depth of 20-25 cm and planking is done immediately to minimise soil moisture loss. Hot weather cultivation consisting of ploughing the field during summer months (May-June) reduces the incidence of soil-borne diseases and pests and also controls perennial weeds.

Seed plot technique

In the past, potato seed crops in the north Indian plains were planted late in winter or early spring so that the tubers could endure storage at high ambient temperatures till the next planting. Such crops were exposed to virus infiltration by aphid vectors. "Seed plot technique" developed by CPRI has made it possible to raise healthy seed potatoes in the plains by planting in autumn and dehaulming before aphid population crosses a critical level (20 aphids/100 compound leaves). The seed has, however, to be kept in cold stores, which have come up. This concept has gained wide acceptance and is being utilized for seed potato production programme in the country.

True potato seed technology

Normally the potato is propagated vegetatively. The founder Director of CPRI Dr. S Ramanjuam conceived the idea of propagating the potato from true seed. However, the high variability of the seedlings from the heterozygous material hindered the commercial exploitation

of this non-conventional approach. Interest in true potato seed (TPS) has been revived with the development of more or less homozygous material which is now available under a programme "Develop technology for potato production through TPS" of CPRI and also with the International Potato Centre (CIP), Lima. The programme consists of producing tuberlets from TPS in the first year and planting them thickly next year after storage to raise a commercial potato crop.

Weed management

Since inception of agriculture, weeds have been recognized as potential pests. They pose a serious problem in potato crop in the plains as well as in the hills. Weeds compete with the crop for moisture, nutrients, light and space during crop growth and also serve as an alternate hosts of several insects/pests and diseases. A conservative estimate of 10% loss in crop yield may be taken as realistic for potato (1). About 50 years back, with adequate and cheap labour, mechanical method was the choice with the farmers. In due course with the advent of knowledge, use of herbicides for weed management in potato has been researched. Herbicides checks early weed growth, reduces mechanical damage to the plants, is quick and less laborious and also minimizes the spread of mechanically transmitted viruses like virus X and S by minimizing manual contact during crop growth period. The herbicides used for weed management in potato along with their time of application and types of weed flora controlled are given in Table 1. Later on, the concept of integrated weed management technology has been developed which consists combining cultural methods such as adoption of crop sequence, inter-culture, hot-weather cultivation, growing of a smother crop or a green manure crop, hand weeding and growing of healthy potato crop to smother the weeds.

Table 1: Herbicides for weed management in potato

Name of herbicide	Dose(kg a.i./ha)	Time of application	Type of weed flora controlled
Fluchloralin	0.70-1.00	Pre-planting*	Annual grasses and broad leaf weeds
Pendimethalin	0.50	***Pre-planting****	Annual grasses & broad leaf weeds
Alachlor	1.00-1.50	Pre-emergence	Annual weeds, grasses and nutsedge
Atrazine	0.50	Pre-emergence	Annual grasses and broad leaf weeds
Isoproturon	0.75-1.00	Pre-emergence	Broad leaf weeds
Linuron	0.50-0.75	Pre-emergence	Annual grasses and broad leaf weeds
Methabenzthiazuron	1.00	Pre-emergence	Annual grasses and broad leaf weeds
Metribuzin	0.75-1.00	Pre-emergence	Annual grasses and broad leaf weeds.
Oxyfluorfen	0.10-0.20	Pre-emergence	Annual grasses and broad leaf weeds
Simazine	0.50	Pre-emergence	Annual grasses and broad leaf weeds
2, 4-D	0.50	Pre-emergence	Broad leaf weeds
Paraquat	0.40-0.60	Post-emergence**	Annual grasses and broad leaf weeds

* Spray on soil before planting and incorporate in soil to reduce volatilization.** At 5 percent plant emergence.

Plant population and crop geometry

The optimum plant population density per unit area varies with environment, genotype, planting time and season. Studies also brought out that plant population could be defined not only in terms of number of plants but also stem density per unit area. The skip row and paired row plantings have been developed to adjust intercrop and to economize irrigation water. In

paired row planting, two rows of the crop are brought closer by reducing inter-row spacing. These changes may not alter main crop yields. In skip row planting one row of the main crop is skipped and one or more rows of intercrops are adjusted in this space.

Time and method of planting

Planting time is most important non-monetary input affecting yields of crops. In potato it is a critical input for higher yield. Time of planting varies with variety, agro-climatic conditions and crop growing season and also the cropping system in which potato crop is grown. The optimum planting time gives high yields due to suitable environment at all growth stages.

More than 90 per cent of area under potato is planted manually after opening the shallow furrows, broadcasting or placement of fertilizer mixture and then placing seed tubers followed by ridging with spade or bullock drawn or tractor drawn ridger. Another method is that first ridges are formed after application of fertilizers and insecticides and then tubers are dibbled with *Khurpi* (a narrow blade tool) 5-7 cm deep on the ridges manually. Care has to be taken that tubers do not come in direct contact with the fertilizers and should remain 4-5 cm above or at the side of fertilizer zone. Potatoes are also planted with a tractor drawn semi or automatic potato planters which combine few or all the operations *viz.*, opening the furrows, application of fertilizers, placement of seed tubers, ridging and application of insecticides in one operation.

Seed size, spacing and seed rate

Seed is the costliest input in potato production and accounts for about 40% of the cost of production. Seed rate depends on the size of tubers used in planting for ware as well as seed crop. Technology has been developed to use different size of seed tubers effectively without increasing seed rate by space adjustment. In general, 25-50 g tubers are recommended for ware as well as seed production in the plains. About 25 to 35 q/ha seed rate is recommended depending on the size of seed tubers. The inter-row spacing for seed crop for manual, bullock drawn and tractor drawn implements can be kept at 45, 50 and 60 cm, respectively. A plant population of 1.00 to 1.11 lakh per ha is maintained to derive the maximum benefit and stem density of 40-45 stems/m^2 for optimum number and yield of tubers.

Nutrient management

During the past 60 years of potato research in India, nutrient management has received considerable attention from the agronomists and soil scientists. The results of the field experiments conducted at CPRI enabled to recommend efficient and economic use of plant nutrients. Soil and plant tests methods have also been developed to recommend fertilizers on the basis of these tests to potato crop. Also different nutrient carriers were evaluated for their efficiency in potato crop. Studies were also made on the residual and cumulative effects of plant nutrients applied in a cropping system.

Nitrogen: Nitrogen is the most extensively researched plant nutrient in potato. The recovery of applied N from conventional fertilizer is quite low for potato (30-40%). Timely N application is one agronomic technique which has helped considerably in increasing nitrogen use efficiency. It is now well established that nitrogen must be applied in potato crop in two or three split doses coinciding with crop growth stages when N requirement is high. Urea is the most common and cheapest source of N. Its application at planting time may affect emergence. This can be avoided by applying urea before the pre-planting irrigation. Normally basal application

of urea at higher rate should be avoided, however, at earthing up, being cost effective, urea may be preferred. The efficiency of foliar application of urea is 1.5 times more than that of its soil application in alluvial soils. The field experiments have been done by CPRI to show that nitrification inhibitors and slow release N fertilizers can reduce loss of applied N and increase its efficiency. The residual effect of N on subsequent crops has been reported and more than 15 per cent of N applied to potato is recovered by succeeding wheat indicating that fertilizer input cost can be reduced in multiple cropping system and fertilizer efficacy can be increased (7).

Phosphorus: A healthy crop of potato removes about 25-30 kg P_2O_5/ha. As P is not mobile, hardly 15-20% of applied P is utilized by the potato crop while rest remains in soils in a fixed state, being acted upon by various physico-chemical and biological mechanisms leading to its slow but consistent availability to succeeding crops over the years. Localized application of P and K is desirable to improve their efficiency. Nuclear technique helps in studying the quantity as well as intensity of distribution of P in various parts of the plant when it is applied through soil. It is now well accepted that the placement of P in the vicinity of plant roots is the best method for potato. Soaking seed tubers in solutions containing P and micronutrients is a promising innovative approach to averting their deficiency economically (4). The residual value of this important input has been utilized to recommend its dose in different cropping systems. Agronomic differences between crops and seasons decline as the P fertility is built up and the residual P is accessible to all crops in the system though not to the same degree.

Potassium: Potassium is the third limiting plant nutrient in potato production. A healthy crop of potato removes about 170-230 kg K_2O/ha with K fertilizer use efficiency of 50-60 per cent. Thus, the residual effect of P and K applied to potato affects the fertilizer needs of succeeding crops. The furrow placement of K has been more economical than broadcasting or band placement. In most of the situations, the recommendations is to apply the full dose of potash as a basal dressing. However, over the years, recommendation for split application of K has been emerging for potato crop in light textured soils in high rainfall areas. A decrease in the intensity of frost with increase in K dose has been reported, as high concentration of K in leaves helps in lowering the freezing point of cell sap thereby helping the plant to escape frost. Potassium also contributes greatly to achieve water economy, imparts resistance to late blight and reduces occurrence of black scurf in potato.

Healthy Potato Crop

Secondary and micronutrients: Use of high analysis fertilizers in the intensive cropping system has resulted in wide spread deficiency of secondary nutrients, particularly of sulphur and need to be addressed wherever required. Extent of deficiency of different micro-nutrients is increasing in potato growing areas, the most important being zinc particularly in rice-potato crop sequence and must be applied on soil test basis.

Integrated Plant Nutrient supply system (IPNS): Before fertilizer promotion programmes of 1950s, farmers used to grow one crop in a year. Due to increasing fertilizer costs and associated environmental problems, integrated nutrient management including organic manures, crop

residues, green manure and bio-fertilizers have aroused considerable interest. Mention may be made at this juncture of long term manurial and fertilizer trials conducted at Jalandhar in Punjab which have clearly brought out the importance of integrated plant nutrient management in potato crop. Experiments conducted at Modipuram in central Indo-Gangetic alluvial plains have revealed that vermicompost is a better source of organic manure than FYM. The reasons could be presence of enzymes, hormones, growth regulators along with plant nutrients in vermicompost. Green manuring with sesbania or sunnhemp has been found to economize the use of fertilizer and improve the yield by balance nutrition to crop and improving soil physical conditions. Integrated use of biofertilizers *viz* Azotobacter and phosphate solubilizing bacteria along with organic manures improves the soil fertility and yield of potato.

Organic farming: With the increasing demand of organic produce, the attempts are being made at this Institute for organic potato production with the use of improved seed, crop rotation, manuring through organic materials (*viz.* crop residues, animal excreta, nitrogen fixing legumes, green manure, off-farm organic residues), biofertilizers (*viz. azotobacter, phosphorus solubilizing bacteria, mycorrhiza etc.*), mineral bearing rocks (*viz.* rock phosphate and gypsum) and management of pests and diseases through non-polluting substances like biopesticides.

Cropping Systems

Cropping system is the kind and sequence of crops grown on a given area of soil over a period of time. Traditionally, two or more crops were often grown together in mixed stands to serve against crop failure caused by ambient weather or outbreak of pests and diseases with stabilizing effect on yield over different seasons. With the availability of irrigation facilities and organic manures and fertilizers, farmers started to grow more than two or more crops in a year. Breeding of short duration and high yielding varieties of crops brought out a dramatic change in the cropping systems resulting in adjustment of agro-techniques. The energy crises and escalation in the input prices emphasized the need for developing and popularizing suitable agro-techniques that are least expensive and feasible for their wider adaptability on cropping system basis (6,7).

Considering the specific needs of different regions, concerted efforts were made to design new cropping systems. These include potato based sequential and inter cropping systems. Significant advantages in land use efficiency, crop productivity and monetary returns in intercropping as compared to sole cropping of potato have been demonstrated in different agro-ecological regions. In intercropping systems the component crops should be compatible so that the complementary effect is preserved and competitive effect is subdued. For this, the active growth period of one crop should coincide with the slack growth of other. For example, Potato+sugarcane, both autumn planted, synchronise potato lifting with cane earthing up.

Manuring in cropping system: Relative responses of crops to organic manures and the fertilizers and their residual effects should be taken into consideration for judicious manuring on system basis. Potato crop is most responsive to direct application of FYM or to PK fertilizers but rotational crops such as maize, rice and wheat can subsist on the residual effects. The dose of N to wheat and sunflower taken after potatoes can be reduced to one-half. Cool-season crops are generally more responsive to P than *kharif* crops. Application of 30 t/ha of FYM can not only meet full P and K needs of potato but also of succeeding wheat crop besides maintaining higher yield than with P and K from inorganic fertilizers (7). The residual effect of P and K applied to potato crop is found pronounced in cereals, however, the residual effect of P and K applied to cereals is not sufficient on potato crop because of its sparse rooting system indicating that direct application of P and K to potato is needed for getting optimum yields.

Water management

Water is a prime natural resource and important for assured potato production. During past four decades valuable results have been generated on water management in potato crop. A humble beginning has also been made in the area of soil- plant- atmospheric water relationship and on-farm water management in the hills for successful growing of potato crop. The water requirement of potato crop varies from 400-600 mm depending upon agroclimatic condition, duration of variety, length of growing period, cropping pattern and management practices adopted. The crop requires frequent and light irrigations. The modern methods of irrigation *viz.* micro-irrigation/fertigation through drip and sprinkler systems have been developed to ensure high quality produce and yield per unit area and time. Drip irrigation method involves slow application of water in the plant's root zone. Under fertigation technique, the fertilizers are applied directly near the root zone through drip irrigation. Micro-irrigation methods improve the efficiency of irrigation water and fertilizer nutrients by increasing availability of these inputs. Under drip irrigation the moisture availability always equal to the field capacity in surface soils throughout the period of crop growth. However, these modern methods require high initial investment and technical knowledge to operate.

Crop modelling

Inherent capability of the potato to produce high value food in a short duration and amenability to fit into cropping systems is unsurpassed. However, realizing the full potential of the crop requires exacting application and utilization of resources. Systematic agricultural field experimentation through traditional tools and methods is costly and time consuming. Moreover, it is impossible to conduct field experiments for every conceivable situation and location. Use of crop models is an alternative approach to increase the efficiency of agronomic experimentation. For this, recently a crop model INFOCROP-POTATO was developed for tropical/sub tropical conditions (5). It simulates various growth processes under different soil and environmental conditions. Possible applications of the model are optimizing the date of planting, nitrogen fertilization and irrigation, as also in identifying the possible growing period in an agro-climatic situation and tuber yield forecasting.

Concluding remarks

Out of the host of factors that affect potato production, agronomic aspects like seed size and spacing, nutrient supply, water and weed management along with cropping systems management to tailor crop production cost-effective, are considered as agronomic challenges. Thus, working out the best combination of all these factors for each agro-ecological situation is perhaps the best bet and calls for revising our agronomic strategy to tackle the issue in an altogether new dimension. New techniques have been put forward to plan profitable potato based cropping systems for optimizing resource use and to identify efficient crop zones. Concepts of input management practices are centering on integrated approaches. Consequently, potato production activity has come a long way from subsistence farming to commercialized enterprise.

Future strategies

The need for increased potato production is as important today as it was in 1960s. While the human population continues to grow unabated, the potato production has stagnated iin the country. The reasons for the stagnation of potato production include nutrient imbalances/ deficiency, changes in physico-chemical properties of soil, decline in productivity of modern varieties, irrigation related problems and build up of insect pests and diseases. Under these situations to sustain potato productivity on long run the following research strategies are suggested for our country.

1. Research on system based agro-techniques rather than on component crops.
2. Decentralised agro-techniques to make location specific adjustments to exploit their full potential.
3. Large volume of work has been done on soil and plant tests to assess fertilizer need of potato crop. There is a need to make it more efficient and user-friendly.
4. Development of matching agro-techniques for the new plant types being evolved through plant breeding, tissue culture, genetic engineering and plant biotechnology.
5. Standard and authentic methods for screening of varieties/lines for their efficiency to utilize nutrients from soil and fertilizers should be developed.
6. With the global requirement of organic food increasing at a faster rate, the decline in yields of the system's component at the initial levels is bound to come. So more research on this aspect is needed in terms of crop yield, quality of produce, soil fertility on sustainable basis.
7. Testing of crop management model INFOCROP-POTATO to avoid too much field research on agro-techniques.
8. Agro-techniques need to be developed in context of global climate change and CO_2 concentration. There is much need of inter-disciplinary collaboration on this aspect.
9. Identification and quantification of nutrient efficiency traits including use of radiotracer technique.
10. In future only one approach to combat weeds will not be sufficient. The more effective combination of integrated weed management practices involving chemical and mechanical methods is required.
11. The crop modelling, decision support systems, remote sensing techniques and geographical information system need to be effectively used for various input management in potato crop.

LITERATURE CITED

1. Lal, S.S. and J.S. Grewal. 1991. Weed Management in Potato. CPRI Technical Bulletin No.33. pp 43.
2. Sahota, T.S. and P.M. Govindakrishnan. 1984. Effect of split application of phosphorus to potato in acidic hill soils of Shillong. *J. Indian Potato Assoc.* **11**:126-30.
3. Sekhon, H.S. and M. Singh. 1985. Optimising seed rate and stem density for seed potato production. *J. agric. Sci. Camb.* **105:** 189-91.
4. Sharma, R.C., J.S. Grewal and M. Singh. 1977. Soaking of seeds in phosphate solution to economize on fertilizer input. *Plant and Soil* **46:** 145-52.
5. Singh, J.P., P.M. Govindakrishnan, S.S. Lal and P.K. Aggarwal, 2005. Increasing the efficiency of agronomy experiments in potato using INFOCROP-POTATO model. *Potato Research* **48:** 131-152.
6. Singh, J.P., V.K. Dua, Manoj Kumar, P.M. Govindakrishnan and S.S. Lal. 2008. Cultural Management of Crops in Potato Based Cropping Systems in India. CPRI Extension Bulletin No. 39. pp 48.
7. Singh, J.P., V.K. Dua, Manoj Kumar, P.M. Govindakrishnan and S.S. Lal. 2008. Resource Management in Potato Based Cropping Systems. CPRI Technical Bulletin No.83. pp 48.

Impact of Potato Research in India

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The Green Revolution in India during 1960s helped transform the agrarian economy from an abyss of intermittent famine to a reservoir of food surpluses. It contributed to a substantial reduction in poverty despite 82 per cent increase in population from 1971 to 2001. The agricultural research that underpinned this Green Revolution focused on genetic enhancement, production technologies and crop protection with the intermediate goal of increasing food production and reducing food insecurity. This historical focus on productivity-enhancing technologies in the country has been undeniably successful in achieving the food production goals of major crops like wheat and rice.

Potato research in India is also a great success story which has been instrumental in revolutionary growth in production and productivity of potato in the country. The food, which was introduced to India about 400 years ago and the cultivation of which started just 150 years ago, has now become the 'bread of life' for the poor in many parts of the country. Potato production in the country went up from just 1.66 million tonnes in 1950-51 to about 24.0 million tonnes in 2005-06. All this became possible through sustained indigenous research on potato which started in 1935 with the establishment of 3 breeding and seed production stations at Shimla, Kufri and Bhowali under the Imperial Agricultural Research Institute, New Delhi. The subsequent establishment of Central Potato Research Institute at Patna in 1949 was a historical event that triggered potato revolution in the country through development of indigenous potato varieties and production technologies.

Healthy Seed Potato Production in Hills

The number of varieties released or technologies standardized may be important indicators of research output, but the actual impact of research could be assessed only by quantifying the improvements in agricultural growth, farm income and consumer welfare, which will depend on the actual adoption of the developed technologies by the end-users. The potato has responded well to research, especially for the sub-tropical plains of India. Plant breeding continues to result in significant improvements in the crop, and with the use of modern biotechnological tools, safe movement and conservation of potato germplasm is now practically feasible. The release of indigenous potato processing varieties has improved the processing of potatoes from less than 1 per cent to around 5 per cent of the total potato production in the last one decade.

The development of 'Seed Plot Technique' in 1970s enabled healthy seed potato production in the sub-tropical Indian plains. Availability of short duration varieties has further helped in increasing cropping intensity in the entire Indo-Gangetic plains. With the development of heat tolerant potato variety, the cultivation of potato could be further extended to non-traditional warmer areas of the country. While the diagnostics research in potato virology has advanced greatly, management of late blight continues to be an enigma to plant pathologists and breeders alike. Standardization of storage techniques at higher temperatures with or without CIPC treatment has facilitated potato processing round the year and has helped in controlling seasonal fluctuations in potato prices.

Impact of Crop Improvement

Like other crops, genetic enhancement of potato received highest priority among various disciplines. The potato was introduced into India from Europe where the crop is grown in summer with long photoperiod (14-16 hours) and crop duration of 140-180 days. The exotic varieties belonging to *Solanum tuberosum ssp. tuberosum* introduced by the British found hospitable climate in the Indian hills and spread quickly in the entire region. However, these proved unsuitable for cultivation in sub-tropical Indian plains having shorter photoperiod (9-11 hours) and crop duration (90-100 days) during winters.

After the failure of repeated attempts to acclimatize the European potato varieties to Indian plains, the major challenge for the potato breeders was to develop potato varieties adapted to shorter days. The organized potato breeding programme was initiated in 1935 at the Potato Breeding Station, Shimla. However, regular breeding programme started only in 1949 with the establishment of Central Potato Research Institute. The major breakthrough in potato improvement programme came in 1958 with the release of 6 potato varieties and later in 1968 with the release of 9 potato varieties. Since then, improved potato varieties suited to different agro-climates were released at regular intervals and by 2008, CPRI had released 45 indigenous varieties for Indian hills and plains (Table 1).

Promising Varieties of Potato in Cultivation

The development of indigenous potato varieties has contributed substantially towards spectacular growth in area, production and productivity during the last six decades. The country recorded an increase in area under potato from 0.24 million hectares in 1950-51 to 1.4 million hectares in 2005-06 with the corresponding increase in production from 1.66 to 23.9 million tonnes (Fig.1). The productivity also improved from 69.2 q/ha in 1950-51 to 170.6 q/ha in 2005-06. Thus, there has been a phenomenal increase in area, production and productivity of potato over this period by 483 per cent, 1340 per cent and 146 per cent, respectively.

Table 1: Potato Varieties Developed by CPRI

Sl. No.	Variety	Year of release	Maturity	Adaptability
1.	Kufri Kisan	1958	Late	North Indian plains
2.	K. Kuber	1958	Medium	North Indian plains & plateau region
3.	K. Kumar	1958	Late	North Indian hills
4.	K. Kundan	1958	Medium	North Indian hills
5.	K. Red	1958	Medium	Plains of Bihar & WB
6.	K. Safed	1958	Late	North Indian plains
7.	K. Neela	1963	Late	South Indian hills
8.	K. Sindhuri	1967	Late	North Indian plains
9.	K. Alankar	1968	Medium	North Indian plains
10.	K. Chamatkar	1968	Late	North Indian plains
11.	K. Chandramukhi	1968	Early	North Indian plains & plateau region
12.	K. Jeevan	1968	Late	North Indian hills
13.	K. Jyoti	1968	Medium	Hills & plains
14.	K. Khasigaro	1968	Late	North-eastern hills
15.	K. Naveen	1968	Late	North-eastern hills
16.	K. Neelamani	1968	Late	South Indian hills
17.	K. Sheetman	1968	Medium	North-western plains
18.	K. Muthu	1971	Medium	South Indian hills
19.	K. Lauvkar	1972	Early	Plateau region
20.	K. Dewa	1973	Late	North Indian plains
21.	K. Badshah	1979	Medium	North Indian plains & plateau region
22.	K. Bahar	1980	Medium	North Indian plains
23.	K. Lalima	1982	Medium	North Indian plains
24.	K. Sherpa	1983	Medium	North Bengal hills
25.	K. Swarna	1985	Medium	South Indian hills
26.	K. Megha	1989	Late	North-eastern hills
27.	K. Jawahar	1996	Early	North Indian plains & plateau region
28.	K. Sutlej	1996	Medium	North Indian plains
29.	K. Ashoka	1996	Early	North Indian plains
30.	K. Pukhraj	1998	Early	North Indian plains & plateau region
31.	K. Chipsona-1	1998	Medium	North Indian plains
32.	K. Chipsona-2	1998	Medium	North Indian plains
33.	K. Giriraj	1999	Medium	North Indian hills
34.	K. Anand	1999	Medium	North Indian plains
35.	K. Kanchan	1999	Medium	North Bengal hills
36.	K. Arun	2005	Medium	North Indian plains
37.	K. Pushkar	2005	Medium	North Indian plains
38.	K. Shailja	2005	Medium	North Indian hills
39.	K. Chipsona-3	2006	Medium	North Indian plains
40.	K. Surya	2006	Early	North Indian plains & peninsular India
41.	K. Himalini	2006	Medium	All Indian hills
42.	K. Himsona	2007	Medium	North Indian hills
43.	K. Sadabahar	2007	Medium	UP & adjoining areas
44.	K. Girdhari	2008	Medium	North Indian hills
45.	K. Khyati	2008	Early	North Indian plains

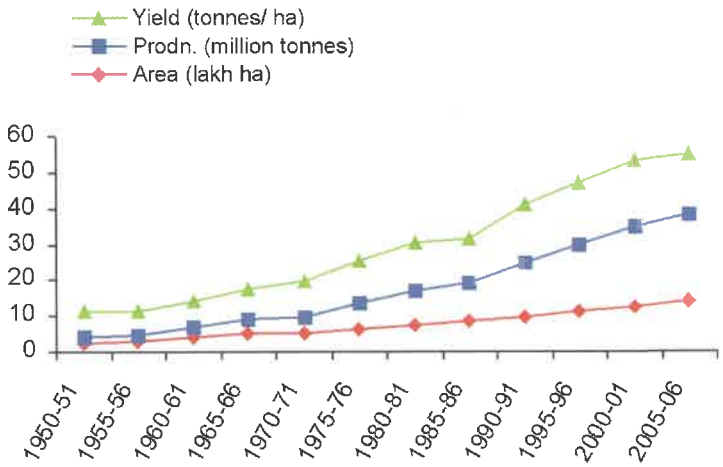


Fig. 1 : Trends in area, production & yield of potato in India

Perusal of Table 1 and Figure 1 reveals that the growth spurts in area, production and productivity of potato have been generally preceded by release of improved varieties by CPRI. The major growth spurts after 1960-61, 1970-71 and 1985-86 indicate a visible impact of improved varieties that were released before. Until 1950s, India was a potato importing country, but after that it became self-sufficient in potato production. The indigenous varieties also eliminated the country's dependence on imported varieties. And the most important fact is that about 90 per cent of total potato production comes from the sub-tropical Indian plains which became possible only through the better adapted indigenously developed varieties.

The European varieties imported for the purpose of kitchen gardening, and later on for commercial cultivation, were low yielding and highly susceptible to degenerative diseases under sub-tropical plain conditions. These varieties, mainly *Phulwa*, *Gola*, *Satha*, Magnum Bonum, Craig's Defiance and Up-to-date were under cultivation in the hills and plains of the country before 1950s. However, these are no more the mainstream varieties under cultivation in India, though they still enjoy consumer preference in small pockets of the country. Those imported varieties have been entirely replaced by the improved indigenous varieties developed by CPRI, Kufri Jyoti being the most popular one cultivated throughout the country and occupying about 40 per cent of total potato area. Kufri Bahar is the second most popular variety occupying 28 per cent of total potato area followed by Kufri Pukhraj, Kufri Badshah, Kufri Sindhuri, Kufri Chandramukhi and others according to the survey research conducted by social scientists of CPRI during 2005. The adoption of these high yielding varieties by the farmers has been largely instrumental in rapid growth of production and productivity of potato in the country.

Impact of Processing Varieties

Although India is the 3rd largest producer of potatoes globally, yet less than 5 per cent of total produce is utilized for processing in contrast to the developed nations where 40-60 per cent of the total production is consumed in processed form. This is due to non-availability of suitable processing varieties and quality raw material round the year. However, the processing varieties developed by CPRI have changed the scenario of potato processing in the country. The processing of potatoes from total production has increased from less than 1 per cent to

about 5 per cent during the last 5-6 years. It is expected that potato processing may touch the figure of 7 per cent by the end of the year 2010.

Table 2: Comparison of processing parameters of potato varieties

Varieties	% Dry Matter	Reducing Sugar(mg/100 g fresh weight)
Kufri Jyoti	18-21	106-275
Kufri Chandramukhi	18-20	250-324
Kufri Lauvkar	18-20	200-250
Kufri Chipsona-1	21-24	45-100
Kufri Chipsona-2	21-25	44-93
Kufri Chipsona-3	21-25	23-52
Kufri Himsona	22-25	32-93
Atlantic	22-25	60-70
Fritolay-1533	21-24	100-105

In India, potato processing in organized sector started about a decade ago, and the recent proliferation of this sector mainly results from the development of 3 indigenous potato processing varieties, viz. Kufri Chipsona-1, Kufri Chipsona-2 and Kufri Chipsona-3. In 2007, another processing variety Kufri Himsona was released, which is suited for growing in the lower and mid-hills. Besides, the heat tolerant variety Kufri Surya, released in 2006 is also being used for processing purposes owing to high dry matter content. These varieties are superior in dry matter and reducing sugar content to varieties like Kufri Jyoti, Kufri Chandramukhi and Kufri Lauvkar used earlier for processing. These varieties are also superior to American varieties Atlantic and Fritolay-1533 earlier imported by processing industries in India (Table 2).

The indigenous processing varieties are now exclusively used by the industries in India for processing into chips and French fries. M/s PepsiCo India, the biggest manufacturer of snack food in the country, utilized as much as 10,000 tonnes of the produce of Chipsona varieties during the year 2005. These varieties produce superior quality chips having attractive light colour, crispy texture and low oil content. Owing to superior chipping quality, better yield performance and resistance to serious diseases like late light, these varieties are now replacing the exotic American varieties imported by some multinational companies 5-6 years ago. This is evident from the increasing demand of breeder's seed of Kufri Chipsona-1 and K. Chipsona-2 as mentioned in Table 3.

Due to availability of indigenous processing varieties, potato processing is emerging as a fast growing industry in the country with more entrepreneurs joining and existing ones increasing the capacity of their processing units. PepsiCo India is the leading company in this sector, while the other players are ITC, Haldiram, Balaji Wafers, McCains, Vegit Potato Specialities, Bikano Namkeen, etc. The farmers in the identified areas, suitable for growing processing quality potatoes, have started contract farming to supply processing potatoes to these industries. This arrangement has ensured quality raw material to the processors, while assuring profitable returns to the contract farmers. This will help strengthening of rural economy in a big way keeping in view the increasing demand of processed products due to growing urbanization, rise in per capita income, changing lifestyles and fast expanding

tourism. The coming up of a large number of national and multinational companies in the potato processing sector has also boosted the urban economy by providing employment opportunities to the urban skilled workers and labourers.

Table 3: Supply of breeders' seed potato of processing varieties from CPRI

Year	Quantity supplied (q)	
	Kufri Chipsona-1	*Kufri Chipsona-2*
1999-00	236	153
2000-01	449	233
2001-02	992	413
2002-03	2045	530
2003-04	1662	643
2004-05	1532	910

(Source: *Potato Statistics: India and World*, Technical Bulletin No. 81, CPRI, Shimla)

Potato Products

Impact of Seed Plot Technique

This technique was developed in 1970s to enable healthy seed potato production in the sub-tropical Indian plains under low aphid period. This technique aided by bio-technological approaches for virus elimination, micro-propagation and effective viral diagnostics has sustained the National Potato Seed Production Programme by producing about 3000 tonnes of breeder's seed annually. This amount of breeders' seed, if multiplied 216 times through 3 successive generations to about 6,48,000 tonnes of certified seed by the State Departments of Agriculture/ Horticulture, is able to meet the entire seed potato requirements of Indian farmers.

The decentralization of potato breeding from hills to plains in India through the seed plot technique enabled the development of varieties suited to different agro-climatic regions of the country. The area under seed potato production also increased by 12 times and enabled the availability of seed potato throughout the country in proper physiological state. India was a seed potato importing country until 1950s. With the development of seed plot technique, the country has become self-sufficient in production of seed and saves about 648 million US dollars as most Asian countries like Pakistan, Bangladesh and even China continue to import seed potatoes from Europe. Moreover, the indigenously produced seed is available to the farmers @ Rs. 5000-7000 i.e. US$ 100 to 140 per tonne as against US$ 1000-1200 per tonne in our neighbouring countries, thereby saving a lot of money of our rural people.

Impact of Tissue Culture in Seed Production

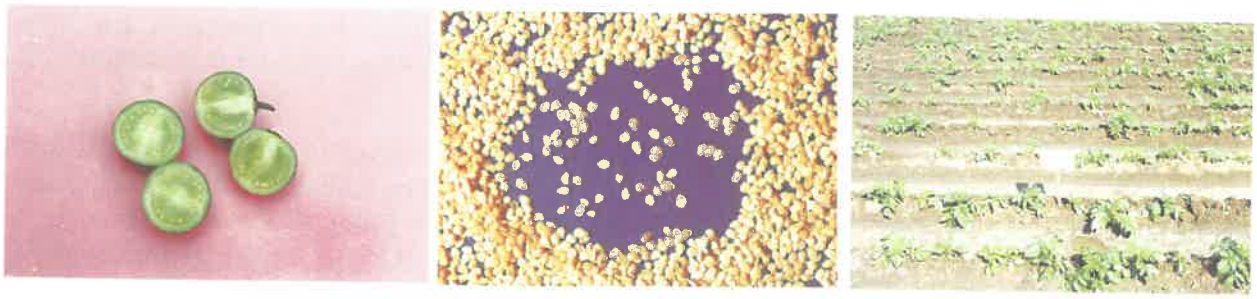
About 23 viruses and virus-like agents infect potato. In the absence of chemical control of viral diseases, meristem tip culture is the only effective method available till date to eliminate virus infections from potato cultivars. This tissue culture technique has been standardised for rapid multiplication of disease-free planting material through *in vitro* induced microtubers and *ex vitro* produced minitubers from the microtubers.

Traditionally, potato is propagated vegetatively through seed tubers. Due to low rate of multiplication (5-6 times), several field multiplications of initial disease-free material are required resulting in progressive accumulation of degenerative viral diseases in seed tubers. As a result, the availability of quality seed potato is a major constraint, particularly when the cost of seed potato alone accounts for 40-50 per cent of total cost of production. The micro-propagation technique has reduced the number of field multiplications needed to produce the desired quantity of disease-free breeders' seed and also increased the rate of multiplication by many times.

Presently, about 40 per cent breeders' seed production programme is fed annually by microtubers/ minitubers produced through tissue culture and it is targeted to produce 100 per cent of breeders' seed through tissue culturally propagated material by the end of XIth Plan. This technology has ensured greater availability of disease-free seed for cultivation which will ultimately help in boosting overall potato production in the country.

Impact of True Potato Seed (TPS) Technology

TPS is the botanical seed produced through sexual reproduction. It is an alternate technology for crop production in areas where quality seed tubers cannot be produced due to unfavourable agro-climate and transportation of seed potatoes from distant places is very expensive. These areas are Karnataka, Maharashtra, Gujarat, Madhya Pradesh, Orissa, Jharkhand, Bihar, West Bengal and north-eastern states. The TPS technology offers low cost on seed, ease in storage and transportation, and lower incidence of diseases and insect-pests. It has also the potential to save a large quantity of food material (tubers) for table consumption.



TPS Technology

Three TPS hybrids viz. TPS C-3, HPS I/13 and 92 PT-27 have been recommended by CPRI for commercial cultivation in different parts of the country. These hybrids are high yielding and produce 270-340 quintals of potatoes per hectare. On the other hand, the cost on seed, which accounts for 40-50 per cent of the total cost of production, is very low. About 100 g of TPS costing Rs.2000 to 3000 is all that one needs to plant a hectare of potato as against 2-3

tonnes of seed tubers costing Rs.15,000 to 20,000. Low cost coupled with high labour requirement have made this technology especially suited to small and marginal farmers of seed deficient states of Bihar, Orissa, Madhya Pradesh, Maharashtra, Karnataka, Gujarat, and the North-East.

The maximum impact of this technology is visible in the state of Tripura, where more than 50 per cent of potato area is under TPS and consequent upon this, the potato yield (150 q/ha) in Tripura is far better than those in other north-eastern states (average 66.8 q/ha). In view of the potentiality of this technique, TPS is now being produced in bulk by the state governments of Tripura, Karnataka, and private firms like Beejo Sheetal Pvt. Ltd. Thus, the TPS technology has helped in extending potato cultivation to the entire country, particularly to the north-eastern and southern states where transportation of seed tubers from north Indian plains is very expensive.

Impact of Agro-techniques

On the basis of multi-location trials in the country, *package of practices* has been developed for potato production in different agro-climatic zones indicating nutrient, water and weed management, etc. Integrated nutrient management schedule, worked out for judicious use of organic manures, chemical fertilizers, micro-nutrients and bio-fertilizers, has helped in achieving the goal of sustainable potato production. For example, the use of biofertilisers like azotobacter and phosphobacterium in potato has helped in reducing the dose of nitrogen by 20 kg/ha and that of phosphorus by 25-50 kg/ha. Similarly, better water management techniques like mulching, drip and sprinkler irrigation, and use of water harvesting structures have helped in judicious use of irrigation water and increasing the area under irrigation with the available water. The standardization of micro-irrigation system has reduced the irrigation water requirement by 40-50 per cent and has become very popular in water deficient states like Gujarat and Maharashtra.

The Institute has also refined and standardised the technology for *organic potato production*. This has facilitated the use of locally available material, particularly in the hilly states where large areas of forest and large number of cattle per unit area provides higher amount of organic matter. The use of locally available materials like farm yard manure, compost, green manure, crop residues and dried tree leaves saves a lot of money of the rural people which are otherwise spent on fertilizers, pesticides, herbicides, etc. Besides, the organically produced potato fetches higher price in the market and the farmers are getting good returns in states like Gujarat and Maharashtra..

The potato crop has a wide flexibility in its planting and harvesting time and can fit well in various intensive *cropping systems*. It can be profitably intercropped with wheat, maize, mustard and sugarcane. Several profitable potato-based inter-cropping and crop rotations have also been identified for different regions of the country. Due to input-intensive nature of the crop, adoption of optimum cultural practices for achieving higher potato productivity becomes a limiting factor for the small and marginal farmers. For these categories of farmers, agro-techniques with low-cost input technology for potato production have been standardized. Adoption of the profitable cropping systems along with low-cost production technologies by the farmers has led to increase in their income by way of efficient management of natural resources.

The diminishing per capita availability of agricultural land has compelled the country to produce more food per unit area and time. Being short duration crop of 80-90 days, potato can

fit very well in the widely prevalent rice-wheat system in the north Indian plains. The development of early maturing varieties like Kufri Ashoka, K. Jawahar and K. Pukhraj along with their agro-techniques for cultivation in north Indian plains has resulted in increase in the cropping intensity and income of the rural community. This has also helped in expanding the potato area in the country. With the standardization of agro-techniques for the recently released early maturing and heat tolerant variety Kufri Surya, the potato cultivation is now ready to move to the non-traditional warmer areas of Peninsular India.

Potato Implements

Investment on human labour accounts for 15-20 per cent of total cost of potato production since it requires about 1800 manhours per hectare for various operations. Potato cultivation has been mechanized in selected regions through the fabrication and development of cost-effective tools and implements like potato planter, ridger, crust breaker, fertiliser and insecticide applicator, haulm cutter, digger, grader, etc. So far about 60 implements/equipments have been designed and developed by the Institute for various cultural operations in potato cultivation and post-harvest handling.

Most of the implements/equipments developed by the Institute are being commercially manufactured by different firms and used by the potato growers in Punjab and adjoining states. The mechanisation of potato has helped in reducing the cost of cultivation, particularly for the large and medium scale farmers of Indo-Gangetic plains, thereby increasing their net income. Large scale potato farming, as practised in Punjab, Haryana and western Uttar Pradesh, could not have been possible without the use of farm machineries. The mechanisation has also helped in improving the potato productivity by way of ensuring timely operations and increasing the effectiveness of various operations from planting to harvesting and post-harvest handling.

Impact of Plant Protection Technologies

The potato is prone to many diseases and insect-pests. Effective management practices have been devised for the major potato diseases and insect-pests in India. The Institute has developed sensitive virus detection techniques like ELISA, ISEM, NASH and PCR, which have been of great help in eliminating quarantine material having low concentration of viruses/ viriods. Use of these techniques along with micro-propagation in seed production has been responsible for practically zeroing the virus incidence in basic/nucleus seed.

Late blight caused by *Phytophthora infestans* is the most devastating disease of potato which cause losses as high as 70-80 per cent. It occurs every year in the hills and alternate years

in the plains. Even after 160 years of intense research the disease, which caused the famous Irish famine in 1845, continues to be a major challenge for the potato breeders and pathologists. So far the Institute has developed 28 potato varieties resistant to late blight and has made the policy to have at least moderate degree of resistance against this disease in all the varieties to be developed in future. A package of chemical control through the use of mancozeb, metalaxyl and cymoxanil has been found to be very effective in controlling the disease in hills and plains under epiphytotic conditions. However, the development of complex races of the pathogen renders the resistant varieties and fungicides ineffective, and requires continuous research and breeding in this area.

Besides, chemical control measures, the Institute has also standardised a number of eco-friendly cultural practices to control the diseases and insect-pests. Proper irrigation, suitable crop rotation, green manuring, deep and hot weather ploughing, and flooding of the potato field have been found to be effective in managing soil-borne diseases like bacterial wilt, common scab, black scurf, soft rot, etc. and insect-pests like potato tubermoth, white grubs and cutworms. The development of late blight resistant varieties coupled with disease forecasting system for hills and plains enabling the early warning mechanism for the appearance of the disease, has reduced the indiscriminate use of fungicides by the farmers to protect the crop.

Potato tuber moth (PTM) is an important insect-pest in the plateau region and some pockets in the hills. Covering of potato heaps from below and top with dried leaves of *Lantana* and *Eucalyptus* is highly effective in reducing tuber damage in the country storages. Aphids, white flies and mites serve as vectors for viruses in potato crop. Suitable chemical measures devised for their control have been found to be very effective at the farmers' fields. However, growing of potato crop in relatively aphid-free period and dehaulming of crop before vectors cross the critical limit has reduced the use of insecticides and helped in protecting the natural fauna while ensuring disease-free seed potato production.

Impact of Potato Storage Technologies

In European countries, the potato crop is grown in summer and the main storage season is the cold winter. However, in India, 85 per cent of potato is produced in winter and stored during long hot summer. This requires storage of potatoes in cold storages at 2-4°C, which involves substantial cost. It also leads to accumulation of reducing sugar in the potato tubers resulting in sweetening of potatoes. This makes stored potatoes just unfit for processing and lose preference for table purposes. The Institute has standardized a technology to store potatoes for table and processing purposes at 10-12°C with CIPC treatment. The CIPC (isopropyl-N-chlorophenyl carbamate) applied @ 25 mg a.i. per tonne tubers acts as an effective sprout inhibitor, and prevents shrinkage and rotting of tubers at 10-12°C.

Subsequently, the Institute encouraged the cold storage owners to adopt this practice by laying small trials at different cold storages in the country. Now most of the cold storage owners have adopted this practice which has helped in stabilizing the seasonal fluctuations of potato prices in the country. This is evident from the wholesale price data of potato in Delhi Azadpur Mandi during the year 2008 (Table 4) which is considered as a bumper production year. On the other hand, if we see the data of 2006 and 2007, we find wide range of fluctuation in potato prices. The CIPC treated potatoes are now being sold in India under the misnomer 'Sugar-free Potatoes'. Although these potatoes are essentially not sugar-free, yet these have very low accumulation of reducing sugars making fit for table and processing purposes.

Table 4: Average monthly wholesale price of potato in Delhi Azadpur Mandi

Month	Wholesale price of potato (Rs./q)		
	2006	2007	2008
January	476	313	483
February	474	377	471
March	506	469	446
April	537	532	385
May	562	576	397
June	616	659	476
July	589	1058	379
August	609	1196	358
September	760	1082	400
October	853	1177	399
November	694	790	-
December	365	582	-

(Source: *The Economic Times*, Daily)

About 168 cold stores of India, with total capacity of 240,000 tonnes, stored potatoes at 10-12°C with CIPC treatment during the year 2006. This practice has benefited the producers and consumers alike through stabilization of potato prices round the year. The producers have been able to come out of the curse of distress sale during harvesting time and during high production years. The consumers also got rid of from the situation of high inflation during the lean season. This practice has also been found to be successful in supplying the processing grade raw material to the industries round the year. If continued in future, it is likely to have a cascading effect in periodic gluts and scarcities, which will ultimately benefit the small and medium scale potato growers of the country.

The cold storage of potato involves substantial cost and the small and marginal farmers cannot afford the high storage cost. There are a number of traditional low-cost and non-refrigerated storage structures (essentially based on evaporative or passive evaporative cooling) like sand pits, diffused light storage rooms, thatched mud wall rooms, etc., which are in use in India with varying degrees of success. The temperature inside these stores remains 6-12°C lower than the ambient and the relative humidity is around 90 per cent. These structures do not require electric energy and farmers can store potatoes with or without CIPC treatment for 3-4 months for table and processing purposes with only 5-6 per cent storage losses. These traditional structures have been studied, validated, refined and popularized for particular regions. This practice has also enabled the small and medium scale farmers to avoid distress sale and get a price at least twice as much as they would have got at the time of harvest.

Impact on Potato Trade

With well developed seed production programme suited to sub-tropical climate, India has acquired the potential to export seed potatoes to other Asian countries. Indian potatoes are truly free from the prohibited disease like wart, black scruf, and pests like tuber moth and nematodes, which are the barometer for phytosanitary standards. India has also the natural

advantage of exporting fresh table potatoes during January to June when supply from European countries dwindles. It can also supply fresh potatoes round the year because India has diverse agro-climates and potato is grown throughout the year in one or the other part of the country. Moreover, Indian potatoes are produced at low production cost which provide competitive edge in the international market.

India was a potato importing country until 1950s, however, it has been a net exporter in potatoes since 1960s till date. As a result of sustained potato research and development programmes, India began to produce export quality potatoes. India's share in world's table potato export increased from 0.018 per cent in 1967 to 0.75 per cent in 2004 (figuring around 67,000 tonnes). The major countries to which India exports table potato are Nepal, Sri Lanka, UAE, Mauritius, Malaysia, Maldives, Singapore, Bangladesh and USA, whereas the seed potatoes are mainly exported to Nepal, Sri Lanka, UAE, USA, Singapore, Maldives, South Africa and Mauritius. The major destinations of Indian processed potato products are Sri Lanka, UAE, Maldives, USA, Mauritius, Nepal and Oman (Source: *FAOSTAT Database*).

Consequent upon export potentialities of Indian potatoes, four potato export zones have been established in the country viz. in Uttar Pradesh, Punjab, Madhya Pradesh and West Bengal. The major potato markets in these states are Agra, Hathras, Kanpur, Meerut, and Farrukkhabad in UP; Jalandhar, Ludhiana, Phul and Patiala in Punjab; Ujjain, Indore and Dewas in MP and Hoogly, Burdwan and Howrah in West Bengal. Also, potato is traded in the Indian commodity exchange namely, Multi Commodity Exchange of India Ltd.

India has a huge population to feed and, that is why, has a large demand for this crop. As a result, very small quantity of potatoes is left for the exports making India's share in world exports insignificant and inconsistent. However, there is a great scope for export of Indian potatoes, particularly the processed ones to the international market. It is understood that the national and multinational companies investing in potato processing sector and retail business in India would also provide a boost to the Indian potato export through supply to their international outlets.

Improved Human Nutrition

Potato is a highly nutritious, easily digestible and wholesome food containing carbohydrates, proteins, minerals, vitamins and high quality dietary fibre. It provides more nutrition than cereals and vegetables. The biological value of potato protein is better than wheat, maize, peas, beans, and comparable to milk. Due to sustained efforts of CPRI, the potato production in India has increased from 1.66 million tonnes in 1950-51 to 24.0 million tonnes in 2005-06. As a result, the per capita per year consumption of potato in the country has been estimated to increase from 3 kg to 17 kg during this period. Since potato is a wholesome food, the increase in its per capita consumption has contributed significantly to the improvement in health standards of rural and urban peoples.

Employment Generation

Potato is a labour-intensive crop and contributes significantly to employment generation in the rural economy. Potato requires an input of 250 mandays for cultivation of the crop in one hectare area. With the efforts of CPRI in technology generation and transfer, the area under potato has increased from 0.24 million hectares in 1950-51 to 1.4 million hectares in 2005-06 with annual compound growth rate of 3.34 per cent. This has resulted in the generation of rural

employment to the level of 29.0 crores mandays on account of incremental area of 1.16 million hectares brought under potato cultivation. It has benefited the farming community, particularly the small and marginal farmers significantly. In addition, the revolutionary increase in potato output has generated lots of employment opportunities in the post-harvest operations of storage, transportation and marketing.

In recent years the demand for processed potato products has grown up at a fast pace due to increased urbanization, rise in per capita income and fast expanding tourism. The CPRI has so far developed 7 potato varieties for processing viz. Kufri Chipsona-1, Kufri Chipsona-2, Kufri Chipsona-3, Kufri Himsona, Kufri Jyoti, Kufri Chandramukhi and Kufri Lauvkar. It has also standardized the production techniques of a number of potato products like chips, French fries, flour, flakes, custard and cubes. About 90 percent of potato processing in India is done in the unorganised sector which provides employment to a large number of rural women.

Table 5 : State-wise poverty ratio and per capita production of potato

Sl. No.	State	Poverty ratio (%)			Per capita production of potato (kg/year)		
		1973-74	1999-00	% Decrease	1970-71	2000-01	% Increase
1.	Andhra Pradesh	48.86	15.77	**33.09**	0.03	0.18	**500**
2.	Arunachal Pradesh	51.93	33.47	18.46	12.7	29.51	132
3.	Assam	51.21	36.09	15.12	7.57	25.41	236
4.	Bihar	61.91	42.60	19.31	19.9	2.89	-16
5.	Gujarat	48.15	14.07	34.08	3.59	1.41	-60
6.	Haryana	35.36	8.74	**26.62**	6.36	12.18	**91**
7.	Himachal Pradesh	26.39	7.63	18.76	24.83	25.50	67
8.	Jammu & Kashmir	40.83	3.48	**37.35**	1.28	2.46	**92**
9.	Karnataka	54.47	20.04	**34.43**	1.24	8.38	**576**
10.	Madhya Pradesh	61.78	37.43	24.35	4.69	5.46	16
11.	Maharashtra	53.24	25.02	28.22	1.07	0.75	-29
12.	Meghalaya	50.20	33.87	16.33	70.3	78.32	11
13.	Mizoram	50.32	19.47	30.85	2.73	2.70	-1
14.	Orissa	66.18	47.15	19.03	10.15	2.33	-77
15.	Punjab	28.15	6.16	**21.99**	15.94	48.73	**205**
16.	Rajasthan	46.14	15.28	**30.86**	0.17	0.50	**194**
17.	Tamil Nadu	54.94	21.12	33.82	2.35	1.66	-29
18.	Tripura	51.00	34.44	16.56	11.99	30.10	151
19.	Uttar Pradesh	57.07	31.15	**25.92**	16.82	51.13	**204**
20.	West Bengal	63.43	27.02	**36.41**	20.71	95.70	**362**

(Source : Office of Registrar General, India and

Potato Statistics: India and World, Technical Bulletin No. 81, CPRI, Shimla)

Impact on Poverty Alleviation

India is home to 260 million people who do not have incomes to access a consumption basket which defines the poverty line. Since agriculture in India sustains the livelihood of about 70 percent of our population, agricultural development has been the prime mover of poverty alleviation programmes. In this context, importance of potato is noteworthy for several

reasons. The nutritive value of potato augers well for its potential in reducing malnutrition of millions of people of our country. Also, due to short vegetative cycle combined with high protein:calorie ratio, potato yields more edible energy, protein and dry matter per unit area and time than many other food crops. For instance, the potato produces 3 kg of protein/ha/day as compared to only 2.5 kg/ha/day in wheat, 1.2 kg/ha/day in maize and 1kg/ha/day in rice. These factors combined with employment generation potential make potato an important food security crop for poverty alleviation.

Although poverty alleviation involves a galaxy of factors and the factorial contribution of potato may be meager, yet positive association between increase in per capita production of potato and decline in poverty ratio in many states of India could be inferred from Table 5. It might be due to the fact that better-endowed states have adopted a large number of improved potato technologies, which significantly contributed towards enhancing food security and reducing poverty ratio in those states. Potato has become an important part of people's diet in many states of India during the last century. In these states, none of the dishes is prepared without having combination with potato. In West Bengal, even non-vegetarian dishes are prepared in combination with potato. It needs to be pointed out that there is generally positive correlation between consumption of a food item in a particular region and production of that particular food crop in the region. Employment generation potential of potato production is another important factor contributing towards poverty alleviation.

Conclusion

India is the second most populated nation and third largest producer of potato in the world. In order to feed all of its population, no crop other than potato can make a significant impact. Indian attachment with potato is not a historical one since it was introduced in the country only in early 17th century. However, India has become self-sufficient in production of table, seed and processing potatoes mainly due to the development of indigenous varieties, production and protection technologies and the establishment of National Potato Seed Production Programme. The impact of potato research on agricultural development and social welfare in India has been enormous but not well documented in the past. Hence, many of the information given in this article are subjective in nature and need thorough empirical study.

Unlike developed nations of the world, potato in India is still considered as a vegetable crop. In the absence of having the status of food crop, potato development in India has not received the due attention in agricultural policies and missions despite having greater potential to contribute towards food security. Potato offers vast potential for intensifying agriculture in the sub-tropics and ensuring food security of the country. Being short duration crop of 80-90 days, it can be easily incorporated into many prevailing cropping systems, including the rice-wheat system of north Indian plains. For realizing greater impact of potato research in India, appropriate policy environments and infrastructural facilities are needed on the part of all the stakeholders of potato development.

ICAR at a Glance

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The Indian Council of Agricultural Research (ICAR) is an autonomous organisation under the Department of Agricultural Research and Education, Ministry of Agriculture, Government of India. Formerly known as Imperial Council of Agricultural Research, it was established on 16 July, 1929 as a registered society under the Societies Registration Act, 1860 in pursuance of the report of the Royal Commission on Agriculture. The ICAR has its headquarters at New Delhi.

The Council is the apex body for coordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. With over 90 ICAR institutes and 45 agricultural universities spread across the country this is one of the largest national agricultural systems in the world.

The ICAR has played a pioneering role in ushering Green Revolution and subsequent developments in agriculture in India through its research and technology development that has enabled the country to increase the production of foodgrains by 4 times, horticultural crops by 6 times, fish by 9 times (marine 5 times and inland 17 times), milk 6 times and eggs 27 times since 1950-51, thus making a visible impact on the national food and nutritional security. It has played a major role in promoting excellence in higher education in agriculture. It is engaged in cutting edge areas of science and technology development and its scientists are internationally acknowledged in their fields.

The Mandate

- To plan, undertake, aid, promote and co-ordinate education, research and its application in agriculture, agroforestry, animal husbandry, fisheries, home science and allied sciences.
- To act as clearing house of research and general information relating to agriculture, animal husbandry, home science and fisheries through its publications and information system, and instituting and promoting transfer of technology programmes.
- To provide, undertake and promote consultancy services in the fields of education, research, training and dissemination of information in agriculture, agroforestry, animal husbandry, fisheries, home science and allied sciences.
- To look into problems relating to broader areas of rural development concerning agriculture, including post-harvest technology, by developing co-operative programmes with other organizations such as the Indian Council of Social Sciences Research, Council of Scientific and Industrial Research, Bhabha Atomic Research Centre, and universities.
- To do other things considered necessary to attain objectives of the Society.

Organization

- Union Minister of Agriculture is the ex-officio President of the ICAR Society.
- Secretary, Department of Agricultural Research & Education Ministry of Agriculture, Govt. of India & Director-General, ICAR – the Principal Executive Officer of the Council.
- Governing Body is the policy-making authority
- Agricultural Scientists' Recruitment Board
- Deputy Directors-General (8)
- Additional Secretary (DARE) and Secretary (ICAR)
- Additional Secretary and Financial Advisor
- 24 Assistant Directors-General
- National Director, National Agricultural Innovation Project
- Directorate of Information and Publications of Agriculture

Milestones

- Initiation of the first All-India Co-ordinated Research Project on Maize in 1957
- Status of Deemed University accorded to IARI in 1958
- Establishment of the first State Agricultural University on land grant pattern at Pantnagar in 1960
- Placement of different agricultural research institutes under the purview of ICAR in 1966
- Creation of Department of Agricultural Research and Education (DARE) in the Ministry of Agriculture in 1973
- Opening of first Krishi Vigyan Kendra (KVK) at Puducherry (Pondicherry) in 1974
- Establishment of Agricultural Research Service and Agricultural Scientists' Recruitment Board in 1975
- Launching of Lab-to-Land Programme and the National Agricultural Research Project (NARP) in 1979
- Initiation of Institution-Village Linkage Programme (IVLP) in 1995
- Establishment of National Gene Bank at New Delhi in 1996
- The ICAR was bestowed wih the King Baudouin Award in 1989 for its valuable contribution in ushering in the Green Revolution. Again awarded King Baudouin Award in 2004 for research and development efforts made under partnership in Rice Wheat Consortium.
- Launching of National Agricultural Technology Project (NATP) in 1998 and National Agricultural Innovation Project (NAIP) in 2005

Glimpses of CPRI

SK Pandey and Manoj Kumar

Trust of Indian planners in the potential of South American native potato was realized even before independence. As a result, potato research in India formally began on April 1, 1935 with the opening of a Potato Breeding Station at Shimla and two seed production farms at Bhowali (Kumaon hills, Uttaranchal) and Kufri (Shimla hills, Himachal Pradesh) as a part of the Indian (then Imperial) Agricultural Research Institute, Delhi. In 1945, a scheme for the establishment of Central Potato Research Institute was drawn up under the guidance of the then Agricultural Advisor to the Government of India, Sir Herbert Steward. Dr. S. Ramanujam, who was then working as an Economic Botanist at IARI, was appointed as an Officer on Special Duty for implementing the scheme in 1946. The Institute was established in August 1949 at Patna and started functioning on a 10 ha piece of land in an old single-storey, barrack-type building provided by the Government of Bihar with Dr. S. Ramanujam as its founder Director. Three small units under IARI looking after potato, namely Potato Breeding Station at Shimla, Seed Certification Station at Kufri, and Potato Multiplication Station at Bhowali were merged with the newly created CPRI. Drs Mukhtar Singh, Agronomist, MJ Thirumalachar, Plant Pathologist, RP Chaudhary, Entomologist and Pushkarnath, Economic Botanist joined the Institute and pioneered research in different aspects of potato. The headquarters of CPRI were later shifted to Shimla, Himachal Pradesh in 1956 in order to facilitate hybridization work and better maintenance of seed health. The Institute was transferred to the Indian Council of Agricultural Research (ICAR) in April, 1966.

Location

The Central Potato Research Institute is situated in the heart of Shimla (31° N and 77° E), approximately 4 kms from Bus Stand and 6 kms from Railway Station on the National Highway No. 21. The seat of the Institute is at an altitude of 2,000 metres above mean sea level and has wet temperate climate. The annual precipitation is about 1,500 mm out of which 1,252 mm is received as rainfall and rest as snowfall. The minimum and maximum temperatures during winter range from -2°C to 15°C, whereas, that during summer range from 18°C to 28°C, respectively.

The Mission

Carry out research, education and extension on potato in collaboration with national and international partners for enhancing productivity and profitability, achieving sustainable food and nutritional security, and alleviating rural poverty.

The Mandate

The Central Potato Research Institute (CPRI), working exclusively on potato has played a key role in popularizing potato cultivation and utilization under sub-tropical agro-ecosystem. The mandate of the Institute is outlined as:

- To undertake basic and strategic research for developing technologies to enhance productivity and utilization of potato.
- To produce disease-free basic seed of notified varieties developed by the Institute.
- To act as a national repository of scientific information relevant to potato.
- To provide leadership and co-ordinate network research with state agricultural universities for generating location and variety specific technologies and for solving area-specific problems of potato production.
- To collaborate with national and international agencies in achieving the above objectives.
- To act as a centre of training in research methodologies and technology for upgrading scientific manpower in modern technologies for potato production.
- To provide consultancy in potato research and development.

Thrust Areas

- Eco-region specific technology generation based on maximum productivity of available natural resources like climatic condition, soil fertility and water. Information technology (IT) tools like geographic information system (GIS), crop modeling, precision farming for sustainable utilization of natural resources. Development of technology packages as an integral component of multi-functional agriculture of the specific zone, and IT-based decision support systems for technology transfer.
- Development of early and medium maturing potato varieties; varieties suitable for French fries, flakes and flour production; varieties with durable resistance to multiple diseases; heat, drought and salt tolerant varieties; and varieties with efficient nutrient and water use efficiency.
- Soil health improvement to overcome the widespread macro- and micro-nutrient deficiencies-the "hidden hunger". Increasing soil organic matter content by incorporating crop residues, green manuring, application of FYM, compost, vermi-compost, biofertilizers and other bio-digested products. Biosafety and biosecurity of introduced bioagent or living modified organism (LMO).
- Strengthening quality seed production in seed deficit potato growing regions. Integration of tissue culture techniques for disease-free seed production.
- Integrated management of emerging diseases and pests. Identification of new and effective bio-molecules for management of biotic stresses and deployment of resistance sources. Gene pyramiding and multiple disease resistance for eco-friendly and sustainable management of diseases and pests.
- Diversification of potato utilization, renewed emphasis on storage and post-harvest processing, encouraging export.
- IT based enabling mechanism for technology transfer and socio-economic impact analysis of technologies developed by the Institute.

The Infrastructure

Research Facilities

The Institute has created state-of-the-art laboratories for conducting basic and strategic research in the field of biotechnology, genetics and plant breeding, plant protection, soil sciences and agronomy, plant physiology, biochemistry, and post harvest technology. The CPRI is the first Institute, among plant science research institutes of India, to introduce ELISA (1984) and ISEM (1987) for plant virus diagnosis. The virus diagnosis laboratory has been notified by the Government of India as an accredited laboratory for potato virus diagnosis and detection.

The biotechnology laboratory of the Institute, created in 1992, presently houses all the facilities for transgenic research, DNA fingerprinting, molecular breeding, micropropagation and cryo-conservation. A new laboratory has recently been created for conducting basic research on cell biology and somatic cell genetics. The radio-tracer laboratory of the Institute was created in 1996 for carrying out basic research on nutrient dynamics in soil and plant. This laboratory is also helping in molecular diagnosis of plant pathogens and other molecular biology related works. The Institute has a well-equipped Fungal Pathology laboratory that has world-class facility for basic and applied research on late blight pathogen, *i.e. Phytophthora infestans.* Besides, the Institute also has laboratories for Plant Physiology and Post Harvest Technology works. The Institute is creating similar research laboratories at its regional stations.

Seed Production Farms

India is the only country in Asia, other than Japan, that has a well-established seed production programme and the Institute singly produces about 3,000 tonnes of breeder's seed annually from about 521 ha of farm area distributed over 15 units. The breeder's seed is supplied to the State Department of Agriculture/Horticulture for further multiplication in three stages as Foundation-I, Foundation-II, and Certified seed. At present about 40% breeder's seed is produced through tissue culture and in a couple of years or so, the entire breeder seed will come through tissue culture derived nucleus material. For this purpose, tissue culture facilities have been created at Shimla, Modipuram, Shillong, Jalandhar and Ooty.

Library

The CPRI Library at Shimla is the second largest potato library in the world. It houses about 42,000 documents comprising of about 12,400 books, 13,000 back volumes of journals, 2,300 serials, 1,880 annual reports, 580 thesis, 250 standards, 41 maps/atlases and 1,660 reprints *etc.* Besides, the seven regional stations of CPRI are having their own libraries. These libraries have a collection of 21,112 documents. The library at Shimla has complete collection of CABCD, AGRICOLA (NAL), AGRIS (FAO), Current Contents–AB&ES, Derwent Biotech. Abstracts, FSTA (IFIS), ISA on CD, Nucssi on CD, and CDROM databases.

Agricultural Research Information Service (ARIS)

The Institute has an ARIS Cell that extends Local Area Network (LAN) facility to all scientists, administrative staff and major laboratories. A web server with Linux operating system was installed on which Institute website is hosted (http://cpri.ernet.in). A 256 KBPS VSAT antenna was installed for Internet connection from ERNET. A gateway level firewall with antivirus, antispam & intrusion detection & prevention (IDP) modules have also been installed.

Agricultural Technology Information Centre (ATIC)

The ATIC is functioning in the Institute since 2002 on the principle of "single window delivery system". It provides all relevant information to the visiting scientists, agricultural officers, farmers and students. It houses a Farmers' Museum displaying all aspects of potato cultivation in *Hindi* language and a TV room for film projection. About 1,000 visitors come to ATIC every year. The ATIC also undertakes the activity of selling CPRI publications and a resource of around Rs. 15,000 is generated annually. It also helps farmers with respect to soil and plant testing.

Museum

The Institute has a small but compact museum depicting information on origin and spread of potato, potato producing areas of the world, seed production techniques, seed distribution channel, *etc* in the form of charts and translides. Besides, specimens and live samples of potato products and machineries are displayed in an elegant manner.

Consultancies

CPRI provides consultancy services on potato cultivation and harvesting, potato seed production, rapid multiplication of planting materials, micropropagation, true potato seed production technology, potato storage, potato processing, farm equipment fabrication, potato starch manufacturing technology, seed health testing, post-entry quarantine clearance, testing for virus/viroid freedom of planting/propagation stocks/field samples, biocontrol of potato tuber moth, evaluation of agro-chemicals *viz.*, new pesticides, insecticides, fungicides, growth promoters, sprout suppressants, fertilizer additives, *etc.* The Consultancy Processing Cell of the Institute looks after these activities.

Human Resource Development

The Institute regularly imparts training to the agriculture/horticulture officers of State Departments, Scientists of SAUs, and NGO's. These officers further impart training to the farmers and facilitate the adoption of improved potato production technologies. Besides, the Institute also imparts training directly to the farmers on limited scale through frontline demonstration, *kisan melas*, field days, field visits and lectures. The Institute is also a resource center for training of scientists of South, South-East, and West Asia.

In addition, CPRI is an approved center for Doctoral research of The Himachal Pradesh University, Meerut University, Punjab University, and Pt. Ravisankar University. The M.Sc. and Ph.D. students of Dr. YS Parmar University of Horticulture and forestry often carry out part of their research work at the Institute.

The Portfolios

The Institute critically analyzed the strengths, weaknesses, opportunities, and threats (SWOT) of potato in India, and accordingly identified the priority areas for research and development. Since most of those priority areas needed multidisciplinary approach, the Institute's research mode was re-oriented from the usual departmental mode to the programme mode from 1999 onwards. At present, research on potato is being carried out under 19 different programmes. Besides, several externally funded projects are running in the Institute.

Salient Research Achievements

- Established a germplasm collection consisting of around 2,700 accessions.
- Released 45 high yielding varieties suitable for cultivation under diverse agro-climatic conditions of the country. These varieties occupy about 95% of the total potato growing area of the country.
- Identification of low aphid period for seed potato production has led to development of "Seed Plot Technique" and establishment of the national disease-free seed production programme for hills and plains. Standardized techniques for rapid multiplication through *in vitro* micro-propagation have given a boost to seed programme.
- True potato seed (TPS) technology is also being used commercially in several states of India where biotic and abiotic conditions are not suitable for healthy seed potato production.
- Transgenic potatoes with durable resistance to late blight, reduced cold-induced sweetening, bacterial wilt tolerance, and better protein quality produced.
- Agro techniques including cultural practices, fertilizer recommendations and profitable potato-based cropping systems for diverse agro-climates has led to its wide spread cultivation in the country.
- Agricultural implements developed by the Institute including an oscillating tray type potato grader, fertilizer applicator-cum-line marker, potato culti-ridger, soil crust breakers, granular insecticide applicator, two/four row automatic potato planter, and potato digger are being used in major potato growing areas.
- Integrated management of late blight, bacterial wilt, viruses, and soil- and tuber-borne diseases has decreased losses due to these diseases.
- Use of modified ELISA procedures and immunosorbent electron microscopic techniques has made potato virus detection more confirmatory.
- Developed methods of screening for high thermo-period resistance and used them to select heat resistant lines.
- Relationship developed between tuber dry matter content and specific gravity has led to identification of areas suitable for producing high dry matter processing potatoes. Studies on sugar accumulation in potatoes stored at different temperatures have identified genotypes that accumulated less reducing sugars.
- On-farm non-refrigerated storage using chemical control of sprouting in an insulated store equipped with passive evaporative cooling is becoming handy to avoid distress sale of potatoes at the time of harvest.
- Farmers' Participatory research under Lab-to-Land, ORP, TAD and IVLP improved the adoption of potato technology including high yielding varieties at farmers' fields.
- Annual Quick National Outlook Surveys for preparing advance estimates of potato production and prices.
- Training programmes on modern methods of potato production and seed certification, and other transfer of technology activities like *Kisan Melas*, Field Days, Demonstrations, Potato School on AIR, *etc.* have improved the knowledge of beneficiaries w.r.t. potato technology.

Staff Position as on 31.03.08

Category	Sanctioned	Total filled
Scientific	109*	90*
Administrative	122	113
Technical	207	190
Supporting	211	175**
Total	**649**	**570**

*Excluding one RMP
** Including three post of canteen staff

The Regional Research Stations of CPRI

A potato research network was established by setting up Potato Experimental and Trial Centres of the Institute during 1957-64 at Jalandhar (Punjab), Ootacamund (Tamil Nadu), Rajgurunagar (Maharastra), Babugarh, Mukteshwar (Uttar Pradesh), and Darjeeling (West Bengal). For wart testing, centres at Shillong (Meghalaya) and Daurala (Uttar Pradesh) were started in 1971. In 1978, after the opening of research station at Modipuram (UP) in 1977, which coincided with the closing of establishment at Babugarh, all these trial centres were renamed as Central Potato Research Station and both Modipuram and Daurala units were amalgamated. To take up seed multiplication in central plains, a research station was opened up at Morena in MP in 1979 which was later shifted to Gwalior. The stations at Mukteshwar, Darjeeling and Rajgurunagar were closed as the objectives for which they were established were achieved. The Modipuram station was upgraded to Campus of the Institute in 1999. Therefore, at present the Institute has six regional stations located at Kufri, Jalandhar, Gwalior, Patna, Shillong and Ootacmund, besides one campus at Modipuram.

Under the able guidance of Director and dynamic leadership of respective Heads, the regional stations of CPRI have contributed significantly towards fulfilling the mandate of the Institute and also the local aspirations. These stations have made their impact through important research achievements, strong seed programme as well as through efficient transfer of technology.

Central Potato Research Institute Campus, Modipuram, Meerut

The history of the campus is linked with the establishment of Potato Experimental and Trial centre at Babugarh, Meerut, UP in 1957; Seed Production Farm at Machhri near Daurala (Meerut) in 1971 and subsequently, a Potato Research cum Seed Production Unit at Modipuram, Meerut in 1977. It coincided with the closing of establishment at Babugarh. In 1978, both Modipuram and Daurala units were amalgamated and the station was renamed as Central Potato Research Station, Modipuram in 1979 which was later upgraded to the campus of the Institute in 1999.

Heads of the campus

Sr. No.	Name	Period
1.	Dr. SM Verma	1976 - 85
2.	Dr. Jagpal Singh	1985 - 2000
3.	Dr. BP Singh	2000 onward

Major achievements and their impact

- A total of 10 varieties developed by the campus both for table and processing purposes are Kufri Bahar (1980), Kufri Lalima (1982), Kufri Chipsona-1(1998), Kufri Chipsona-2 (1998), Kufri Anand (1999), Kufri Arun (2005), Kufri Surya (2005), Kufri Chipsona-3 (2005), Kufri Sadabahar (2007) and Kufri Himsona (2007).
- Developed two TPS families, HPS I/13 and TPS C-3. Besides, technology for True Potato Seed (TPS) production in plains using extended photoperiod and production of seedling tubers in nursery beds for raising commercial potato crop were also standardized.
- The campus produces 10-12 thousand q. of breeder's seed annually which is about 35% of the total breeder's seed produced by the Institute. This generates receipts worth 1.5 to 2.0 crore annually.
- Standardized micro methods of irrigation (drip and sprinkler) for potato for increasing productivity and conserving natural resources.
- Developed fertilizer prescription equations based on nutrient uptake and soil test values for finalizing fertilizer recommendations of different varieties.
- Identified most promising cropping system for the region. Intercropping of potato with sugarcane gave highest potato equivalent yield (71.4 t/ha) followed by potato-wheat-paddy (58.8 t/ha).
- Developed multipurpose digger for harvesting potato and a sub-soiler for deep tillage.
- Developed late blight forecasting system known as JHULSACAST for Central Indo-Gangetic plains. The system is able to forecast the outbreak of the disease 10 days in advance giving enough time to the farmers to protect their crop.
- Identified a bio-agent B_5 which provides adequate control of bacterial wilt and other fungal diseases of potato. It also enhances the tuber yield by 10-15%. Similar effects were recorded on wheat, rice and other vegetable crops. The bio-agent has since been patented.
- Developed IDM for late blight, white fly vector in seed crop and hopper burn and mites in early planted crops.

CPRIC, Modipuram

Potato+Sugarcane Intercropping

- A new potato virus causing apical leaf curl disease was detected and identified as 'gemini virus' which is closely related to tomato leaf curl virus.
- Population dynamics of aphid vectors, *Myzus persicae* and *Aphis gosypii* was studied and based on their initial appearance, resistance to insecticide and subsequent buildup, spray schedules have been developed for managing their population within the threshold limits.
- Developed 'Elevated temperature storage technology' for storing processing potatoes and efficient heap storage method for short term (2-3 months) to avoid gluts.
- Developed parameters for identification of processing varieties and production schedule for providing desired quality raw material to the industry.
- Working as a centre for technology dissemination and human resource development for upgrading the skill and knowledge of the state officials involved in potato production.

Central Potato Research Station, Jalandhar

Central Potato Research Station, Jalandhar (Punjab) was established in 1957. The station is located 6 km from Jalandhar bus stand on Nakodar Road in village Badshahpur with a farm area of 80.72 hectares. The station carries out research and development work on different aspects of potato in six divisions; Crop Physiology & Post-Harvest Technology, Agricultural Engineering, Crop Production, Crop Protection, Crop Improvement and Seed Technology under 12 Institute programmes, 9 All India Coordinated Potato Improvement Projects (AICPIP), and many consultancy and collaborative projects. Consequent to the research and developmental work at the station, the Punjab state has emerged as a quality seed potato production area, which caters to potato seed requirement of many other states.

Heads of the station

Sr.No.	Name	Period
1.	Sh. LC Sikka	1960-68
2.	Dr. SNS Srivastava	1967-73
3.	Sh. AK Singh	1973-76
4.	Dr. GS Kang	1991 onwards

Major achievements and their impact

- Developed technology for improving traditional pit and heap as well as double walled passive evaporative cooling (ECS) storage to avoid distress sale at harvest.
- Salicylaldehyde and menthol, eco-friendly naturally occurring volatile compounds have been identified as potential sprout suppressants and experiments on their use on commercial scale as an alternative to CIPC are being carried out.
- Information generated on yield evaluation and processing quality of advanced hybrids after harvest and storage was utilized in releasing chipping varieties.
- Varieties/advanced hybrids suitable for fresh fried chips, dehydrated chips, French fries, *Lachha*, flakes, flour and starch were evaluated and identified.

- Processing varieties suitable for autumn and spring season were identified and their optimum time for planting was worked out for the benefit of potato growers and processing industries.
- Cold chipper as well as high dry matter and superior chipping quality *tuberosum* accession were identified. These accessions are being used as parents in various breeding programmes of the institute.
- A positive correlation between basal invertase activity and reducing sugar accumulation and between enzymic discoloration and total phenol content in stored tubers was established.
- Development of various machines for mechanized potato cultivation viz. Automatic Potato Planter, low cost potato digger, potato exposing equipment and potato grader.
- Precision farming fertilizer prescriptions were developed for rice, potato and late wheat crops. For precision farming, hyperspectral indices for remote sensing the nitrogen and water stress in standing potato crop were developed.
- To diversify rice-wheat cropping system, the most profitable systems rice-potato-late wheat, rice-potato-sunflower, groundnut-potato-late wheat and rice-vegetable peas-late wheat were identified.
- Identified potato cultivars with high nutrient efficiency. Kufri Pukhraj was the most N, P and K efficient potato cultivar in the absence as well as presence of green manuring with *dhaincha*.
- Identification of aphid free period resulted in the development of 'Seed Plot Technique'. This together with virus free nucleus seed production every year, forms the base for production of breeders' seed. This station produces more than 5000 q of breeder's seeds of different popular varieties.
- Eco- friendly technologies for management of soil and tuber borne diseases including treatment with 3% boric acid of seed potatoes, soil solarization, use of strains of *T.viride* have been developed. Etiology of emerging problems such as russet scab was investigated and its management through soil solarization, alteration in dates of planting and avoiding excessive irrigation was worked out.

CPRS, Jalandhar

- Nine high yielding, well adapted potato varieties have been released for plains /plateau region viz. Kufri Sindhuri (1967), Kufri Chandramukhi (1968), Kufri Sheetman (1968), Kufri Alankar (1968), Kufri Badshah (1979), Kufri Jawahar (1996), Kufri Sutlej (1996), Kufri Pukhraj (1998), Kufri Pushkar (2005).

Central Potato Research Station, Gwalior

This Station was originally established in October, 1978 at Morena (M.P.) as a Regional Station under Central Potato Research Institute, Shimla. It was shifted to Gwalior during April, 1981. The station is located at a latitude of 26° N, 78° E and receives annual rainfall ranging 400-800 mm. The soil of the farm is silty clay loam to silt loam in texture. The Station has substantially contributed in the growth and development of potato in the region.

Heads of station

Sr.No.	Name	Period
1.	Sh. SS Saini	1978-83
2.	Dr. Chokhey Singh	1983-86
3.	Sh. SG Phadtare	1986-92
4.	Dr. VS Kushwah	1992 onward

Major achievements and their impact

- Maintenance of health standard of nucleus and breeder seed, multiplication of micro tubers, micro plants and mini tubers and production and supply of breeders' seed (3000 to 4000 q) of potato to different agencies.
- Low Input Technology with reduced seed rate, tillage operations, number of irrigations and fertilizer doses developed for small and marginal farmers.
- Potato based cropping systems (Paddy – Potato – Wheat, GM – Potato – Wheat, Urd – Potato – Wheat and Potato + Pea inter cropping) have been developed for Central Plains of India.
- IDM for Control of Stem Necrosis and black scurf diseases of potato developed.
- Among different thrips species identified, *Thrips palmi* is responsible for the transmission of Tospo virus in Potato and Imidacloprid @ 0.02% was found to be better than neem product and bio-pesticide against thrips.
- Two spray schedule of insecticide (monocrotophos @ 0.03% + DICOFOL 18 EL 0.02%) and recommended dose of fertilizers @180 Kg N + 80 Kg P_2O_5 +100 Kg K_2O/ha reduced the vector population (leaf hopper, White fly and thrips) on early potato crop.

CPRS, Gwalior

Central Potato Research Station, Patna

Initially, Central Potato Research Institute was setup in August 1949 at Patna, which was headed by Dr. S. Ramanujam as Director and Dr. Pushkarnath was officiating Director between 25.09.51 to 19.05.52. Different sectional heads were Dr. Mukhtar Singh (Agronomy), Dr. MJ Thirumalachar (Plant Pathology), Dr. RP Chaudhary (Entomologist) and Sh. MJ Deshmukh (Asstt. Botanist). Besides the sectional heads, Research Assistants namely, Sh. Pritam Singh (Agronomy), Sh. BN Roychoudhray (Entomology), Sh. SM Verma (Botany), Sh. K. Swaminathan (Agric.Chemistry), Sh. BL Barua (Botany) and Sh. VC Gupta (Plant Pathology) were involved in research programmes on potato. The farm area was acquired on lease basis from Deptt. of Animal Husbandry, Govt. of Bihar. In 1956, the headquarters shifted to Shimla and this became a regional research station.

Heads of station

Sr.No.	Name	Period
1.	Dr. Mukhtar Singh	1956-58
2.	Dr. MB Patkar	1958-59
3.	Dr. MJ Deshmukh	1959-60
4.	Dr. PN Arora	1960-62
5.	Dr. KK Nerula	1962-63
6.	Dr. KD Paharia	1963-64
7.	Dr. KL Mehra	1964-66
8.	Dr. VB Ghai	1966-72
9.	Dr. SK Bhattacharya	1972-73
10.	Dr. CP Gajaraja	1973-74
11.	Dr. SNS Shrivastva	1974-82
12.	Sh. CL Khusu	1982-83
13.	Sh. BB Das	1983-85
14.	Dr. AP Saxena	1985-88
15.	Dr. D Sahai	1988-92
16.	Dr. R Sinha	1992-97
17.	Dr. VS Verma	1997-02
18.	Dr. AN Singh	2002-03
19.	Dr. RP Rai	2003 onward

Major achievements and their impact

- Development and release of short duration variety, namely Kufri Ashok, which has become very popular in many potato growing areas. This variety has made it possible to diversify rice-wheat system into rice-potato-wheat system.
- Development and release of TPS population, namely 92-PT-27 which has become popular in Bihar and north eastern states. The variety is resistant to late blight and is high yielder.

CPRS, Patna

- The identification of low aphid period from late October to mid January has led to systematic production of breeder's seed. The breeder's seed production is taken up with respect to several varieties like Kufri Ashok, Kufri Pukhraj, Kufri Jyoti, Kufri Kanchan, Kufri Arun, Kufri Chipsona-1. On an average, 2000 quintals of breeder's seed are produced annually and supplied to different states like Punjab, Haryana, UP, Bihar, W.Bengal, Jharkhand, Madhya Pradesh and Chhatisgarh.
- The station has been giving short term training to farmers on all aspects of potato cultivation.

Central Potato Research Station, Shillong

The Central Potato Research Station, Shillong was established in 1959 under the Central Potato Research Institute, Shimla as a potato experimental and trial centre in an area of about 10 ha land donated by the then Government of Assam. The centre was strengthened and upgraded to the status of a "Research Station" during the 5th Five-year plan and 3 ha area was given by the Forest Department, Government of Assam. The station was strengthened to enable conducting research on the regional problems in potato cultivation.

CPRS, Shillong

Heads of station

S. No.	Name	Period
1	Sh. BL Barua	1959-74
2	Dr. RN Khanna	Jan.- Feb. 1974
3	Sh. KN Subramanyam	1974-75
4	Dr. S Ray	1975-76
5	Sh. BL Barua	1976-85
6	Dr. UC Sharma	1985-87
7	Dr. L Lal	1987-95
8	Sh. VK Bahal	1995-2000
9	Sh. K Singh	2000-2003
10	Dr. S Kumar	2003-06
11	Dr. RR Burman	2006-07
12	Dr. S Ramani	2007 onward

Central Potato Research Station is located in Upper Shillong at an elevation of 1860 m above msl and is spread over an area of 12.6 hectares. The station is about 8 km from Shillong on the road to Shillong Peak. It is strategically located in East Khasi Hills, which is an important potato growing district of Meghalaya.

Major achievements and their impact

- Production of disease free planting material of Kufri Giriraj, Kufri Jyoti and Kufri Kanchan through micro-plants, micro tubers/mini tubers and True Potato Seed (TPS) tuberlets under controlled condition through tissue culture and in polyhouses and their supply to various states in NEH region.
- Sustainable potato production technologies have been standardised for cultivation under the acidic soil conditions of the region through on-station and on-farm evaluation trials.
- Organic farming of potato using vermicompost has been encouraged through establishment of production units.
- Remunerative potato based cropping systems have been recommended for Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, and Tripura *e.g.* potato–paddy–french bean, potato–paddy–carrot, potato–potato–vegetable in lower and higher hills and paddy–potato, black gram/green gram/kharif vegetable–potato, paddy–potato–vegetable in plains.
- Management of late blight disease in autumn grown TPS potato and effective control of storage pest potato tuber moth (PTM) using dried and chopped *Lantana camera* leaves developed.
- Through on-farm demonstrations, farmers have been trained on scientific methods of harvesting, tuber treatment and storage under diffused light.

- On the basis of verification trials through on-station and on-farm trials, the recommended technologies were refined to develop location specific technologies for wider acceptability and adoption among the farmers of this region.
- Potato production through TPS was popularised in north eastern states through more than 250 on-farm demonstrations.
- Community level seed storage structure was constructed and house hold level storage structure for table potato was popularised.
- More than 1,400 farmers and 80 extension officers have been trained in the last few years on improved potato production, protection, post harvest and storage technologies.
- Promoted the "Mylliem Potato Farmers' Club" in East Khasi Hills district of Meghalaya in collaboration with the Mylliem branch of Meghalaya Rural Bank with financial assistance from National Bank for Agriculture and Rural Development (NABARD), Meghalaya Regional Office.
- Several Technical Bulletins and Extension Folders have been published to serve the information needs of farmers and officials of the development departments of the North Eastern States. Some of the extension folders have also been translated into local tribal language *Khasi*.

Central Potato Research Station, Ootacamund

The Central Potato Research Station, Muthorai started functioning from April 1957, as Potato Experimental and Trial Centre at Nilgiris to cater to the needs of potato area coming under Tamil Nadu, Kerala, Karnataka and Andhra Pradesh. The station is working on the basic problems of potato production in this region in addition to the dissemination of latest technologies for improving the crop productivity. The station is located at an altitude of 2130 meters above msl and 8 km away from Ootacamund town on the Ooty-Emerald road near to Muthorai village. The farm has an area of 16.6 hectares of which about 12 hectares are cultivable. The first Officer in-charge Sh. JT Karnani was instrumental in acquiring the farm land from Forest Department under the stewardship of then Director Dr. Pushkarnath and transforming it into the present form of bench terraced land. Earlier to the occupation by CPRI, this farm used to be called as Ergot Farm under the administrative control of then Madras Government.

CPRS, Ooty

Heads of station

Sr.No.	Name	Period
1.	Sh. JT Karnani	1957-58
2.	Sh. MD Azariah	1958-64 & 1966-77
3.	Sh. KSS Rao	1964-66
4.	Dr. DS Singh	1977-81
5.	Dr. ID Garg	1981
6.	Dr. V Kishore	1981-83
7.	Sh. CP Gajaraja	1983-88
8.	Dr. KS Krishna Prasad	1988-2006
9.	Dr. G Ravichandran	June 2006 to Nov. 2006
10.	Dr. TA Joseph	2006 onward

Major achievements and their impact

- Released four late blight resistant potato cultivars viz., Kufri Neela, Kufri Neelamani, Kufri Muthu and Kufri Swarna. Of these, Kufri Swarna possesses resistance to both late blight disease and cyst nematodes and it is the first cyst nematode resistant variety released in the country.
- The station now possesses about 1000 hybrids in different stages of selection trials. Of these two advance hybrids namely OS/93-D-204 and OS/94-L-956 possessing combined resistance to cyst nematodes and late blight disease have undergone adaptive research trials at the farmer's fields and OS/93-D-204 is in the pipe line for release.
- A potato germplasm developed at the station having combined resistance to both species of potato cyst nematodes and late blight disease has been registered as a new elite germplasm and has been assigned national identity as INGR No.5022.
- The station has also developed sustainable potato based cropping systems both sequential and inter cropping systems such as potato–cabbage and potato + French beans (3:2).
- It has standardized the technology to grow both ware and seed potatoes under different seasons both under rainfed and irrigated conditions.
- The station is also working on various crop management aspects including nutrition, weed control, nematode management, cropping systems, seed production and storage techniques, etc.
- The station produces 100 to 120 tonnes of seed potatoes annually and the same is distributed among the farmers. Efforts are now being made to multiply and supply more quantity of seed of varieties, Kufri Giriraj, Kufri Swarna and Kufri Jyoti to the farmers.

Central Potato Research Station, Kufri

Kufri is one of the oldest station, where potato seed certification scheme was started in 1942, even before establishment of Central Potato Research Institute under the aegis of the then Imperial Agricultural Research Institute. In 1949 it became a part of CPRI and in 1963, it was

redesignated as Central Potato Research Station, and Fagu unit was also attached with it. Over the years the station has played significant role not only in quality breeder seed production but also contributed largely to varietal development programme of the Institute due to congenial climatic conditions for potato hybridization.

Heads of station

Sr. No.	Name	Period
1	Sh. KT Janabandhu	1961-64
2	Dr. SNS Srivastava	1965-67
3	Sh. SK Anand	1968-69
4	Sh. VK Garg	1970
5	Sh. HS Chauhan	1971-73
6	Sh. TR Dayal	1947
7	Dr. VK Garg	1975-77 & 1988-2002
8	Dr. Jagpal Singh	1978-84
9	Dr. Sarjeet Singh	1985-87
10	Dr. RS Chandel	2002-04
11	Dr. KR Dhiman	2004-08
12	Dr. Vinod Kumar	April 2008 onward

CPRS, Kufri

Major achievements and their impact

The station has played significant role in the development of 45 high yielding varieties of potato and production and protection technologies for augmenting potato production in the country.

- Nearly 1500 quintals of disease free breeder's seed production of potato variety Kufri Jyoti and Kufri Gririraj for the Hills is a major activity taken up at the station. Besides this, small quantities of potato variety Kufri Kanchan is also produced especially for the

state of Sikkim. Seed potato production of newly developed potato varieties Kufri Shailja (2003), Kufri Himalini (2005), Kufri Himsona and Kufri Girdhari (2007) has also been taken up.

- New hi-tech seed production system involving micro-propagation has been started. The quality of the seed produced through micro-propagation will be better on account of reduced field multiplications to two rather than four under the conventional seed potato production system.
- The congenial climatic conditions of the station for potato hybridization, has contributed largely to the varietal development programme of the Institute. All the 45 varieties released by CPRI and a number of pipe line varieties have their origin from Kufri only. Among them, eight varieties namely, Kufri Kumar, Kufri Kundan, Kufri Jeevan, Kufri Jyoti, Kufri Giriraj, Kufri Shailja, Kufri Himalini and Kufri Girdhari were exclusively developed at this station.
- Presently about 1150 tuberosum accessions and ninety indigenous samples are being maintained in the fields. A large number of germplasm lines have been evaluated for yield, floral attributes and their reaction to late blight.

CPRI PUBLICATIONS

Books and Proceedings/Reports

Sr.No.	Name of Publication
1.	Recent Technology in Potato Improvement
2.	Potato Production, Storage and Utilization
3.	True Potato Seed Technology and its Commercial Utilization
4.	Potato Research in India: Bibliography
5.	Diseases and Pests of Potato
6.	Seed Potato Production Manual
7.	Krishi sabdabli (Dictionary) Hindi
8.	Beej Aloo ka Utpadan (Hindi)
9.	QRT Report (period 1.1.2001 to 31.12.2005)

Technical Bulletins

Tech. Bull. No.	Name of Publication
1.	Potato in India
2.	Potato in India-Bibliography
3.	Potato Cultivation in Kashmir
4.	Potato Cultivation in Mysore

5. Hairy Sprout Disease of Potato
6. Breeding Potato Varieties Resistant to Charcoal Rot
7. Utilization of Haploids in Breeding and Genetics of Potato
8. Investigation on Purple Top Roll and Witch's Broom Diseases of Potato
9. Hereditary Variation in the Ability of Myzus persicae to Transmit Potato Leaf Roll and Virus "Y"
10. Breeding Potato Varieties Resistant to Brown Rot
11. A Potato Store run on Passive Evaporative Cooling
12. Potato Cultivars Released by CPRI
13. Catalouge of Potato Germplasm Collection, Group Tuberosum
14. Selection Procedure in Potato Breeding
15. Potato in Himachal Pradesh
16. Potato Tuber Moth with Special Reference to India
17. Potato in Karnataka
18. Potato in North-eastern India
19. Wart Disease of Potato in Darjeeling Hills
20. Agronomic Studies on Potato under All India Co-ordinated Potato Improvement Project
21. Bacterial Soft Rot of Potato in India
22. Riverbed Potato Cultivation in Gujarat, India
23. Micronutrient of Potatoes
24. True Potato Seed for Potato Production in India
25. Potato Equipment Developed at CPRI
26. Potato Aphids
27. Potato Late Blight
28. Water Management in Potato
29. Soil and Plant Tests for Potato
30. Potato Based Cropping System
31. Phosphorus and Potassium Nutrition of Potato
32. Nitrogen Management in India
33. Weed Management in Potato
34. Potato Processing in India
35. Potato Viruses and Viral Diseases
36. Inventory of Potato Germplasm (Group Tuberosum) Collection
37. Agro-techniques for Potato Seed Production
38. Potato Bacterial Wilt in India
39. Tissue Culture Techniques for Potato Health, Conservation, Micropropagation and Improvement
40. Potato Statistics : India and the World
41. Soil and Tuber Borne diseases of Potato
42. Transfer of Potato Technology

43. 20 Years of Potato Research – AICPIP
44. Economics and Marketing of Potato in India
45. Potato Pests and their Management
46. Inventory of Potato Germplasm (Group Andigena) Collection
47. Storage of Potatoes Processors in India
48. A Guide to Potato Processors in India
49. Potato - a Wholesome Food
50. Indian Potato Varieties
51. Indian Potato Varieties for Processing
52. World Potato Statistics
53. Potato Biotechnology
54. Stem Necrosis Disease of Potato
55. Aalu ke Vyanjan (Hindi)
56. Potato Recipes for you
57. Statistical Methodology for Long Terms Experiments
58. Traditional Methods of Potato Storage in the Malwa Region of Madhya Pradesh.
59. Advanced Potato Hybrid
60. Aalu ki Bhartiye Kisame(Hindi)
61. Potato White Grubs in India
62. Aphid, their Importance, Monitoring and Management in Seed Potato Crop
63. Quality Seed Potato production in NEH Region of India
64. Dehydrated Potato Chips.
65. True Potato Seed - An Alternative Technology for Potato Production in North-eastern Hill Region
66. Potato Tuber Moth (Phthorimaea operculella (Zeller))
67. Technological Empowerment of Potato Growing Tribal Women in Meghalaya
68. New Potato Hybrids
69. Use of Information Technology for Potato R&D
70. CIPC for Potato Suppression in Potatoes during Storage
71. Inventory of Cultivated Potato Germplasm
72. Technologies for Production of Quality Seed & Production Material in Horticultural Crps.
73. Traditional Potato Cultivation Practices in Meghalaya.
74. Research at CPRI – Bibliography
75. Potato Breeding in India
76. Results of Permanent Manurial trails at Jalandhar.
77. Integrated Development of Horticulture in North-Eastern States of India (MM-I).
78. Potato Cyst Nematodes & Their Management in Nilgiris.
79. Catalogue of Indian Potato Cultivars
80. National Test Guidelines for the conduct of Distinctness, Uniformity and Stability (DUS).
81. Potato Statistics – India & World
82. Modified Heap and Pit Storage for Table and Processing Potatoes.

83. Resource Management in Potato Based Cropping Systems

84. Potato Scenario in India – A Thematic Analysis.

- Two publications of AICRP (Potato) with their own numbers i.e. (1) 35 yrs. Of AICRP (P) and (2) Eco-friendly ..... Pests .

85. Scenario of Potato Production and Processing in West Bengal

86. Inventory of Potato Germplasm (Group Andigena Collection)

- Hindi Version of Technical Bulletin No. 82 "Dher va Gadhon Main Aloo ka Bhandharan".

- Hindi Version of Technical Bulletin No. 48 "Aloo Vidhayan Marg Dharshika".

87. Infocrop – Potato – A Mode for simulating growth and yield of Potato in the Sub-tropics

(Un-nu Bio B5 – An Ecofriendly Biopesticide-cum-Biofertilizer for management of soil & mbered)tuber borne diseases of potato & other crops.

Extension Bulletins

Extn. Bull. No.	Name of Publication
1.	Potato Varieties
2.	Seed Plot Techniques
3.	Potato a Food Crop and The Need for its Promotion
4.	Why Potato
5.	Potato Cultivation
6.	Seed Potato
7.	Diseases of Potato
8.	Potato Pests
9.	Potato, a Food Crop
10.	Hints for Successful Potato Cultivation
11.	Potato Cultivation in UP Hills
12.	Potato Cultivation in North-eastern Hills
13.	Potato Cultivation in Nilgiri Hills
14.	Package of Practices for Seed and Table Potato Production in North-western Hills
15.	Package of Practices for Seed and Table Potato Production in Western Indo-Gangetic Plains
16.	Package of Practices for Seed and Table Potato Production in Central Indo-Gangetic Plains
17.	Package of Practices for Seed and Table Potato Production in Eastern Indo-Gangetic Plains
18.	Package of Pratices for Seed and Table Potato Production in Plateau Region
19.	Dormancy Breading in Seed Potato
20.	Use Whole Tuber as Seed
21.	Bacterial Wilt of Potato and its Management
22.	Potato Tuber Moth and its Management
23.	Late Blight of Potato in Northern Plains of India
24.	Alu Ki Sudhri Kheti (in Hindi)

25. Coping -up with Drought in Potato Cultivation
26. Solar Dehydrator
27. Potato Cultivation Equipments
28. Kufri Swarna - A High Yielding Late Blight and Nematode Resistant Potato Cultivar Suitable for Cultivation in Tamil Nadu Hills
29. Kufri Megha- A High Yielding Late Blight Resistant Potato cultivar suitable for north-eastern India Hills
30. Manual for True Potato Seed (TPS) production and Utilization
31. Bacterial wilt of Potato and its Eco-friendly management
32. Vidhayan Ke liye aalu ki nai kisame
33. Production of Potatoes for Processing
34. Potato Cultivation in North-Eastern India(Hindi & English)
35. Nutritional and Medicinal Values of Potatoes
36. Aalu ki vegyanic kheti(a radio talk) hindi
37. Aalu ki vegyanic kheti(a radio talk) hindi (Modipuram)
38. Aloo utpadan : Samasain avam samadhan (In Hindi)
39. Cultural Management of Crops in Potato Based Cropping Systems in India
- Punjabi Version of Extn. Bull No. 35

Un-numbered Technology in Aid of Healthy Potato Production

Folders

Sr.No.	Name of Publication
1.	Management of Late Blight in Potato(H&E)
2.	Management of Bacterial Wilt/Brown Rot in Potato(H&E)
3.	Major Potato pest in North-Eastern India and their Management(H&E)
4.	Potato Cultivars for NEH Region of India(H&E)
5.	The Potato – a wholesome crop
6.	Bio B5 (For CPRIC, Modipuram)
7.	Potato in India – An overview
8.	True Potato Seed for Potato Production in North Eastern States of India
9.	Good Agricultural Practices for the management of Late Blight and other Potato Diseases – A Manual
10.	CPRS – Shillong – A Glimpse
11.	Potato Diseases and insect pests : Indian Scenario
12.	CIPC (chlorpropham) for control of Potato Tuber Moth in Country Stores

Periodicals

1. Annual Reports (Every Year)
2. Research Highlights*(1984-1989 only)
3. Newsletter (Quarterly) - 'Potato'
4. Samahit (Hindi) - Yearly

Special Publications

1. Souvenir- Golden Jubilee of CPRI (1949-1999)
2. Potato Research in India-A Success Story of Fifty Years
3. Vision- 2020 (perspective Plan of CPRI)
4. Social Impact of Potato Research & Development in India
5. Souvenir-Dr. S Ramanujam Birth Centenary 2-3 Oct.2003
6. TAR-IVLP New Era of Participatory Research-Success Stories
7. Vision- 2025 (perspective Plan of CPRI)

Miscellaneous Publications

1. CPRI Brochure(Hindi and English)
2. Research Programs and Achievements 1984-1989
3. Research and Development Programs 1990-1995
4. CPRI : A Profile 2020
5. Profiles : Directors of CPRI
6. CPRI : Last 5 Years 1989-1994
7. CPRI: A Success Story of 50 Years

CPRI Director's Profile

SK Chakrabarti

The Central Potato Research Institute has been fortunate enough to be led by very eminent scientist and leaders as its Directors since its inception. It was put on strong foundation by Dr. S. Ramanujam its first Director. The Institute was built and strengthen further by Dr. Pushkarnath, its second Director with the longest term (1957 to 1969) and by its subsequent Directors Dr. Mukhtar Singh (1969 to 1975), Dr. B. B. Nagaich (1975 to 1982), Dr. N. M. Nayar (1983 to 1989), Dr. J. S. Grewal (1989 to 1994), Dr. G. S. Shekhawat (1994 to 2001), Dr. SM Paul Khurana (2002 to 2005) and Dr. S. K. Pandey (2005 to Cont.). To date CPRI had 9 Directors, all eminent scientists and forceful leaders. Their personal abilities and contributions have taken the Institute to a new high.

Dr. Srinivasa Ramanujam was born on October 2, 1903 at Vanavasi near Salem, Tamil Nadu. He had his early schooling in Salem and Madras. He took his honours degree in Botany and Geology in 1925 and was awarded the M.A. degree of the Madras University in 1927. In 1935, he joined King's college, London and obtained his Ph.D. from the London University in 1937.

Dr. S. RAMANUJAM
(1949-1951 and 1952-1956)

Dr. Ramanujam began his professional career as a Research Assistant to the Paddy Specialist at Coimbatore. From 1938-1946, he worked as the Second Economic Botanist at the Indian Agricultural Institute, New Delhi. Dr. Ramanujam was closely associated with the establishment of Central Potato Research Institute from its initiation in the year 1945, when the scheme to establish the Institute was drawn up under the guidance of the then Agriculture Advisor to the Government of India, Sir Herbert Steward and Sir Pheroz M. Kharegat, Secretary, Ministry of Agriculture. Dr. Ramanujam along with Dr. B. P. Pal, Dr. Pushkarnath, and Dr. R.S. Vasudeva participated in the formulation of the scheme and in establishment of the Institute. Dr. Ramanujam was appointed as an Officer on Special Duty for implementing the scheme in 1946. He took over as Director of the Institute after its establishment in August, 1949 at Patna and continued in that position till 1956, except for one year (1951-52) when he worked as Director, Central Rice Research Institute, Cuttack. Subsequently, he joined as the Director of Research, Department of Agriculture, Government of Bihar, where he organized and guided all aspects of agricultural research of the state till 1966.

During his initial research carreer, Dr. Ramanujam along with Dr. N. Parthasarathy, FNA, initiated cytological studies under the overall leadership of Dr. K. Ramiah, the then Paddy Specialist, Coimbatore. For the first time, haploids, triploids and tetraploids were identified in rice, their cytological and breeding behaviour studied and their utility in crops improvement evaluated. The finding that twin/polyembryonic seedlings could be of different ploidy levels was an important contribution of the group. On joining the Indian Agricultural Research Institute in 1938, Dr. Ramanujam took up the systematic exploitation of colchipolidy. Polyploids of a large number of crop plants were induced and their breeding behaviour assessed. Most

fruitful was the persuit of amphidiploidy, obtained by colchicine treatment of interspecific crosses in different genera. His group was able to elucidate the origin of the naturally occurring taxon, *Brassica juncea*, a widely cultivated oilseed crop of India, from detailed study of the amphidiploids obtained from the interspecific cross, *Brassica campestris x B.nigra*. An entirely different plant *Sesamum indicatum*, was obtained by his group from the interspecific cross *Sesamum orientale x S. prostratum*. His group also initiated mutation breeding in rice using X-rays and identified ring formation as a result of translocation, chlorophyll deficiency and asynaptic plants in the mutagenised material. During his Ph.D. work in London, he studied the cytological behaviour of interspecific hybrid, *Oryza sativa x Oryza officinalis* and their progeny, including triploids and aneuploids (2n+1, 2n+5) derived from the cross and elucidated the inter-relationship between the two species.

As Director, CPRI, Dr. Ramanujam contributed to the betterment of the potato crop in India, through the development of improved varieties and improved management practices. After thorough screening of a large numbers of true seedlings obtained through hybridization, several improved varieties of potato suitable for cultivation in the plains and hills of northern India were developed. An important idea developed by him of stabilizing workable homogeneity in populations raised from true seed to provide the commercial crop, is now being extensively pursued as an answer to disease degeneration problem inherent in tuber reproduction. The results of the researches carried out by Dr. Ramanujam and his students have been incorporated in a number of papers published in leading scientific journals.

Dr. Ramanujam was a member of the Genetical Society of Great Britain and of the British Association for the advancement of Science. He became a fellow of Indian National Science Congress in 1952. He was the founder-member of the Indian Society of Genetics and Plant Breeding of which he also became the Secretary and President in subsequent years. After retirement, he settled down in Bangalore. Even after his retirement his expertise was much sought after and he continued to be associated with several expert committees of ICAR, INSA, Government of Bihar and the University of Agricultural Sciences, Bangalore. Dr. Ramanujam passed away on 9th June, 1979 at Bangalore.

Dr. Pushkarnath was born at Srinagar (Jammu & Kashmir) on 20th March, 1910. He obtained B.Sc. (Hons.) in 1931 and M.Sc. (Botany) from Punjab University, Lahore in 1932. He became Associate (Agricultural Botany) of Indian Agricultural Research Institute and was awarded Ph.D. degree from Punjab University in 1941. He did Post Doctoral work on characterization of potato genotypes at Imperial Bureau, Cambridge during 1945-46. He also received advanced training on virus pathology and breeding of potatoes.

Dr. PUSHKARNATH
(1956 to 1969)

Dr. Pushkarnath was appointed as Officer-in-Charge of Potato and Wheat Breeding Station of IARI at Shimla in 1935. After the establishment of Central Potato Research Institute (CPRI) at Patna in 1949, he was appointed as Botanist in 1950 at the Potato Breeding Sub-station, Shimla. In 1955 he joined as Director of Agriculture (H.P.) and continued till May, 1956 when he came back to CPRI and took over as its Director in 1956 after Dr. S. Ramanujam relinquished charge of Director. He continued in this position till his retirement in 1969. Dr. Pushkarnath was Honorary Fellow of Indian Potato Association. He was the Chairman of numerous Government and other official committees including the All India Board of Research, ICAR. He was also the President of Indian Society of Genetics and Plant Breeding. After his

retirement he was appointed as consultant to National Seeds Corporation, New Delhi and Chairman of Council of Science and Technology, Himachal Pradesh.

Dr. Pushkarnath was also associated with the establishment of CPRI from the very beginning and spent his entire life on research and development of this crop. During his assignment as Director of Agriculture, Himachal Pradesh, he strived to make the state a producer and supplier of good quality seed potato. He played a crucial role in shifting the Headquarters of CPRI from Patna to Shimla in 1956, and subsequently created a network of regional research centres at Jalandhar, Babugarh, Kufri-Fagu, Rajgurunagar, Ootacamund, Shillong and Darjeeling representing different potato growing regions of the country. Dr. Pushkarnath did pioneering work on male sterility and incompatibility in potato. While at CPRI, he collected tuber samples from all over the country, some of which were identified as well-known European potato varieties, whereas, for others the counterparts were not available in Europe, hence came to be known as indigenous varieties. To this basic collection he added from UK a part of the then Empire Potato Collection and laid the foundation of potato germplasm collection in India.

He bred a large number of improved potato cultivars of which the most popular are Kufri Chandramukhi, Kufri Sindhuri and Kufri Jyoti. With the release of these varieties the varietal pattern in the country changed. Another important aspect of his work was the development of "Seed Plot Technique" which made it possible to produce healthy seed potatoes under low aphid conditions in the North Indian Plains where the breeders' seed production was started. The increased availability of healthy seed of new varieties dramatically increased the country's potato production. Dr. Pushkarnath wrote a monograph "Potato in India: Varieties" and a book "Potato in Sub-tropics". He published nearly 90 research papers and wrote several technical bulletins. Dr. Pushkarnath was awarded the coveted Rafi Ahmed Kidwai Award of Indian Council of Agricultural Research in 1968 in recognition of his contribution to the potato.

Dr. Mukhtar Singh was born in West Punjab (now in Pakistan) on 5th January, 1915. He did his graduation in 1934 followed by the Master's degree in Plant Physiology from the Punjab University in 1942. He got his Ph.D. degree in Agronomy from Edinburgh, U.K. in 1948.

DR. MUKHTAR SINGH
(1969-1975)

Dr. Mukhtar Singh began his career as Research Assistant in the Department of Agriculture, Punjab in 1935 and continued there till 1945. During 1945-48 he was at Edinburgh, UK to obtain his Ph.D. in agronomy. On his return to India he joined as Agronomist at the Central Tobacco Research Institute, Rajahmundry (Andhra Pradesh). In 1950, he moved to the Central Potato Research Institute, Patna as its first Agronomist and worked for nearly seven years. Thereafter, he joined Indian Agricultural Research Institute, New Delhi. He was promoted to the post of Dy. Agriculture Commissioner (Agronomy) and worked in this position for three years. In 1965, he became the Director, Indian Grassland and Fodder Research Institute, Jhansi and during 1968-69 held additional charge of the post of the Director, Central Arid Zone Research Institute, Jodhpur. Dr. Mukhtar Singh took over as Director, Central Potato Research Institute in 1969 and retired at the same post in October, 1975.

As Research Assistant at the Department of Agriculture, Punjab during 1935-45, Dr. Mukhtar Singh conducted agronomical and physiological research in cotton for Punjab and

Sind region. He worked on the agronomy of potato crop at Edinburgh (1945-48) and of tobacco at Rajahmundry (1948-50). At IARI, New Delhi, Dr. Singh worked on agronomy with special reference to irrigation of several crops. He also taught post-graduate classes for nearly five years. During his stay at CPRI, he made outstanding contribution on potato agronomy, soil and water management, fertilizer use and weed control. He did commandable work on the interrelation between seed size, spacing and fertilizers, water management, the effect of growth regulators on potato, dormancy breaking of freshly harvested tubers, post-harvest treatment and storage management. He started the programme on the direct, cumulative and residual effect of fertilizers in different crop rotations, both in the hills and the plains, as well as in inter-cropping and multiple cropping patterns with potatoes. He invented the technique of smoke-screen method which helped the growers to protect their crops against frost; a crust-breaker for special use on ridges; and a seed-treatment chamber for breaking the dormancy of freshly harvested tubers with triple (vapour) treatment of thiourea, ethylene chlorohydrine and GA_3. His research on the country storage design at Patna has relevance even today in areas where facilities of refrigerated storage are not available. Dr. Singh guided over 15 students for their M.Sc. and Ph.D. degree.

Dr. Mukhtar Singh was Fellow of a number of professional societies in India and abroad. He was Chairman of the Soil Science Agronomy Panel, ICAR during 1970-72, Chairman of the Indian Society of Plant Physiology in 1972 and Founder President, Indian Potato Association in 1974-1975. He was leader of the study team on Potato and Tuber Crops and was a member of the Sub-groups on water use, agro-climatic regions, fodder crops under National Commission on Agriculture. After his retirement he was appointed by ICAR as Scientist Emeritus (Agronomy) in which capacity he remained engaged in guiding a team of research workers/students in the Agronomy Department of Punjab Agricultural University, Ludhiana.

Dr. Banke Bihari Nagaich was born on 11th August, 1931 at Rath, District Hamirpur, Uttar Pradesh. In the year 1955 he obtained M.Sc. (Ag.) degree in Plant Pathology from Agra University. Later he obtained his Doctoral degree from the University of Illinois (US). Dr. Nagaich joined the Indian Agricultural Research Institute at its regional station at Shimla in 1958 and continued to work there till 1963. In 1963, he joined the Central Potato Research Institute, Shimla where he worked as a Virologist and as Head, Division of Plant Pathology in close association with Dr. Pushkarnath and Dr. Mukhtar Singh. In October 1975, Dr. Nagaich took over as the Director of Central Potato Research Institute, Shimla and retired from this post in 1982.

DR. B.B. NAGAICH
(1975-1982)

Dr. Nagaich is a founder life member of Indian Potato Association (IPA). He was its President during 1976-78 and 1980-81. He was also the first Editor-in-Chief of the Journal of Indian Potato Association. He was the secretary General of Asian Potato Association in 1979. He is a member of European Association of Potato Research and represented India in their Triennial Conference. Dr. Nagaich is also the Life Member of Indian Phytopathological Society (IPS), Association of Microbiologists of India and Bundelkhand Farm Development Society. He was the President of Indian Phytopathological Society in 1982. He was a member of the Scientific Panel of ICAR from 1967 to 1970 and Science Information Service in Phytovirology under FAO. He has been nominated on several state level committees dealing with agriculture and horticulture in U.P. Dr. Nagaich attended many symposia and conferences on plant diseases, presented research papers and key-note addresses both in India

and abroad and chaired sessions of plant viruses and viral diseases organized by IPS in 1974 and 1979. He organized two International Seminars on potato, one each in 1978 in collaboration with IPA and in 1979 in collaboration with International Potato Centre (CIP) and the Summer Institutes on Potato in 1976 and 1980. Presently he is the Director General, Bundelkhand Farm Development Centre, UP and the Advisor, Vegepro Food and Feeds Ltd.

As a Research Fellow at Illionois, Dr. Nagaich worked on a new viral disease of tomato. He also assisted Prof. Thornberry in survey and surveillance of plant viruses. During his stay at IARI Regional Station Shimla (1958-63) he reported several viruses on fruit trees, vegetables and cereals. He also discovered a new aphid vector. At CPRI, Shimla he made important contributions in identifying and studying yellow diseases. He discovered Purple Top Roll and Marginal Flavescence diseases of potato and evolved techniques of elimination of potato leaf roll virus from the tubers. He identified new species of leaf hopper transmitting MLOs and aphid vectors for viruses. He was closely associated with the production of virus tested nucleus seed and was responsible for bringing in a qualitative improvement in seed stocks of improved potato varieties. Dr. Nagaich has over 134 research publications to his credit. He edited four books on potato and published a number of Technical Bulletins. He guided 8 students for the award of their Ph.D. degree. Dr. Nagaich was honoured with Guiness Award in 1979, Kheti Award in 1980 and Prof. Narsimha Award in 1984.

Dr. Narayanan Madhavan Nayar was born on 6th May, 1933 at Thakazi, Kerala. He did his B.Sc. (Hons.) in Agriculture in 1953 from Delhi University. He became Associate at IARI in 1958 and got his Ph.D. degree from Louisinana State University, USA in 1962. He was a Professional Fellow in 1970-72 at the University of Gottingen, W. Germany where he specialized in Plant Breeding and Botany. He was awarded Senior Post Doctoral Fellowship of AV Humboldt Foundation, West Germany.

DR. N.M. NAYAR
(1983 to1989)

Dr. N.M. Nayar started his carreer as Extension Officer, Community Project, Chalakudi during 1953-54. He worked as Assistant Botanist at Rice Research Station, Moncompu during 1958-59 and as Suprintendent, Agricultural Research Station, Kozha in 1963. In 1963, he joined the Central Potato Research Institute, Shimla as Cytogeneticist and continued till 1970. After his return from West Germany he worked as Joint Director and Officiating Director of Central Plantation Crop Research Institute, Kasargod during 1972-82. He also officiated as Director, Central Tuber Crop Research Institute, Trivendrum during 1982-83. In February 1983, Dr. Nayar joined as Director, Central Potato Research Institute, Shimla and after completion of his tenure, returned to active research at Indian Agricultural Research Institute, New Delhi. Prior to his retirement in May, 1993 he joined as Director, Central Tuber Crop Research Institute, Trivendrum.

During his assignment as Cytogeneticist at CPRI, Dr. Nayar worked on induced mutations and cytogenetics in potato. As Director of CPRI, he got all the research projects reviewed by the experts and reorganized the work on modern lines. The work done at the institute was also reviewed by Quinquennial Review Team of ICAR and the Research Review was done by an International Team of scientists. Extensive surveys were conducted in different parts of the country for collecting old indigenous potato varieties, studying the economics of potato cultivation in major potato growing regions, assessing the spread of wart disease of potato, identifying possible seed potato growing areas in South India and assessing problems of potato

cultivation in different parts of the country.

Dr. Nayar organized International training course on Late blight and Potato Tuber Moth for the officers of State Departments of Agriculture/Horticulture and the University Scientists, training in research methodology in potato and Summer Institute on Virology. He brought out package of practices for potato cultivation in different potato growing regions. He promoted development of professional competence of staff by sending them for training in India and abroad. He also added several modern instruments for the Institute's infrastructures. He edited two books and published over 75 research publications in international and national journals.

Dr. Nayar has been associated with a number of Scientific bodies and Professional societies, Expert committees, Scientific Panels etc. He was member of Research Advisory Committee of CFTRI, Mysore; Rubber Board; Potash Research Institute of India; Tea Board; RRL Trivendrum; MERADO, Cochin; Committee of Scientists to Formulate Safeguards for Preservation of Silent Valley; Permanent Panel on Techno-Economic Studies of Pepper Community, Indonesia; and IBPGR Consultant on Coconut Genetic Resources, Rome etc. Dr. Nayar was the first Editor, Journal of Plantation Crops 1973-80. Dr. Nayar was invited by Botanical Survey of India to write on Distribution and Taxonomy of genus Oryza for revision of Bentham & Hooker Flora of India (1977). He was also invited to prepare articles and reviews in Advances in Genetics (Origin & Cytogenetics of Rice) 1973, in evolution of Crop Plants (Sesame) 1976 and was invited to present paper at 1st International Symposium on Reproduction of Flowering Plants, Christ Church, New Zealand (1979). He is now working as Scientist Emeritus of ICAR.

Dr. Jagdev Singh Grewal was born on 7th July, 1934 at Ludhiana, Punjab. He was awarded M.Sc. (Ag.) degree in Soil Science in 1956 and Ph.D. degree in 1964 from Punjab University. He received advance training in Crop Production, Soil Fertility and Modern Instrumentation in CSIRO Laboratories and the Universities at Brisbane, Adelaide, Melborne, Canberra and Sydney.

DR. J.S. GREWAL
(1989-1994)

Dr. Grewal started his career as Research Assistant in the Department of Agriculture, Himachal Pradesh/ Ministry of Food & Agriculture, Govt. of India, New Delhi in May, 1957. In October, 1958 he joined as Senior Research Fellow in an ICAR Research Scheme at the College of Agriculture, Ludhiana, Punjab. He served as Analytical/ Asstt. Soil Chemist at Punjab Agriculture University, Ludhiana during 1961 to 1968. From August, 1968 to June, 1972 he served as Soil Scientist at IARI, New Delhi. He joined the Central Potato Research Institute in 1972 and served as Principal Scientist and Head, Division of Crop and Soil Science. On 12th April, 1989 he took over as the Director, CPRI, Shimla and retired from the same post on 31st July, 1994.

Dr. Grewal worked on evaluation of soil fertility, organic manures and fertilizers during his tenure in the Dept. of Agriculture, Himachal Pradesh. He worked on potassium and ammonium fixation in soils at the College of Agriculture, Ludhiana. At the Punjab Agriculture University, Luhiana, he studied the micronutrient status of soil and micronutrient need of crops. He also taught under-graduate and post-graduate classes. He continued to work on micronutrients in soils and plants at IARI during 1968-72. At CPRI, Shimla he was responsible for planning, conducting, guiding, supervising and coordinating research and development work in the disciplines of agronomy, soil science, agricultural engineering, agricultural statistics

and agricultural economics, crop production and transfer of technology for crop production. He made significant contributions on fertilizer use in potato based cropping systems in India, fertilizer use efficiency and management in potato and on phosphatic fertilizers.

Dr. Grewal created tissue cultures, physiology and radioisotope laboratories with modern facilities. He promoted consolidation of results on potato research and development in the form of technical bulletins and seminar/symposia proceedings. Dr. Grewal has published 124 research papers, 30 technical and popular articles, authorized or edited 20 technical bulletins and edited two proceedings of symposia. He is one of the editors of a comprehensive book on potato "Advances in Horticulture, Vol. 7 Potato". Dr Grewal received the Fertilizer Association of India (FAI) Award in 1981, PPIC-FAI award in 1983 and Potash Research Institute of India Best Paper Award in 1992.

Dr. Grewal is a Life Member of Indian Potato Association of which he was the Secretary in 1978, Vice President in 1979, 1980 and President from 1983 to 1986 and 1989 to 1992. He is also a member of Indian Society of Soil Science. He was also member of several committees like ICAR Scientific Panel for Soil Science; Fertilizer Advisory Committee, Himachal Pradesh; Indian Potato Development Council; HP Seed Potato Development Board; Fertilizer Association of India etc. He organized two National symposia on potato in collaboration with the Indian Potato Association in 1989 and 1990. Dr. Grewal organized International Training courses on "Modern Methods in Potato Production", SAARC training course on "Late Blight disease of potato" in 1989, True Potato Seed technology training in 1992, 1993 and a Biotechnology Training Course in 1993. He was invited to participate in the International Congress of Phosphorus Compounds held in Brussels, Belgium in 1983. After his retirement he joined in Pepsi. Presently he is residing in Shimla, Himachal Pradesh.

Dr. Girdhari Singh Shekhawat was born on 9th July, 1941 at Turkiawas, Rajasthan. After his graduation from the University of Udaipur in the year 1964, he joined Indian Agricultural Research Institute, New Delhi for Post Graduation and obtained M. Sc. (Agriculture) in the year 1966 and Ph.D. under the guidance of Dr. D.N. Srivastava in the year 1970 with Gold medals. He did Post Doctoral research for nine months (January-September 1976) at Insitute of Phytopathology, Georde Augustus University, Gottingen, West Germany and again for nine months (November, 1984 to July, 1985) at Scottish Crop Research Institute, Dundee, Scotland.

Dr. G. S. SHEKHAWAT
(1995-2001)

Dr. Shekhawat started his career as Assistant Bacteriologist at Indian Agricultural Research Institute, New Delhi in the year 1968 and continued in that position till 1972. He joined CPRI, Shimla as Scientist S-2 in July, 1972 and became Head of the Plant Pathology Division in October 1975 at an young age of 34. Since then, he played a pivotal role in development of this Institute and became its Director in November 1995. He was President of Indian Potato Association (1993-94, 1998-99, 2000-2001); Indian Phytopathological Society (2001); Editor-in-Chief of the Journal of Indian Potato Association (1983-84); Fellow of the National Academy of Agricultural Sciences; and Distinguished Fellow of Indian Potato Association. He was also member of several national and international committees like ICAR Scientific Panel on Plant Pathology; Central Sub-Committee for Crop Standards, Govt. of India; Steering Committee for Global Initiative on late blight, CIP, Lima Peru; Working Group to Formulate Future Work Plan on Bacterial Diseases of Potato, CIP, Lima, Peru; Working Group for Identification of Future Lines of Work on Bacterial Wilt, North

Carolina State University, USA. He organized the Global Conference on Potato in December, 1999 and an International Workshop on Bacterial Wilt of Potato in 1993. After his retirement in July 2001, he became Scientist Emeritus of ICAR and conducted reaserch at Rajasthan Agricultural University, Jodhpur. Dr. Shekhawat expired on January 9, 2007.

Dr. Shekhawat did pioneering work on etiology, epidemiology, histopathology and resistance of bacterial canker of mango, bacterial leaf streak and blight of rice at IARI, New Delhi. After joining Central Potato Research Institute, Shimla, he initiated fundamental research on bacterial diseases of potato and over the year established a state-of-the-art bacteriology laboratory. From this laboratory, he pursued path-breaking experiments on etiology, epidemiology, diagnostic and management of bacterial wilt, soft rot, common scab and mycoplasma like organisms causing diseases in potato. Dr. Shekhawat was a strong believer of research with a purpose. He crystallized scattered experimental evidences into efficient disease management schedules, which are today's benchmark recommendations. The inherent talent of Dr. Shekhawat came to its fulfillment in research management. As Director, CPRI, he contributed immensely for consolidation of resources, modernization of research facilities, human resource development, development of research and production linkages, development of improved potato varieties, development of processing technologies, crop modeling, refinements in seed production system etc.

Dr. Shekhawat was a glaring example of "simplicity is the best policy" for achieving excellence in every facets of human endeavour. Central Potato Research Institute received best ICAR Institution award in its inaugural year, which is a mere reflection of his managerial skill. Dr. Shekhawat was awaded IARI-Golden Jubilee Medal for M.Sc. and Sunitabala Raychaudhary Medal, 1970 for securing highest grade point at IARI, New Delhi. He received Dr. Ramanujam Memorial Award in 1998; Dr Mundkur Memorial Award in 1997; Prof. N. Prasad Memorial Award in 2000; CPRI Golden Jubilee Year Award in 2000; and above all, the coveted Rafi Ahmed Kidwai Award of Indian Council of Agricultural Resaerch in the year 2000 for his life time achievement on potato research. He published more than 250 scientific articles in national and international journals and edited five books.

Dr. Satyendra Mohan Paul Khurana was born on 31st December 1944 at Jalna, Maharashtra. After his graduation in the year 1963 from the University of Gorakphur, Uttar Pradesh, he obtained M.Sc. (Plant Pathology) in the year 1965 and Ph.D. (Virus Pathology) under the guidance of Prof. Dr K. S. Bhargava, in the year 1968 from the same University. He did two years' (1970-72) post-doctoral work on Advanced Plant Virology at Kyushu University, Fukuoka (Japan). He also worked at University of Minnesota, St. Paul (USA) on immunodiagnostics during a sabbatical of one year (1987-88).

Dr. S. M. Paul Khurana
(2002-2004)

Dr Khurana started his scientific career as Junior Scientists (Pathology) at Sugarcane Breeding Institute, Coimbatore and served there for six months in the year 1970. He joined Central Potato Research Institute, Shimla as CSIR Pool Research Oficer in April, 1973 after completing his Post Doc. in Japan. He was absorbed as Scientist S1 in December 1974 and continued at CPRI, Shimla in different capacity till November 2004, when he joined as Vice Chancellor of Rani Durgavati Vishwavidyalaya, Jabalpur, Madhya Pradesh. He became Head, Division of Plant Pathology in October, 1988; Project Coordinator, AICRP (Potato) in the year 1994 and Director, CPRI in January, 2002. During 2002-2004, he held the dual charges of Project Coordinator (AICRP-

Potato) and Director, CPRI.

During his long research carreer, Dr. Khurana made persistent effort for refinement and upgradation of virus detection and diagnostics. He and his team standardized use of the ELISA procedure in the year 1984 and started preparing indigenous ELISA kits by 1990. He also contributed in the development of ISEM technique for virus detection. Under his leadeship, the Institute perfected nucleic acid based virus detection techniques. He also contributed in cloning of several viral genes and their use in development of transgenic potato with pathogen derived resistance. He developed simple and effective laboratory techniques for screening of resistance to viruses and aphids. He also contributed in development of IDM schedules for potato virus diseases, late blight, soil and tuber borne diseases. thereby reducing pesticide usage.

He handled several research projects funded by ICAR, CSIR, DBT, CIP, PL-480, etc including a few International collaborative research schemes. As the Project Coordinator, he recommended release of 10 potato varieties. Besides, he was involved in selection of four new potato varieties namely Kufri Arun, Kufri Shailja, Kufri Pushkar and Kufri Surya. Dr. Khurana was awarded CPRI Golden Jubilee Outstanding Achievements Award (2000); Best Scientist of the Year (2002) Award; Dr. S. Ramanujam Memorial Award for Outstanding research & Leadership in Potato R & D and several others. Dr. Khurana has published over 130 research papers in journals of repute and authored more than 75 reviews/book chapters. He guided 10 Ph.D. students. Dr. Khurana is a widely traveled scientist and visited Bhutan, Canada, France, Japan, Peru, Scotland, The Netherlands, Uganda UK, USA, etc.

Dr. Khurana is a Fellow of National Academy of Agricultural Sciences, New Delhi; National Academy of Biological Sciences, Chennai (India) and Distinguished Fellow of the Indian Potato Association. He held prestigious positions in various professional societies like Indian Potato Association (President for three terms, Editor-in-Chief for three terms and Secretary for one term); Aphidological Society (Vice President for one term and Editor for two terms); Indian Virology Society (Editor-in-Chief for two terms and Editor for one term); Indian Phytopathological Society (President for one term, Editor for three years). He also held several international assignments like Resource Person, Virology Planning Conference, CIP, Lima, Peru; Consultant, CIP-Helvetas, BNPP, Bhutan; Chairman, Plant Protection Session, Asian Potato Conference, Indonesia; Consultant, FAO/IPGRI Meeting, Edinburgh; Special Speaker, International Conference on Tospoviruses, The Netherlands; Keynote Speaker, African Triennial Conference on Potato, Uganda. He also played a key role in several national and internation committees.

Dr. Suman Kumar Pandey was born on 26th June 1948 at village Chhibramau, Farrukhabad, Uttar Pradesh. After graduation from Lucknow University, Lucknow in the year 1968, he did M.Sc. (Botany) from the same University in the year 1970. He did M.Phil (Agril. Botany) from Meerut University, Meerut in the year 1988 and obtained his Ph.D. (Agril Botany) under the guidance of Prof. P.K. Gupta from the Institute of Advanced Studies, CCS University, Meerut in 1993.

Dr. S. K. PANDEY
(2005-continuing)

Dr. Pandey started his carreer as Research Assistant at Central Potato Research Station, Bhowali on 11th January 1971 and was absorbed as Scientist S1 on 1st July 1976. He became Head, Division of Crop Improvement on 3rd November 2001 and Director, Central Potato Research Institute on 20th May 2005 and is presently continuing in the same position. Dr. Pandey is the Fellow of the National Academy of Agricultural Sciences;

Distinguished Fellow of the Indian Potato Association; and Fellow of the Horticultural Society of India. He is a member of several other scientific societies like National Academy of Sciences, Allahabad; Vegetable Society of India, Varanasi; and Indian Society of Genetics and Plant Breeding, New Delhi.

Dr. Pandey held several responsible positions in national and international committees like Member Secretary of Planning Commission's Sub-group on Planting Material under Horticulture, Plantation Crops and Organic Farming for formulation of XIth Five Year plan; Member, Board of Management, Dr. Y. S. Parmar University of Horticulture and Technology, Nauni, Solan, Himachal Pradesh; Member, Governing Board, Himachal Pradesh Seed and Organic Produce Certification Agency, Shimla; Member, National Biodiversity Authority (NBA), Chennai; Member, International Advisory Committee, World Potato Congress Inc., Canada; Consultant & Member of Task Force for Protection of Plant Varieties and Farmers' Right Authority for prepration of DUS guidelines for vegetable crops. He also played a key role in organization of several national and international conferences like Global Conference on Potato, 1999; National Symposium on "Sustainability of potato revolution in India", 2001; and National Conference on IPR and Management of Agricultural Research, 2005. He was Joint Secretary of the Indian Potato Association during 1987-1992; Secretary during 1994-95, Editor-in-Chief of Potato Journal from 2002-2005. Currently he is the President of Indian Potato Association and Vice-President- Horticultural Society of India. He is the Chairman, National Organzing Committee, Global Potato Conference 2008.

During his long research career, Dr. Pandey contributed significantly in the area of potato breeding, especially for disease resistance, processing, heat tolerance and TPS technology. His dynamic leadership in the field of breeding for processing grade varieties resulted in quick development of a number of suitable varieties like Kufri Chipsona 1, Kufri Chipsona 2, Kufri Chipsona 3, Kufri Himsona and technologies for production of processing grade potatoes under sub-tropical condition that started a revolution in the potato processing sector in India. He also actively participated in the development of varieties like Kufri Giriraj, Kufri Sutlej, Kufri Jawahar and Kufri Pukhraj, Kufri Shailja, Kufri Pushkar, Kufri Arun, Kufri Himalini and the first ever heat tolerant variety Kufri Surya that has the potential to mitigate the ill effects of global warming on potato cultivation.

The TPS progeny 92-PT-27 developed by his group is gaining popularity in India and abroad. He has also identified and registered eight elite potato germpalsm that have strengthened the potato varietal improvement schemes and patented a technology for micro-tuber production. He has published more than 138 research papers in national and international journals, almost equal number in proceedings of seminars/symposia or popular scientific magazines and authored/edited nine books. He received several awards including the prestigious Rafi Ahmad Kidwai Award of ICAR; Dr. S. Ramanujam Memorial Award; Dr. L.C. Sikka Endowment Award from National Academy of Agricultural Sciences; Dr. J.C. Anand Gold Medal from Horticulture Society of India etc.

All India Coordinated Research Project on Potato

Prakash S. Naik
Project Coordinator

All India Coordinated Research Project on Potato [AICRP (Potato)] was initiated in the year 1970-71 in the IV Five Year Plan at Central Potato Research Institute (CPRI), Shimla. The mandate of AICRP (Potato) is to coordinate and monitor multilocation trials with improved potato hybrids; agronomic practices related to crop production vis-à-vis identification of remunerative potato based cropping systems; plant protection measures and post harvest technology, all aimed at increasing production, productivity and utilization of potato in the country. The project also acts as linkage between different stakeholders connected with potato production and utilization. Major activities under the project are:

- Development/identification of improved potato varieties.
- Identification of appropriate agronomic practices and profitable potato based cropping systems for different regions.
- Studies on integrated management of nutrients and water.
- Monitoring of diseases/pests and other problems of potato in varied agro-climates and develop appropriate control measures.

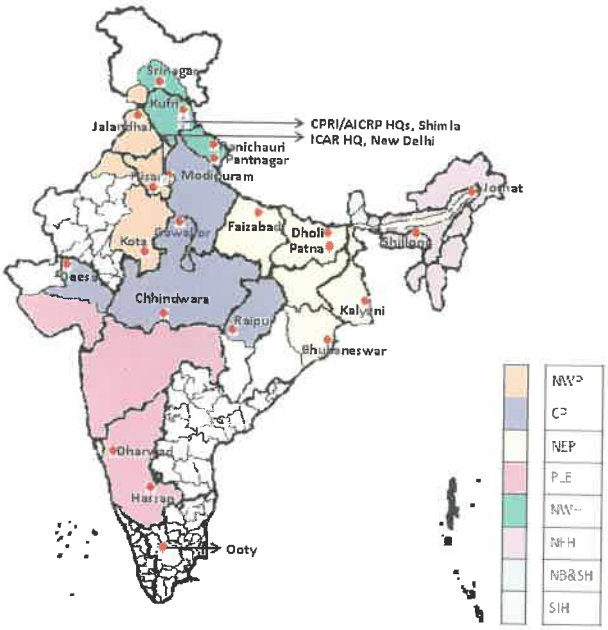


Figure 1: Distribution of AICRP (Potato) centers in different potato production zones of the country. [North Western Plains (NWP); Central Plains (CP); North Eastern Plains (NEP); Plateau Region (PLE); North Western Hills (NWH); North Eastern Hills (NEH); North Bengal & Sikkim Hills (NB & SH); and South Indian Hills (SIH)].

- Identification of areas suitable for production of disease-free potato seed.
- Development of technologies for minimizing post harvest losses.
- Extension and training programmes.
- Developing linkages with Agricultural Universities, State Departments of Agriculture/ Horticulture, and other Developmental/Extension Agencies.

Table 1: Duration and region-wise adaptability of the Indian potato varieties recommended through AICRP.

Variety	Crop Duration			Regions of Adaptability*				
	Early	Medium	Late	NIH	NIP	S&NBH	PLT	SIH
Kufri Lauvakar	✓						✓	
Kufri Dewa			✓		✓			
Kufri Badshah		✓			✓		✓	
Kufri Bahar		✓			✓			
Kufri Lalima		✓			✓			
Kufri Sherpa		✓				✓		
Kufri Swarna		✓						✓
Kufri Megha		✓		✓				
Kufri Jawahar	✓				✓		✓	
Kufri Sutlej		✓			✓			
Kufri Ashoka	✓				✓			
Kufri Pukhraj		✓			✓		✓	
Kufri Chipsona-1		✓			✓			
Kufri Chipsona-2		✓			✓			
Kufri Giriraj		✓		✓				
Kufri Kanchan		✓				✓		
Kufri Anand		✓			✓			
Kufri Shailja		✓		✓				
Kufri Pushkar		✓			✓		✓	
Kufri Arun		✓			✓			
Kufri Surya	✓				✓		✓	
Kufri Himalini		✓		✓				
Kufri Chipsona-3		✓			✓		✓	
Kufri Giridhari		✓		✓				✓
Kufri Khyati	✓				✓		✓	

* NIH= North Indian hills; NIP= North Indian plains; S & NBH= Sikkim and north Bengal hills; PLT= Plateau region; SIH= South Indian hills.

The project operates through 22 centers located in different potato production zones of the country (Figure 1).

The project had been instrumental in recommending 25 high yielding potato hybrids and three True Potato Seed (TPS) populations for commercial cultivation in different agro-climates. Two genotypes PS/F-220 and JN-189 possessing resistance to potato stem necrosis have also been registered with the National Bureau of Plant Genetic Resources as novel parental lines vide registration numbers INGR 04059 and INGR 07040, respectively. Early/medium maturities, resistances to biotic/abiotic stresses and processing quality attributes in some of these varieties enabled diversification of potato cultivation in the country (Tables 1 and 2).

Table 2: Resistance to biotic and abiotic stresses and processing attributes associated with the Indian potato varieties recommended through AICRP.

Variety	LB*		EB		X	Y	PLRV		W	CN	Frost		HT	PA
	R**	MR	R**	MR	R	R	R	T	R	R	R	T	T	
Kufri Lauvakar													✓	✓
Kufri Dewa											✓			
Kufri Badshah		✓		✓	✓									
Kufri Bahar														
Kufri Lalima				✓		✓								
Kufri Sherpa		✓		✓					✓					
Kufri Swarna	✓									✓				
Kufri Megha	✓													
Kufri Jawahar		✓												
Kufri Sutlej		✓												
Kufri Ashoka														
Kufri Pukhraj		✓	✓											
Kufri Chipsona-1	✓													✓
Kufri Chipsona-2	✓											✓		✓
Kufri Giriraj	✓													
Kufri Kanchan	✓								✓					
Kufri Anand	✓													
Kufri Shailja	✓													
Kufri Pushkar		✓												
Kufri Arun		✓												
Kufri Surya		✓											✓	✓
Kufri Himalini	✓													
Kufri Chipsona-3		✓												✓
Kufri Giridhari	✓													
Kufri Khyati		✓												

* LB= Late blight; EB= Early blight; X= Potato virus X; Y= Potato virus Y; PLRV= Potato leaf roll virus; W= Wart; CN= Cyst nematodes; and HT= High thermo- periods; PA = Processing attributes.

**R= Resistant; MR= Moderately resistant; and T= Tolerant.

Development of region specific production technologies comprising integrated crop, nutrient and water management; remunerative potato based intensive cropping systems (Figure 3); use of low inputs, bio-fertilizers & biodynamics; development of agro-techniques for non-traditional areas & seasons; replacement of organo-mercurial compounds by boric acid; development of eco-friendly IPM schedules to address region specific pest problems (Table 3); and improvisation of on farm storage structures have improved the total factor productivity of

Table 3: Integrated pest management schedules for some of the potato pests.

Pest	Host resistance	Agricultural practices	Bio-control agents	Chemicals
Late blight	Resistant varieties, short duration early bulking varieties to escape disease	Judicious irrigation, high ridging, adjustment of dates of planting	*Penicillium aurantiogriseum, Trichoderma harzianum and Aspergillus terrus*	Contact/systemic fungicides
Viruses	Tolerant varieties	Seed Plot Technique*	Meristem culture technique coupled with thermo- and chemo-therapy	
Potato stem necrosis virus	Tolerant varieties	Late planting (to avoid thrips) and sanitation.	-	Contact/systemic insecticides for management of thrips.
Potato apical leaf curl virus	Tolerant varieties	Late planting (to avoid whiteflies), sanitation and use of trap crops.	-	Systemic insecticides for management of whiteflies.
Early blight and leaf spots	Resistant varieties	Balanced fertilizers, sanitation	-	Contact fungicides and urea
Soil and tuber borne diseases	Short duration varieties	Healthy seed, crop rotations, optimum dates of planting/ harvesting, hot/ cold weather cultivation	*Trichoderma harzianum, T. viride, Bacillus subtilis,* non-pathogenic *Rhizoctonia etc.*	Tuber treatment with boric acid/contact or systemic fungicide.
Bacterial wilt	Short duration varieties	Healthy seed, crop rotations, hot/cold weather cultivation	*Bacillus subtilis, B. polymyxa* and *Pseudomonas fluorescens*	Bleaching powder
Wart	Resistant/Immune varieties	Healthy seed, crop rotations, hot/cold weather cultivation	-	-
Cyst nematodes	Resistant varieties	Healthy seed, crop rotations, hot/cold weather cultivation	-	Carbofuran
Potato tuber moth	-	Deep planting, proper ridging and cold storage of tubers	*Granulosis* virus, sex pheromones, Bt protein and leaves of neem, *Lantana*, and *Eucalyptus*	Contact insecticides

* Important components of seed plot technique are: green manuring, crop rotations, hot/cold weather cultivation, tuber treatment with boric acid, use of healthy seed, growing crop under aphid-free period, systemic insecticides at planting/earthing up and roguing off types and diseased plants.

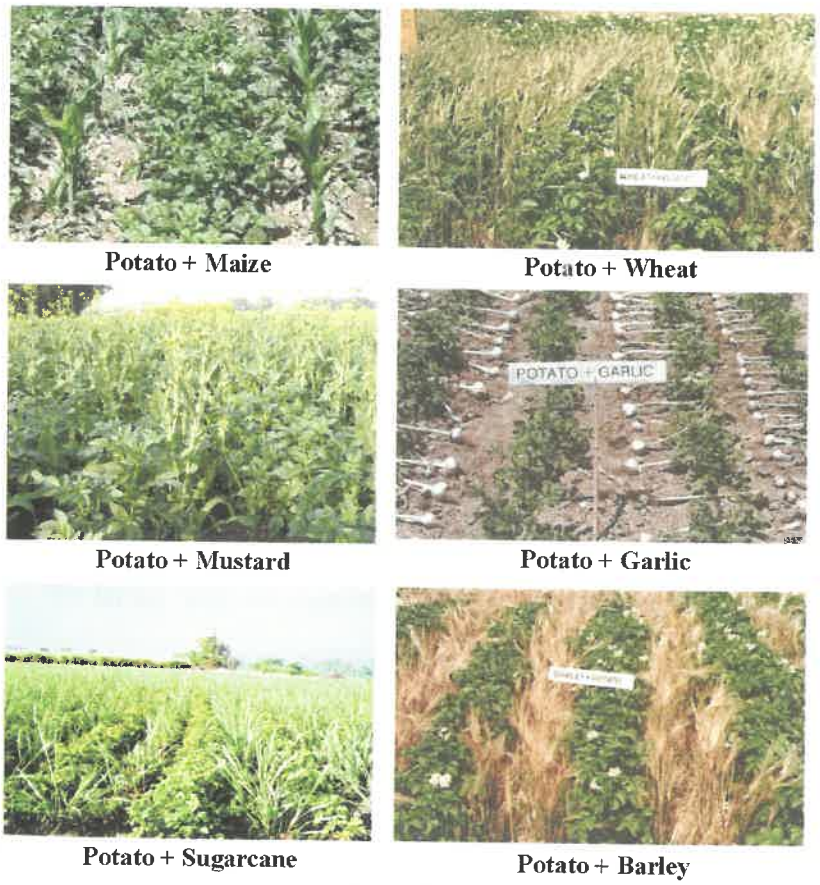


Figure 3: Some remunerative potato based intercropping systems.

potato and fostered socio-economic upliftment of resource poor farmers throughout the country. These developments have also helped in making potato farming economically viable, technologically sound and environmentally safe.

Concerted efforts have also been made under the project to transfer these technologies to end users through elaborate extension activities and strong linkages with the clientele. The synergetic efforts of CPRI and AICRP (Potato) in potato R & D have resulted in increase in area, productivity and production of potato by 5.99, 2.52 and 15.03 folds, respectively during the last five and half decades (Figure 4). Increase in potato area and production has also facilitated emergence of potato based industries

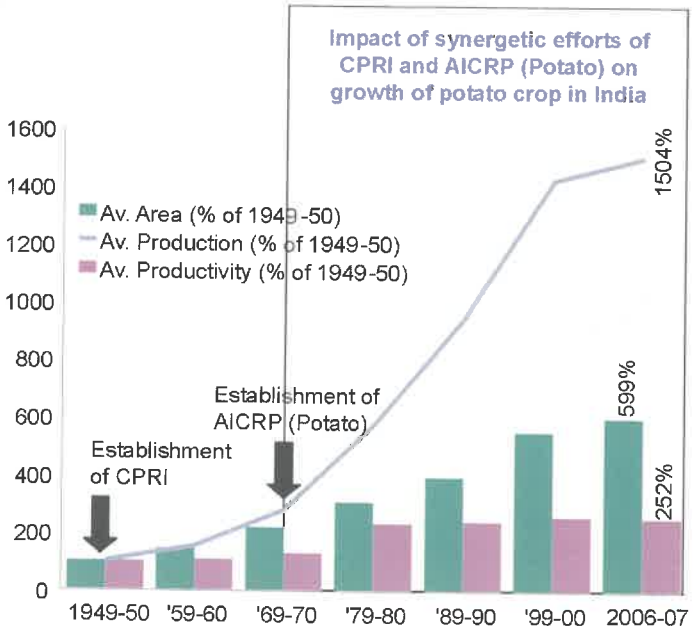


Figure 4: Increase in area, productivity and production of potato in India.

Figure 5: Decoration of AICRP (Potato) with Chaudhary Devi Lal Outstanding AICRP Award.

generating on-farm and off-farm employment in the country.

In recognition of above achievements, the project was awarded Chaudhary Devi Lal Outstanding AICRP Award, 2005 by the Indian Council of Agricultural Research (Figure 5).

Indian Potato Association – A profile

Joginder S. Minhas
CPRI, Shimla

Indian Potato Association was established in 1974 with its Headquarters at Central Potato Research Institute, Shimla (HP). Dr. (Late) Mukhtar Singh, the then Director, Central Potato Research Institute was the guiding force in conceptualizing the idea and giving it a concrete shape. Since then, the Association has been nurtured by many a stalwarts without whom the Association would not have attained the present heights. In the year 1999, the Indian Potato association crossed a milestone by organizing a Global Conference on Potato at New Delhi to celebrate its 25th Year jointly with Central Potato Research Institute, Shimla that also completed its 50th year. It was a memorable year for it as over 500 delegates including 85 foreign delegates shared their experience and ideas on the potato research and technology. The conference was acclaimed as the best organized conference in recent years both by national and international agencies.

Structure

The Association has six zones each of which is headed by a Vice-President and counseled by four councilors. President, Secretary, Joint Secretary, and the Treasurer are all elected from the Headquarters (Shimla), for a two-year term. Director General, Indian Council of Agricultural Research and Secretary, DARE Government of India is the Chief Patron. The Association also has an Editorial Board headed by Editor-in-Chief.

Membership

During the last 34 years, the membership of the Association has grown many folds. At present, it has 880 members of which most of the members are Life members. This is the only scientific association in the country where the farmers outnumber the scientists. Cold store owners, processors, and other industrialists are also registered members of the association.

Mandate

1. Advance the cause of potato research and development, culture and utilization in a systematic manner and in all its aspect.
2. Provide a common forum and opportunity for personal contact and fellowship among workers in different fields embracing the potato.
3. Hold periodical conferences, symposia, workshops, meetings, seminars, exhibitions and such other gatherings as may be decided upon by the General Body or the Executive Council of the Association from time to time.
4. Making sustained efforts for recognition of the potato as an important food crop of high nutritive value and to conduct publicity/publications and other campaigns through

different media for this purpose.

5. Publishing books, reports, summaries of papers and other forms of scientific and technical literature including a newsletter for creating a general consciousness about the potato.
6. Cooperate with other institutions and societies having similar objectives, and fields of activities.
7. Receive grants, subsidies, donations, etc. to achieve the outlined objectives.
8. Promote exchange of scientific and other information and develop other means of communication between those engaged in the potato agriculture and the industry and manufacturers of the processed forms of the potato.
9. To foster regional and international co-operation/collaboration in attainment of the outlined objectives.
10. Organize such other activities that are consistent with and in furtherance of these objectives and those, which are decided upon from.

Activities

1. Publishes a scientific journal named as **Potato Journal**, which was formerly known as the **Journal of Indian Potato Association** to promote exchange of scientific information amongst the members.
2. Publishes quarterly "**Newsletter**" which carries news and also articles on new and important technologies developed in the country. It also carries ready to use information for potato growers.
3. Publishes books on potato for dissemination of new information and technology.
4. Organizes both national and international conferences, seminars/symposia, panel discussion, Farmers' Melas etc. from time to time.
5. Confer awards and honours on eminent potato workers, growers, etc.

Important Seminars/Symposia Organized by the Association

1. International Seminar on "**Approaches towards increasing the Potato Production in Developing Countries"** at Central Potato Research Station, Jalandhar (Punjab), November 20-23, 1978
2. Panel discussion on "**Problems of potato cultivation in India"** at Central Potato Research Institute, Shimla, June 13, 1986,.
3. National Seminar on "**Current facets in potato research"** at Central Potato Research Institute (Campus), December 13-15, 1989.
4. National Symposium on "**Strategies for potato production, marketing, storage, processing**" at Indian Agricultural Research Institute, New Delhi, December 21- 23, 1990.

5. National Symposium on "**Potato- Present and Future**" at Central Potato Research Institute (Campus) Modipuram, March 1-3, 1993.
6. Group Discussion on "**Potato based cropping systems**" at Central Potato Research Institute, Shimla during on 30 July, 1994.
7. National Seminar on "**Potato production constraints in low productivity areas**" at Orissa University of Agriculture & Technology, Bhubaneshwar on September 6, 1997.
8. **Global Conference On Potato,** New Delhi, December 6-11, 1999.
9. National Symposium on "**Sustainability of Potato Revolution in India**" at Central Potato Research Institute, Shimla on July 31, 2001.
10. National Symposium on "**Potato Research Towards National Food and Nutritional Security**" at Central Potato Research Institute, Shimla during October 2-3, 2003.
11. National Conference on "**IPR and Management of Agricultural Research**" at NASC, New Delhi during August 27-29, 2005.
12. Symposium on **"Current Perspectives in Potato Research"** at MPUAT, Udaipur on September 11, 2005
13. Symposium on **"A Step Towards Brown Revolution With Potato"** at CPRS, Ootacamund on January 19, 2007.

Honorary Fellows

The Association has so far conferred Honorary Fellowships on 19 distinguished potato workers/growers for their outstanding contributions in the field of potato research and development. They are:

1.	Dr. S Ramanujam*	2.	Dr. Pushkarnath*
3.	Sh. Hari Kishore*	4.	Sh. IS Dhillon
5.	Dr. BB Nagaich	6.	Dr. KL Chadha
7.	Dr Kirti Singh	8.	Sh. SN Bhargava*
9.	Dr. BP Pal*	10.	Dr. MD Upadhya (Canada)*
11.	Dr. NM Nayar	12.	Dr. RP Singh (Canada)
13.	Dr. JG Hawkes (UK)*	14.	Dr. JS Grewal
15.	Dr. J Horvath (Hungary)	16.	Sh. LC Sikka*
17.	Dr. Mukhtar Singh*	18.	Dr. GS Shekhawat*
19.	Dr. PK Gupta	19.	Dr. KV Raman

*deceased

Distinguished Fellows

The Association elects distinguished fellows from among its members. So far 36 scientists have been elected as Distinguished Fellows of the Association. They are:

1. Dr. SK Bhattacharyya (1994)
2. Dr. SM Paul Khurana (1994)
3. Dr. ML Pandita (1994)
4. Mr. SS Shivalli (1994)
5. Dr. MS Rana (1994)
6. Dr. KC Dubey (1994)
7. Dr. JT Nankar (1994)
8. Dr. KP Sharma (1994)*
9. Dr. RA Singh (1994)
10. Dr. SC Verma (1994)
11. Dr. NM Nayar (1994)
12. Dr. RC Sharma (1995)
13. Dr. KD Verma (1995)
14. Dr. UC Sharma (1996)
15. Dr. PC Gaur (1996)
16. Dr. AK Singh (1997)
17. Dr. SNS Srivastava (1997)
18. Dr. GS Kang (1998)
19. Dr. NP Sukumaran (1998)
20. Dr BL Barua (1999)
21. Dr SM Verma (1999)
22. Dr. Jagpal Singh (1999)*
23. Dr SS Lal (2000)
24. Dr. KSK Prasad (2000)
25. Dr. SK Pandey (2001)
26. Dr. BP Singh (2001)
27. Dr. KC Sud (2002)
28. Dr. VK Chandla (2002)
29. Dr. PS Naik (2003)
31. Dr. KC Garg (2003)
31. Dr. RB Singh (2004)
32. Dr. SV Singh (2004)
33. Dr. JS Minhas(2005)
34. Dr. MS Kadian (2005)
35. Dr. KR Dhiman (2006)
36. Dr. SC Khurana (2006)

*deceased

Awards

The Association has instituted several awards to promote excellence in the field of potato research and development in the country. They are:

1. IPA Medal for the Best Paper published in the Potato Journal
2. Best Poster Award during the conferences/symposia
3. Ramanujam Memorial Award Lecture

Publications

1. Potato Journal – Quarterly
2. Newsletter – Quarterly
3. Books/ Proceedings

List of Books/Proceedings

1. **Potato in Developing Countries** Proceedings of International Seminar "Approaches Towards Increasing the Potato Production in Developing Countries" held at Central Potato Research Station, Jalandhar, November 20-23, 1978.
2. **Current Facets in Potato Research** Proceedings of the National Seminar held at Central Potato Research Institute Campus, Modipuram, December 13-15, 1989.
3. **Strategies for Potato Production, Marketing, Storage and Processing** Proceedings of the National Symposium held at Indian Agricultural Research Institute (IARI), New Delhi, December 21-23, 1990.
4. **Potato: Present and Future** Proceedings of the National Symposium held at Central Potato Research Institute Campus, Modipuram, March 1-3, 1993.
5. **Souvenir** of the Global Conference on Potato, New Delhi, December 6-11, 1999.
6. **Summary Proceedings – Global Conference on Potato**
7. **Potato, Global Research & Development Vol. I and II** Proceedings of the Global Conference on Potato, New Delhi, December 6-11, 1999.
8. **Souvenir** of the **Symposium on "Potato Research Towards National Food and Nutritional Security"** and **Dr. S. Ramanujam Birth Centenary Celebrations,** Shimla, October 2-3, 2003.
9. **Souvenir** of the **National Conference on IPR and Management of Agricultural Research**, New Delhi, 27-29 August 2005.

Year	President	Vice-Presidents	Secretary	Joint Secretary	Treasurer	Editor-in-Chief	Business Editor
1974 1975	Mukhtar Singh	BS Jogi Kirti Singh Hari Kishore US Kang HN Singh A Kelman	LC Sikka	GS Shekhawat	VM Khanna	BB Nagaich	SC Verma
1976	BB Nagaich	BS Jogi Kirti Singh US Kang Kirti Singh Niranjan Prakash JS Niederhauser	LC Sikka	GS Shekhawat	VP Malhotra	BB Nagaich	SC Verma
1977	BB Nagiach	LC Sikka SN Bhargava Daljeet Singh MD Upadhya	JS Grewal	GS Shekhawat	SM Paul Khurana	BB Nagaich	SC Verma
1978	BB Nagaich	LC Sikka SN Bhargava Daljeet Singh MD Upadhya	JS Grewal	GS Shekhawat	SM Paul Khurana	SB Lal	NP Sukumaran

Year	President	Vice-Presidents	Secretary	Joint Secretary	Treasurer	Editor-in-Chief	Business Editor
1979	SB Lal	MS Rana JS Grewal HS Sangha SN Bhargawa	GS Shekhawat	JS Gill	SM Paul Khurana	BB Nagiach	SP Trehan
1980	BB Nagaich	BL Barua SL Dubey AK Singh A Naik Guru Amarjit Singh DS Singh	GS Shekhawat	SS Grewal	SM Paul Khurana	KP Sharma	MS Virk
1981 1982	BB Nagaich	JS Grewal, RN Khanna JK Maheshwari M Shyam DS Singh SM Verma	PC Gaur	SK Pandey	SK Bhattacharya	KP Sharma	MS Virk
1983 1984	JS Grewal	Jagpal Singh BN Singh MD Upadhya SS Saini CL Khushu SP Singh	SM Paul Khurana	PS Dahiya	RA Singh	GS Shekhawat	SM Paul Khurana
1985 1986	JS Grewal	Jagpal Singh BD Sharma OM Bombawala BS Sangar SG Phadtare JT Nankar	SK Bhattacharaya	SS Misra	VK Chandla	SM Paul Khurana	MN Singh
1987 1988	KP Sharma	PC Misra UC Sharma MP Srivastava Nepal Singh Janardan Jee AV Gadewar	RA Singh	RK Birhman	HC Sharma	SK Bhattacharya	BP Singh
1989 1990	JS Grewal	GS Shekhawat Laxman Lal Jagpal Singh SS Saini Janardan Jee KS Krishna Prasad	RA Singh	VK Chandla	MC Sood	SK Bhattacharya	BP Singh
1991 1992	JS Grewal	GS Shekhawat UC Sharma GS Kang Jagpal Singh VS Khushwah RK Arora	VK Chandla	MK Dhingra	SR Yadava	SK Bhattacharya	BP Singh

Year	President	Vice-Presidents	Secretary	Joint Secretary	Treasurer	Editor-in-Chief	Business Editor
1993 1994 1995	GS Shekhawat	RA Singh UC Sharma GS Kang KD Verma Janardan Jee Gowada P Madappa	SK Pandey	R Chandra	KC Sud	SM Paul Khurana	BP Singh
1996 1997	SM Paul Khurana	RC Sharma Kamla Singh JP Singh Jagpal Singh R Sinha KSK Prasad	BP Singh	Shiv Kumar	RK Birhman	GS Shekhawat	SS Lal
1998 1999	GS Shekhawat	PC Gaur BK Sharma IP Chaubey Janardhan Jee PM Govindakrishnan	BP Singh	KC Sud	SR Yadav	SM Paul Khurana	SK Pandey
2000 2001	GS Shekhawat	PS Dahiya SP Trehan SV Singh RP Rai SS Shivalli	PS Naik	KC Sud	SR Yadava	SM Paul Khurana	SK Pandey
2002 2003	SM Paul Khurana	Shiv Kumar Kamla Singh DS Uppal Raj Pal Singh BK De TA Joseph	KC Sud	NK Pandey	JS Minhas	SK Pandey	Brajesh Singh
2004 2005	SM Paul Khurana	VK Chandla YP Sharma RK Arora BP Singh BK Mandal TA Joseph	JS Minhas	SK Chakrabarti	VK Dua	SK Pandey	Brajesh Singh
2006 2007	SK Pandey	MC Sood YP Sharma RS Marwaha BP Singh VS Verma K. Manorama	JS MInhas	SK Chakrabarti	VK Dua	Jai Gopal	Brajesh Singh
2008 2009	SK Pandey	JS Minhas SV Singh RS Marwaha RP Rai S Ramani Sadanand S Shivalli	SK Chakrabarti	VK Dua	NK Pandey	Jai Gopal	Brajesh Singh

Presidents of Indian Potato Association

Late Dr. Mukhtar Singh
(1974-1975)

Dr. BB Nagaich
(1976-78, 1980-82)

Late Dr. SB Lal
(1979)

Dr. JS Grewal
(1983-86, 1989-92)

Late Dr. KP Sharma
(88-88)

Late Dr. GS Shekhawat
(1993-95, 1998-2001)

Dr. SM Paul Khurana
(1996-97, 2002-05)

Dr. SK Pandey
(2006-Contd.)

International Potato Center (CIP)

M Kadian, C Carli and D Campilan
CIP, SWCA, New Delhi

CIP as Global Research Institution

The International Potato Center (known by its Spanish acronym, CIP) seeks to reduce poverty and achieve food security on a sustained basis in developing countries through scientific research and related activities on potato, sweetpotato, other root and tuber crops, and on the improved management of natural resources in the Andes and other mountain areas.

Based in Lima, Peru, CIP is a member of the Alliance of the 15 centers of the Consultative Group on International Agricultural Research (CGIAR). It receives its principal funding from the 58 governments, private foundations and international and regional organizations that constitute the CGIAR.

In 2003 CIP completed a Vision Exercise that allowed the Center to prioritize seven development challenges that reflect eight of the UN Millennium Development Targets. These challenges can be summarized as: reducing poverty and hunger; improving human health; developing sustainable rural and urban systems; and improving availability of new technologies. CIP's 2006-2016 strategy sets out a program of research that is aimed squarely at contributing to the achievement of selected targets of the Millennium Development Goals (MDGs). The MDGs guide CIP's research program, to ensure that the outputs of our work are translated into improvements in the livelihoods of the poor and so contribute to the MDGs.

CIP has redefined its role to be a research partner for development, by adopting new ways of defining research priorities and finding innovative ways for interaction and intervention in its areas of operation. CIP has identified key themes that create a logical connection between its research program and its contribution to the MDGs, representing pathways to impact. These themes are: 1) sustainable use of biodiversity, 2) reducing temporal and chronic hunger in vulnerable communities, 3) improving access to safe and nutritious food, 4) linking farmers to markets, 5) sustainable intensification of potato- and sweetpotato-based farming systems, 6) sustainable and healthy horticulture in and around cities, and 7) institutional learning for pro-poor change.

Global Research Mandate and Functions

CIP was founded in 1971 as a crop improvement center based on the premise of beneficially utilizing the world collections of its mandate crops to make advances in crop improvement and crop protection. In close collaboration with its national partners, CIP scientists have been assembling the world's largest reservoir of root and tuber crop genetic material. Today CIP maintains the world's largest bank of potato germplasm; it currently holds in trust for the world community approximately 2,000 wild and 4,000 cultivated potato samples. CIP has distributed these germplasm holdings to users worldwide, with developing countries receiving most samples.

As an international research institution, CIP has several additional global research functions, specifically genetic enhancement and crop improvement, integrated crop management, natural resources management and innovation systems.

In genetic enhancement and crop improvement, CIP focuses on improving the productivity and quality of potato varieties and enhancing capacity to adapt local needs and opportunities. Compelling new challenges include tolerance to drought and heat stresses; improving agricultural systems; more nutritious food systems; and innovative solutions to critical, recalcitrant traits. Breeding materials developed and distributed by CIP have been used in hundreds of varietal releases in more than 40 countries.

CIP focuses its global agenda for integrated crop management on developing molecular and biological tools for understanding evolution of insect and pest populations, crop modeling and GIS, ecosystems research for improving crop productivity and sustainability, as well as innovation systems theory for crop management. One of the most important goals of CIP's integrated control work is to reduce the amount of harmful agro-chemicals used on crops, particularly potatoes. CIP also works closely with national counterparts in many countries to develop cost-effective, reliable systems for the production of quality, disease-free seed.

Natural resources management complements germplasm research, aiming at increasing productivity while improving the sustainability and reducing the vulnerability of the rural poor. Work includes developing frameworks, tools and methods to identify research needs and opportunities for commodity and food systems research in representative geographic and agroecological target sites.

CIP uses innovation systems thinking to conduct research that generates knowledge, and identify the processes, mechanisms and organizations that will apply and re-use research knowledge. This has already been successfully applied in promoting native potatoes, which uses innovative ways to connect small scale potato growers to urban markets, both domestic and international. One of the resulting commercial products, the T'ikapapa brand of native potatoes, has won the BBC-Newsweek-Shell World Challenge Award and United Nations SEED (Supporting Entrepreneurs for Environment and Development) Award in 2007.

CIP's Global Reach Through Its Regional Programs

CIP's targeting exercises produced a global picture based on the geographical overlapping of different indicators such as poverty, hunger and mortality rates on to potato and sweetpotato distribution maps. This work has guided CIP efforts to focus on 36 countries in the developing world.

CIP operates through a worldwide network of regional and country offices. Its four regional programs include: 1) Latin America and the Caribbean (LAC); 2) Sub-Saharan Africa (SSA); 3) South, West and Central Asia (SWCA); and 4) East and Southeast Asia and the Pacific (ESEAP).

CIP's decentralized organization enables researchers to develop technologies where they will be most readily used, and with the people who will most quickly adopt them. Increasingly, this includes farmers, communities, and local NGOs. Working side by side with developing country research partners and keeping a users' perspective in mind enables new technologies to be user driven and quickly adopted, decreasing the time lag for impact to be seen, felt, and measured. It also allows priority setting to be a dynamic and participatory process reflecting local needs and constraints.

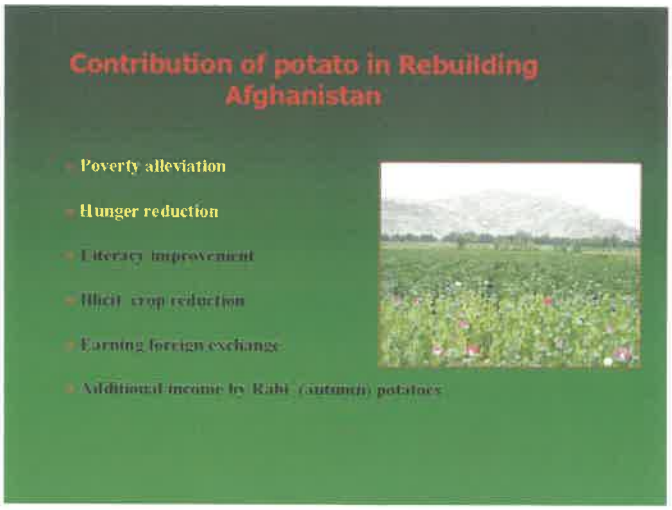
CIP's Regional Office based in New Delhi, India, has been operating for over 25 years. Some of the most important accomplishments of CIP SWCA regional program are:

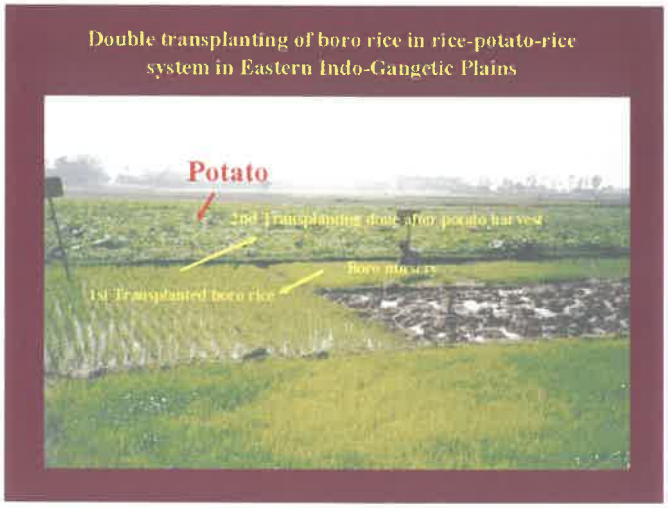
The potato production system in Afghanistan has been improved through: i) provision of healthy starter planting materials, ii) training of NARS on improved seed production technologies for quality seed production at farmers' level, iii) reduction of post-harvest losses by designing and constructing improved storage facilities, and iv) the development of a national seed market chain.

Bangladesh has so far released six varieties from CIP germplasm collection and more recently the var. Sakait with interesting traits of resistance to soil salinity and specifically recommended for the coastal region. CIP is closely working with NARS to bring an additional 0.15 million ha area under potato cultivation in Bangladesh by providing abiotic stress tolerant varieties to farmers. Meanwhile in the mountains of Bhutan, CIP is assisting NARS to produce potato seed for local use as well as for export to neighboring countries. CIP is also assisting commercial potato production through improved crop management and farmers' linkage to markets.

CIP in partnership with NARS introduced and validated double transplanting technology of boro (summer) rice in the predominant kharif (monsoon) rice-potato-boro rice system of the Indo-Gangetic plains of India and Bangladesh. The adoption of improved technology increased farmers' incomes by allowing the potato crop to grow up to full maturity leading to optimum yield without sacrificing the boro rice yield.

True potato seed (TPS) technology is proving to be a highly cost-effective





and appropriate technology for resource-poor farmers of less-developed countries. In Nepal nearly 7,300 ha area is planted from TPS-derived planting materials. The average yield of seedling tubers issued from TPS is around 30 t/ha, significantly higher than the 23 t/ha obtained from the clonal variety Desiree. About 11,500 farm households have benefited from the use of TPS in Nepal, both in the lowlands and the uplands.


CIP clones at Blossoming stage in Uzbekistan

In Central Asia and the Caucasus, CIP has initiated a regional clonal selection in the highland regions of Tajikistan. This has involved the testing of more than 80 advanced clones, plus 20 TPS families and 40 True Seed families. The targeted traits include: earliness, virus resistance, marketability, heat tolerance and nutritive aspects (some of them are characterized by the highest available Fe and Zn content).

This effort has resulted in the selection of some promising clones in Kazakhstan. Two of these, 397077.16 and 388676-1, have been passed to the local State Committee for Variety Testing for further release with the candidate names Alliance and Miras. Meanwhile in Tajikistan and Uzbekistan, many other clones are in advanced selection stage.

CIP has likewise worked with Georgian local scientists and advisors in improving the informal seed potato system. This inolves the establishment of a quality control mechanism, which guarantees ware potato growers that the seed purchased from informal seed producers is of reasonable quality.

MEMORIES & IMPRESSIONS

Highlights

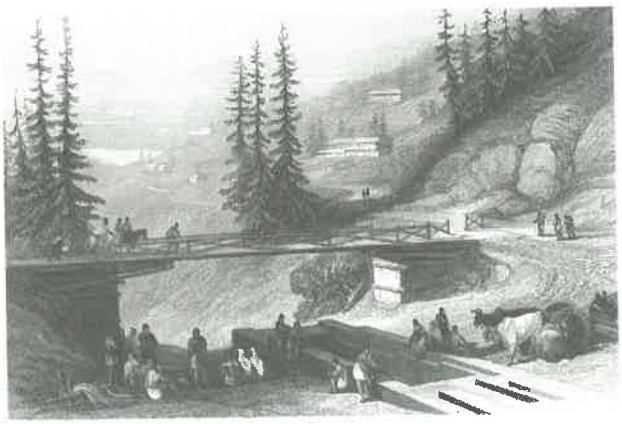
- Reminiscences
- Photo Memoirs of CPRI
- Impressions of Visiting Dignitaries
- Awards Owned by CPRI Scientists
- Roll of Honours of CPRI Scientists

Shimla - The Abode of White Godlings

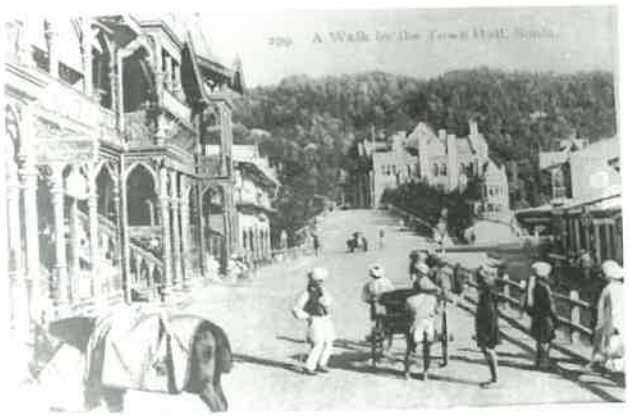
Shriniwas Joshi
Former Spl. Secretary
Govt. of Himachal Pradesh, India

If a story is told of a kingdom whose capital was in a wintry place where there was no electricity, no regular water supply, and no proper roads or heating arrangements, one would think of a location in a long lost era. Could it be one of the Roman cities that one had seen in a Hollywood film where the guards used to light the torches on the walls at the fall of darkness? And when it is told that it was Shimla, the capital of India also called the abode of white godlings, one starts scanning the pages of history. The year 1864; the Governor General and Viceroy Sir John Lawrence wrote to Sir Charles Wood, the Secretary of State for India, that it was impossible for him to work in hot and sticky Calcutta in summers and he wished to spend the 'season' in Simla or else he resigned and returned to England. The Secretary of State apprehending losing a hard taskmaster agreed with the proposal thus opening the gateway for members of the Council also to join their Lord at Shimla. A tiny hill station becomes the summer CAPITAL of India. There was no electricity in the town. A small hydro-electric station built at Chaba utilized the waters of a perennial rivulet Naoti to electrify Simla on the 15th. July, 1913. Prior to that, important buildings were lighted through their own generators. Viceregal Lodge, now Indian Institute of Advanced Study, was the first house in Shimla with an electric system in 1888 and about one thousand bulbs of 16 candle-power each were installed here. Lady Dufferin, the first occupant of the Lodge, was thrilled and she writes, " — and the lighting up and putting out of the lamps is so simple that it is quite a pleasure to go round one's room touching a button here and there."

There were seventeen *baolis* -spring water sources- and several *bhistis* -water carriers- for supplying water at houses. The principal *baolis* were at Combermere Bridge and the Ram



Combermere Bridge connecting Shimla with Minor Shimla, 1929



Old Town Hall of Shimla

Mandir Complex near the Bus Stand. Attempts to offer piped water supply began in 1884 with construction of water storage tanks at Sanjauli and then installing pumping engines at Cheroot Nallah. The water tax was first levied in 1900-01. Properly dressed roads started coming up after the declaration of Shimla as summer capital though Combermere's legacy of the bridge and Jakhu round was ready by 1828.

Dane Kennedy says in *The Magic Mountains*, "Roads and bridges had to be constructed, land cleared and dwellings erected, provisions produced and marketed, visitors and their baggage brought up, fodder and fuel and water provided, and a myriad of domestic drudgeries carried out. These tasks the British relied upon Indians to do, and in large numbers. Hill station censuses suggest that at least ten Indians were necessary to support each European. The *Times* war correspondent William Howard Russell and a friend rented a house in Shimla in 1859 and employed thirty servants, including ten wood-cutters. Russell wrote pieces in superb English from here, the style emulated by many a journalist of his times. A pleasing description of Simla at first sight is, "at a turn of the road, I catch sight of a conical hill, covered with a deluge of white bungalows, dominated by a church behind, and above which again rises a steep of sugar-loaf of fir trees. 'That is Simla! There is Mount Jakko!' I replied with pleasure and thankfulness. To taste such pleasure, we must be sick, wounded, roasted, and worn-out in the dreadful plains of India." He had come wounded to Shimla. His thoughts on rains in Simla are charmingly word- pictured by Pat Barr as, "the low dense clouds had fallen into bed with him; they seemed to have settled in his very boots, and his dressing-table was dank with their dew. The valleys shone green and fresh, the slopes of Jakko were enamelled with wild geraniums, hill anemones, columbines and pheasant's eye, and the effects of the high-banked clouds tinted with rays of occasional gold and pink light over the distant mountains were magical."

No write-up on British Shimla would be complete without the jottings of Rudyard Kipling. He with his parents came to Shimla for the first time in the summer of 1883 and then became a regular summer-bird from 1885 to 1888. Shimla for him was a "centre of power as well as pleasure" and prominently figured in many of his works. No other English writer sold Shimla to the English speaking foreigners as ably as Rudyard did. He rebuts the men in plains,

"Men say, who simmer in the plains below, That Simla people frivol. Be it so."

He loved to be in Shimla during his one month leave in summers. It was "pure joy - every

The Ridge Church, Shimla

Toy Train on Kalka-Shimla Route

In the Institute, Dr. Nagaich (who was earlier the Head of Plant Pathology Division and then the Director of the Institute) in view of my virus background from Prof. K.S. Bhargava's Lab and also two years of post doctoral work in Japan, depended too much on me. He also trained me in practical field virology and diagnostics to a great extent.

AICRP on Potato was initiated in 1971, before I joined CPRI, with Shri L.C. Sikka as the Project Coordinator. It aimed to test and conduct adaptive as well as strategic research on all India-basis representing all potato growing zones. My close ties with Shri Sikka, also the Sr. Chief Production Officer made me well aware of the field problems in the crop. He would discuss at length about his own vast and long field experience in India and the seed training in Canada. Both Dr. Nagaich & Shri Sikka were the core members of the team that brought about Seed Plot Technique, a break through that formed the basis of bringing about potato revolution in the country. Certainly, the pioneering observation of Dr. Pushkarnath & his team (including Dr. R.P. Chaudhuri) based on their classic experience that produce from apparently healthy plants in the hills when grown in aphid free period (main autumn crop) in NW plains (say Jalandhar) proved to result in a very healthy crop, not only quick in growth, and early in maturity but high in yield as well as the produce could be cold stored long enough as 'seed' for the next year.

It was my luck to personally see Dr. S. Ramanujam, founder of CPRI/'father' of potato research in India, on his visit to CPRI in 1975 for QRT. If I remember correct, he was the chairperson of the team and despite old age his enthusiasm was 'contagious'. I found him very sincere and earnest in his approach. Though busy, he allowed me a brief discussion on my doubts regarding future of potato. He observed that potato viruses mainly X, S, Y and leaf-roll took a heavy toll of the crop but it was less than late blight, if it occurred, and also charcoal rot if the spring/crop was not harvested timely. Further, he clearly opined that bacterial wilt or brown not, could be checked best through healthy seed and crop rotation. He also laid emphasis to work on early aphid warnings and late blight forecasting.

Dr. Hari Kishore, Head, Plant Breeding & Genetics Division, was well trained but could not achieve much in CPRI despite his long innings. On retirement, he joined CIP as the Regional Scientist, yet CPRI did not benefit much. I think it was because of his personal differences with Drs. Nagaich, Sikka, Upadhya etc.

Shri Sikka, renowned as a field scientist, was a great asset to CPRI. He was associated with selection of the most predominant varieties like Kufri Chandramukhi, Kufri Jyoti, Kufri Sindhuri and strengthening nucleus/breeders' seed production program. After retirement, through his long association with CIP in Nepal, Bangladesh, African countries helped benefit them through his vast research experience and adoption of the varieties from CPRI.

Considering potato late blight as the number one problem of the crop, at that time everyone used to ask why can't we have/not been able to have many late blight resistant Indian varieties? Luckily CPRI's collaboration for screening against late blight in CIP-Toluca Valley, Mexico got replaced and became easy with the identification of the Indian "Hot-Spot" at Shillong in addition to testing in fields at Kufri (Shimla) and Darjeeling hills wherein Drs. Bhattacharyya/Bir Pal Singh; R.N. Khanna and Shri P.G. Phadtare worked for long periods. Their work led to identification of many new hybrids/varieties that have now helped replace Kufri Jyoti.

Since India has much more potato area in the plains (90%), top priority had to be given for breeding varieties that would tuberize well under short days of mild winter, often killing

the vines due to frost in end of December/beginning of January. Naturally these conditions were different from that in hills. But a compromise could be made, rather was essential in view of late blight becoming an annual feature in the plains. And due to water availability getting scarce everywhere, breeding for day-neutral varieties possessing late blight resistance and a reasonable tolerance to drought called for much intensified search. Dr. M.D. Upadhya, a breeder with CPRI, shifted to CIP in 1980, strongly felt that it is possible but may not be worth the effort and time. He devoted much time working on TPS populations, which was first tried by Dr. S. Ramanujam, the founder Director, but then found ineffective. TPS populations being heterogeneous could escape late blight to a great extent as well as avoid the problems in production and maintenance of large volumes of healthy tuber seeds and their cold storage as well as transportation. Notwithstanding this, TPS technology could not pick up well because extra 4-5 weeks are required for developing seedlings, and their poor survival/stand upon transplanting. Despite prolonged research/effort by CPRI/CIP, the technology has not picked up as expected, at least with the farmers in NW India. My having visited all potato growing areas, as the P.C. &/or Director over 10 yrs, revealed that farmers did not want to continue with TPS after 2 or maximum 3 years. However, it has been adapted to some extent in NE Hills in India and also some parts of Africa for large scale cropping.

Most of the directors, viz. Dr. M. Singh, Dr. Nagaich, Dr. Nair and Dr. Grewal, believed that we were doing very well for achieving required potato growth in the country. It could be easily achieved with enhanced supply of healthy seed of desired varieties and countrywide application of the available agronomic & plant protection measures.

Research on potato varieties and enhanced seed production was therefore the most important. CPRI research got a fillip upon joining of Dr. N.M. Nair in 1982. He brought a radical shift in the thinking and working of the Institute scientists. He catalyzed and infused very analytical approach in planning of the research projects and was not only meticulous but also highly critical while frequently reviewing our achievements. He was a hard task master making everyone accountable. I remember that he started holding not only discipline wise meetings but also invited all scientists to Annual Research Council meetings. He believed that this kept the scientists ever alert and productive in research. And it shall improve the quality & quantity of basic seed production by the Institute. To a great extent, he was successful. But all this invoked a lot of dissatisfaction among the staff including the senior most scientists. Notwithstanding the above, he must be credited with shaping CPRI's R&D functions, had many achievements in his 7 years tenure that brought about a paradigm shift, such as encouraging innovative research and high profile activities through better HRD, revamping execution of research projects, facilities, seed production/distribution, increased financial support, etc. He was directly responsible for initiating an Institution-Industry linkage. And managed to get a number of grants, encouraged scientists for effective communication yet his pursuit for perfection hindered various achievements by CPRI, e.g. a reference book on potato that was compiled but never got edited or published.

Dr. Shekhawat had developed the integrated package for bacterial wilt/brown rot endemic in the mid hills. As the Director, he, however, had the bright idea of diversifying research at a faster pace especially for processing/exporting the produce to check unwanted periodical gluts. This called for not only developing indigenous processing varieties but also search of areas suitable for production of potatoes for chipping and French fries i.e. potato varieties having ideal shape, size, high dry-weight, less reducing-sugars/enzymatic discoloration.

I made good team with both Dr. Grewal (Director:1989-1994) and Dr. Shekhawat's tenure

(Director:1994-2001). In their time, CPRI got various developments and had smooth sailing with remarkable growth, despite a continued retirement/transfer of scientists decline in number. Both achieved higher targets in seed production and brought Laurels to the Institute for quality & quantity both through new varieties, enhanced seed production excellent publications, including a Reference book in 1993 (ed. by K.L. Chadha & J.S. Grewal) and the Global Conference (1999).

A special mention may also be made of late Shri M.L. Khanna and Dr. B.L. Dutt who had retired before I joined CPRI of their helpful guidance to me as a friend and philosopher in several ways. Similarly the lasting impressions of working of both Dr. S.C. Verma (Biochemist) and Shri A.K. Singh (Sr. CPO after Sikka Sab) must be recorded. Besides, I shall also like to atleast mention here the names of both Dr. K.P. Sharma and Dr. P.C. Gaur, my predecessors as the PC (Potato).

Having run the All India Coordinated Potato Improvement Project since 1994, I also took over as the Director, CPRI in Jan. 2002. It was not an easy task to perform dual duties of both the PC and the Director. To do it to the best of my capability, I collected all my nerves and energy. Thanks to the God that I succeeded. It was mainly due to my positive approach and the collective wisdom of the colleagues at the Hqrs and regional stations as well as magnanimous support from ICAR esp. the DDG (Hort.) firstly Dr. K.L. Chadha, S.K. Ghosh and then Dr. G. Kalloo. Over the entire period of 10 years (1994 onwards) I was able to regularly add/update the Institute work plans, organize the AICRP workshops and recommend/approve technology and for release of the hybrids/varieties. Here I would not like to write about my personal research achievements that may seem to brag about myself. However, some of the developments in the Institute's different stations esp. – Kufri, Ooty, Patna and Shillong, extension/renovation of old buildings/labs., updating the museum/extension division's activities, compiling the text book and also developing an e-book on potato, during my period must be placed on record.

My colleagues like Drs. I.D. Garg, Sarjeet Singh, Birpal Singh, M.K. Dhingra, R.P. Rai, (Late) M.N. Singh, V.C. Sharma, Rajpal Singh, R.K. Arora, A.V. Gadewar, Shiv Kumar in pathology were quite supportive and made an effective team in many ways. Similarly senior scientists Drs. G.S. Kang, S.K. Pandey, S.V. Singh, K.R. Dhiman, V.K. Garg, K.S.K. Prasad, V.S. Kushwaha, T.A. Joseph, P.H. Singh, P.S. Dahiya, Jai Gopal, P.S. Naik, S.K. Chakrabarti, Librarian S.R. Yadav, Er. R.K. Chauhan, while Drs. Janardanjee, V.K. Behl, D. Sarkar, D. Patnaik, S.K. Kaushik, K.D. Kokate, N.K. Pandey and many others were quite helpful & instrumental cooperators.

The most unpleasant memory that haunts me and worth placing on record is that during Dr. Nagaich's tenure (1975-1981) he forced punctuality that was much needed, yet lack of flexibility in his approach led to a feeling of resistance at heart. It resulted in lack of team work and affected service(s), because he gave little freedom for innovations. There was a lot of turmoil and strike by the staff union & lower staff during April-May (June) 1978 brining about bad name to the institute. Though he had to resist too long still he succeeded in executing many new ideas, esp. for campus/infrastructural development, met many long awaited requirements and successfully organized/brought about conferences/publications and even held an international seminar (1978).

It was certainly a great event for me to organize the Birth Centenary for the founder Director of CPRI, Dr. S. Ramanujam in Oct. 2003 that was well attended and was marked by the personal presence of not only gracious lady Mrs. Vedam Ramanujam (almost 90) who came

all the way from USA but also the daughters & son-in-laws as well as the grand children of Late Dr. Ramanujam. It was indeed nice to have his bust unveiled by Mrs. Ramanujam; a Potato Varieties' Monument dedicated by DDG Dr. Kalloo and a Text Book on the Potato released by Dr. Mangla Rai, DG, ICAR/Secry. DARE, GOI. I was also lucky to receive the firstever Dr. Ramanujam Memorial Award & the cheque for Rs. 50,000/- for contributions to the potato R&D in India.

I joined CPRI when it was preparing to celebrate its silver jubilee (1949-1974). Since then I wished to be also associated with the Golden Jubilee of CPRI and that came true. Not only this, we first celebrated the Golden Jubilee of Potato Research in India (1935-1985) led by Dr. Nair, and then Golden Jubilee of CPRI.

With all humility, let me also place on record some of my other worth mentioning achievements: Celebration of Golden Jubilee of CPRI together with Silver Jubilee of IPA that included the Global Potato Conference, publication of its proceedings in two volumes (total 1300 pp) and compilation of a text book (2003), Hand book (2007). Held many symposia by IPA. Institution of awards in the name of Late Dr. S. Ramanujam and Late Mrs. Kaushalya Sikka for promoting & encouraging excellence in potato R&D. Adding/starting a robotic ELISA seed testing lab, construction of germplasm lab, additional four storey building for Administration/labs. Selection & release of almost 12 potato varieties including the first ever Indian potato variety for French fries. Brought new schemes and helped develop state of the art lab facilities, updated biotech equipments/capabilities. Initiated effective collaborations leading to quality output/publications. Acquiring/taking possession of the farm land (between Kufri & Fagu) that was forested, having been granted by H.P. Govt. almost 30 years back but forgotten due to lack of an approach road, etc.

Owing to its work culture/achievements, CPRI has a great reputation/goodwill. And I got more than enough opportunities and the recognition in CPRI. That has given me all that I wished and have achieved. Certainly, working in CPRI brought about a lot of satisfaction in life.

But let me add about the repression I had to face for new/non-conforming data/reports. First one I remember candidly was with regard to the high incidence of PVX/(±PVS) in certain potato seed stocks (that were detected biologically by me) but were not agreed upon in the SRC by the "tall" personalities. Similarly, when I first observed/recorded the viroid's association in 1989, with the veinal necrosis in some wild *Solanum* spp., I was told not to speak of it in "national interest". And my test plants in glass house were destroyed/thrown away. Also the relevant part from the Annual Report deleted. It look several years of repeated detection, that too confirmed by sequencing by an Authority in USA, for those to agree who mattered.

Let me conclude with the following 'mantras' – out of my experience – for all, not only in CPRI, but any where to be successful in life :

i) Have the will to work, faith in self, and hope to succeed.

ii) To be successful, three things are must : Desire, Devotion, and Discipline.

iii) Industry, independence and integrity lead to sure success. Also a) embrace change, b) seek learning, c) work in diverse teams, d) use simple language that others will follow, e) take risks, and pursue your passions.

Reminiscences With CPRI

KR Dhiman
Ex Head, CPRS, Kufri &
VC, Dr. YS Parmar UHF, Nauni (Solan)

A Ph.D student of Genetics, I was selected as Scientist S-1 genetics and cytogenetics in the first batch of Agricultural Research Services and joined at Central Staff College for Agriculture at Hyderabad on 1st Septenber,1976. Since it was beginning of the Agricultural Research Services in the country, was a new experience for all in the council. Quite frequently we were reminded of parallel status of IAS and were expected to behave the same way. In between the training programme, I received the posting orders from Director, Central Potato Research Institute, Shimla indicating my posting at Central Potato Research Station, Shillong Meghalaya which I accepted with pleasure. The training at Hyderabad went very well and we dispersed in the last week of December, 1976 to our respective places.

By the end of December, 1976 I reported at Central Potato Research Station, Shillong which is 5km from the Shillong town on the Cheerapunji road , also called Barua farm as Shri B L Barua has been heading the station since its inception. It is a small station but quite important. Potato has been cultivated in the region quite far some time even before the north-western part of the country and most of the European varieties were being cultivated in the region which were not only low yielders but also highly susceptible to late blight(*Phytophthora infestans*) which is most prevalent disease in the north-east.

Having done M.Sc in pulses and Ph.D. in bajra, potato was a new crop for me but thanks to Late Shri S K Anand, Miss Hema Prova Bora and some casual workers who taught me about potato cultivation, hybridization, late blight and other aspects of potato research. My predecessor (Late Shri S K Anand) had developed a good number of high yielding late blight resistant lines which were at F1 stage and one of the progeny has been released as K. Megha. I also started hybridization from the first year itself while using the well established parental lines and produced large number of hybrid seeds every year which were grown in the seedling trays initially and transplanted in the field thereafter. Since Shillong had congenial climatic conditions for late blight screening, a good number of late blight resistant lines were identified. Besides late blight bacterial wilt (*Ralstonia solanacearum*) has been another problem of the region and till date we do not have any bacterial wilt resistant line or a good source of genetic resistance to this disease. The breeding programme at dihaploid level while using diploid wild species was started and some tolerant lines were identified.

Till late 70s farmers in Meghalaya and other parts of the region have been cultivating old European introductions, but the starting of prestigious programme Lab-to-Land during Golden Jubilee year of Indian Council of Agricultural Research proved to be boon for major varietal shift from traditional varieties to K. Jyoti which was high yielding and resistant to late blight.

Regional botanist asked me to start the Lab-to-Land programme in Meghalaya but I was cautioned not to adopt Myliem area as our predecessors did not have the good experience of working in that area. When I visited the area first time, I was not allowed by the village

headman to enter the village as I was non-tribal. Then we decided to send potato seed and fertilizer to all the households first and then to go to the village for discussion. We were welcomed in the village and the programme took off very well. I introduced pre-paddy potato cultivation in the valley area with K. Jyoti and paddy-cum-fish culture in the *kharif* season. Worked at Shillong station for more than five years and was transferred to Central Potato Research Station, Patna (Bihar) and after serving for about 10 months at Patna was selected as Scientist S-2 (Plant Breeding) in ICAR Research Complex for NEH Region with posting at its Sikkim Centre, Tadong. During July, 1990 joined at Central Potato Research Station, Kufri after inter-institutional transfer and started working on breeding varieties for virus resistance. Since 90% of potato cultivation in India is done under sub-tropical conditions where degeneration of yield due to a complex of viral diseases is very common, most of our varieties have degenerated significantly to a uneconomic level of production. Although a good number of germplasm lines are available having resistance to one or the other virus but the incorporation of this trait into high yielding varieties is of prime importance.

Central Potato Research Institute is one of the oldest institute under Indian Council of Agricultural Research and its systematic potato development programmes has revolutionized the potato cultivation in the country and has converted a temperate crop into sub-tropical crop through the incorporation of genes from different sources. Since Indian climatic, cultural and sociological diversity is associated with the agricultural constraints and the efforts of the Institute has clearly defined these locale specific problems and developed the varieties/ technologies to overcome them. The problems are region specific viz; short duration or early maturing varieties for north-western plains, late blight resistance for hills, wart resistance for north-Bengal hills, nematode resistance for Blue Diamond hills, red skin character for eastern India, heat tolerance for Deccan plateau and low sugar and high dry matter for processing purposes. Till date, the Institute has released 45 varieties suitable for different agro-climatic conditions and now potato can be widely cultivated all over the country. Not only the traditional development programme of varietal development, production, protection and processing technology but also with the application of modern tools of micro-propagation and biotechnology, the Institute has attained new heights.

Our country requires about 2600t of breeder seed for meeting the national requirement of quality seed. It was the first Institute to have Revolving Fund Scheme on breeder seed production and today supplies the breeder seed of different varieties to all state Governments for further multiplication and distribution to the farmers. This is one of the best seed production programme not only in India but in South East Asia. The institute has been blending its ongoing programmes with latest technologies of micro-propagation/biotechnology for its technology upgradation. The traditional method of seed production is being replaced by micro-propagation to ensure the quality and the quantity of the breeder seed and a time target of five years has been fixed for the same. The various programmes of potato development are well nit and interdependent eg; germplasm collection evaluation and conservation, utilization of genetic resources for crop improvement, development of production and protection technology for newly developed varieties, breeder seed production of these varieties and their further popularization through extension machinery and to further refine the technology after feed back from the end users, which is a complete development mechanism for any crop improvement activity. I understand, in all the crops similar strategy has to be followed for systematic improvement.

With the efforts of CPRI today potato is being cultivated almost round the year in one or

the other part of the country and there are varieties suitable for different agro-climatic zones with desired characters. Today the institute is working on bio-technological aspects to incorporate traits which otherwise through conventional breeding could not have been possible like varieties tolerant to cold induced sweetening, bacterial wilt resistant, high protein content, heat and draoght problems and so on. The genes regulating these processes have been identified, cloned and have also been transferred to the desirable genetic back grounds and are being evaluated for their expression.

Institute's congenial atmosphere, the vision of the scientists and their systematic efforts shall further revolutionize the potato development in near future to achieve its target to double the potato production in India.

I wish good luck to all associated with potato development.

Memories of CPRS, Kufri

SK Sharma
Ex Head, CPRS, Kufri &
Director, NBPGR, New Delhi

I joined the Central Potato Research Institute, Shimla as a Scientist S-I during 1976, while being enrolled as a Ph.D. student in PG School, IARI, New Delhi. It being winter and consequently the scientific activity at rather a low ebb, I used the time gainfully in writing and submitting the thesis before the Institute picking up the momentum in the month of April with the onset of summer. Dr. B. B. Nagaich, the then Director told me to work and occupy the official accommodation at CPRS, Kufri, a place housing the Potato Hybridization Garden. I worked at the Kufri station till October, 1980 before moving to HPKV, Palampur, to take up a new assignment, where I spent 25 years before assuming the present position in ICAR in 2006.

I was in fact a stranger to potato and hence spent the first crop season in close association with Mr. K. C. Singha, Technical Officer and Sh. Prithi Chand, Beldar. The latter, though illiterate, did have however, the uncanny sense to remember the distinguishable characteristics of many accessions in the germplasm collection. During my long stint at the HPKV Palampur in different positions and even now, the thought of CPRI as my second home has always remained ineluctably glued to my memory. My initial stay of about 4 years at CPRI was both fulfilling and rewarding in a myriad ways. As a young scientist, I was exposed to the nitty-gritty of administrative, management and developmental work in addition to the practical scientific and field activities. The vital experience gained during those formative years has stood me in good stead in the later years of my professional innings.

At Kufri too, the winters used to be quite severe causing deceleration in scientific activities for about 3-4 months. I used to devote a lot more time during that spell in reading and writing. I vividly remember the chowkidar Mr. Sukh Pal Negi burning Bukhari in my room for the much-needed warmth, while incessant night-long precipitation outside had piled up snow to about 4 feet in the morning. There was no library facility at Kufri then, necessitating frequent visits by me to the CPRI, Shimla to keep myself abreast of the scientific developments and browse through the circulars etc. of CPRI/ICAR. In the winters I used to trudge the entire distance of about 8 km in the morning on foot from Kufri to Dhali, returning in the evening. At times, there was a dearth of essential food items, power, water etc. for days together at Kufri due to heavy snowfall. Inspite of all these constraints, my spirits never flagged and I toiled on.

It was a great pleasure to work with Drs. M. D. Upadhayaya, L. C. Sikka, A. K. Singh, K. P. Sharma and many others. After being at HPKV, Palampur, I did not ever let my relationship with CPRI snap. During my official visits to Shimla, I invariably stayed at the CPRI Guest House, took delight in interacting with the scientists there and also spent a few hours in the library, which is probably one of the best in Himachal Pradesh. Creditably enough, it has all the national and international journals, books, literature, information etc., relating to potato.

I am profoundly happy to see the growth of this Institute as a vital hub, both in terms of infrastructure as well as the scientific activities being carried out here. The Central Potato Research Institute has kept the flag of 'Potato' flying high, even well beyond the Indian shores. Realizing the importance of potato as food, FAO has very rightly declared the year 2008 as the International Year of Potato (IYP) and CPRI has taken the lead at a global level to organize "Global Potato Conference -2008".

May Providence bless and inspire the CPRI and its staff in their noble mission to address the future challenges of enhancing productivity and profitability of this important crop in the newly emerging world order!

Memoirs of CPRS, Jalandhar

OM Bambawale
Ex Head, CPRS, Jalandhar &
Director, NCIPM, New Delhi

I began my career at CPRS, Jalandhar in 1978 and in the same year witnessed the International Conference on Potato organized at such a tiny but strategically important research station. I could get familiar with all my colleagues from other regional stations and a large contingent of potato researchers from India and abroad. I could also understand the important role played by the seed industry in improving productivity, and feel their gratitude towards the scientific community as they had organized memorable field trips. The event instilled in me a sense of team work as my colleagues set a very high standard of joint efforts in organizing the big event and raised my self esteem many folds. I became proud of my crop and it prepared me to go for contributing something for this crop.

One good thing about a regional station for a young scientist is that there are hardly any distractions; hardly any visitors. As a result we forged very good rapport amongst the colleagues, a good sense of belonging to the system and could focus on our own work at a leisurely pace and also could spare time to seriously know about the work of other colleagues and offer suggestions/unconditional help and encourage them in difficulties. I can readily think of a number of my colleagues who set for me high standards as role models, and who shaped my attitudes towards science. Dr J.J. Solomon had prepared just a one para annual report on his work of commissioning the ultracentrifuge (lying idle for long) and the quantity and titer of the antiserum, instilling in me a sense of modesty. Dr M.S. Rana, Head of the Station, proved to be a very likable leader who would oversee the activities of the station in a friendly manner without making us realize the enormity of the task. Dr M. Shyam and Sh. Rajinder Singh, managing the engineering workshop and mechanization part of potato cultivation, and involving me in developing a spraying machine, seed treatment plant, and ozone generator chamber; Drs H.N. Kaul and Ashiv Mehta working on indigenous storage system and taking us once in a while to their facilities and welcoming our suggestions; Dr N.L. Meena and Shri B.S. Bhullar managing the seed production and overawing us by their busy schedule and heavy work load; Dr R.S. Marwah with his trips to the agriversity at Ludhiana on weekends to carry out chemical analysis, coming back and again working; Dr Jai Gopal for his germplasm and photoperiod studies; Shri Saini and Dr Govindakrishnan for the long-term agronomic experiment and keeping the farm in excellent condition; are some of the vivid memories I cherish. We had a large contingent of plant pathologists at Jalandhar comprising of Dr Vashisth, our Head, Dr V.C. Sharma, Dr J J Solomon for a short time, Dr B.L. Dhar, Dr A.K. Verma, Dr A.K. Somani and myself. The major task was the nucleus seed production and Foundation Seed Certification and we used to help the core team with serological testing and survey and monitoring of seed certification. We could learn critically what is meant by a seed certification system, how to prepare antisera, and the significance of seed production in lifting the overall potato production.

We used to be a part of various teams going for the purchase of bullocks, bamboo, sale of various farm produce, and we used to willing share the responsibility entrusted to us by our Head. We experienced a high level of local political unrest during 1984-87 but still we used to carry out all our duties including the field surveys, etc., and mixing with the farmers. I remember even going several times with the fleet of vehicles, the jeep, tractor and the truck of the Centre to the Bank at the Jalandhar town to camouflage during the disturbances. I was also in charge of the cold storage, which held the precious nucleus seed and other planting material, and this instilled in me a high sense of responsibility. The Engineering section used to give me a lot of support.

During the first four years of my stay at Jalandhar, Dr B.B. Nagaich was the Director, and subsequently Dr N.M. Nayar took over. These two leaderships shaped the destiny of the potato crop as a whole and also influenced us highly positively. Nagaich Sir was instrumental in forging the seed production system in the country on scientific lines. Nayar Sir systematized the energies of the individual scientists. He encouraged frequent interactions amongst the scientists by way of annual research council meetings (ARCOMs) and the Division's meetings. He encouraged the scientists to take up tours and take writing of their reports seriously. The quarterly and annual reporting of the projects was streamlined.

As of my scientific contributions, I think I could do a proper justice to my task at that time mainly because of the conducive and positive atmosphere at the Station and in the Institute as a whole. There was a high level of continuity of efforts with regard to the late blight epidemiological work and I could generate meteorological information for 8 years in a row. I also could find out the ozone injury on potato, which happens to be as sensitive a biological indicator as Virginia tobacco Bel W3, to the ozone generated in the troposphere because of high automobile activities. This work had a sound scientific foundation of ozone measurement, symptom reproduction, and managing the leaf spot with ozone specific chemicals. A good number of papers were published and are even now quoted globally. This work instilled in me a high level of self-confidence. I continued the attitude even after leaving CPRI in 1987 to readily accept working on insect pathogens at cotton institute, Nagpur; changing the course of my future career.

I owe whatever little I could achieve in my scientific career to my initial grooming during the formative 9 years and the superb atmosphere I had at CPRS, Jalandhar and the Institute as a whole. I rate it as the golden period of my career now spanning 30 years!

My Reminiscences of CPRI

NM Nayar
Former Director, CPRI

I had 3 stints in CPRI: during 1963 -1966 as Cytogeneticist, 1968 -1970 as Geneticist, and during 1983 -1989 as Director.

I joined as Cytogeneticist on 01 August 1963, after I was selected to the post in absentia by the UPSC (CPRI was then directly under the Union Ministry of Agriculture). I had applied to the UPSC for a position while doing my PhD (Plant Breeding/Botany) in the USA. The late Mr M L Khanna was the officiating Director at the time of my joining. I arrived in Shimla by train on 31 July 1963 in the afternoon, and proceeded directly to CPRI. Mr Khanna was good enough to immediately arrange my accommodation in the YMCA and leave me there later in the evening.

The late Dr Pushkarnath was the regular Director then. He was a good organizer and administrator, but was a 'terror' of sorts to the scientists and staff. He also used to expect every scientist to give him co-authorship in their research papers. The Genetics -Plant Breeding and Entomology -Nematology Divisions were located in the Lower Laboratory at that time. I initiated 2 research projects, Interspecific relationships in tuber-bearing *Solanums* and Induced mutagenesis in cultivated potatoes.

In the latter project, my immediate objectives were to standardize dosages of radiations and chemical mutagens and also obtain nonred tubers in Kufri Red variety. In the 3 seasons that I worked as Cytogeneticist, I was able to achieve both these objectives (and also more). I was also able to publish 3-4 papers during the period. At a personal note, I got married in Janurary 1965 while working as Cytogeneticist.

During mid-1968, I was appointed in CRRI Cuttack as Senior Research Officer in a new mutagenesis project in rice. I worked in CRRI for 20 months. Soon after I returned to CPRI in July 1968, I was selected for a higher grade post of Geneticist in CPRI. By this time, all the institutes under the Ministry of Agriculture, including CPRI, had been transferred to the ICAR, and the recruitment of scientists had also been transferred from the UPSC to the ICAR.

This was my second stint in CPRI. Dr Pushkarnath had superannuated in the meanwhile and Mr M L Khanna had taken over as acting Director. I was given charge of the library and vehicles and was also allotted a room in the administrative block, where I used to sit in the afternoons. I continued my researches in the 2 projects that I had started during my first stint.

In early 1970, the Alexander von Humboldt Foundation Germany, jointly within the Ministry of Education, Government of India, selected me for a senior post-doctoral research fellowship tenable in West Germany. I chose to work in the University of Goettingen, which has the distinction of producing the most number of Nobel laureates in Germany. At Goettingen, I worked on cell division synchrony. I worked in Germany close to 3 years.

The highlight of my tenure was the celebration of the golden jubilee of potato research in India on 01 April 1987. This consisted of a Group Discussion on the future of potato research in India that had two-thirds expert participants from outside the country, and issue of a commemorative stamp and first day cover on the occasion.

Towards the end of my tenure, I was the Member-Secretary of a Quinquennial Review of the Institute. Its important recommendations included upgrading the Modipuram station to be the headquarters of the Institute and winding up the Darjeeling, Mukteswar and Rajgurunagar stations. The plans for setting up a major seed farm for peninsular India (in Hassan Karnataka), which had reached an advance stage (including the sanction of Karnataka government to hand over 120 ha land) at the time of my departure was aborted after I left CPRI, I learned later.

During my tenure at CPRI, I was assigned also the responsibility to set up the NRC Mushroom at Solan from scratch. The work began by taking over some building and land from the Solan Agricultural University, transferring 16 scientists from CPRI, exposing and training them in mushroom culture, and so on. I continued to be in charge of the NRC-M for close to 4 years, including 2 years even after a regular Director had been appointed there.

When I completed the tenure in mid-1989, I was appointed successively as Director of 2 new research institutes being set up, on cashew and spices. I declined the offers, and chose to return to full time research. I then joined IARI, the first and still the only Director to return to research.

I continue to do full time research now also working (and publishing) mainly on crop plants evolution, biodiversity and environment issues.

My Reminiscences of CPRS, Modipuram

J.B. Misra
Actg. Director, NRC for Groundnut
Junagadh-362 001, Gujarat

The year was 1976. After qualifying the first all India ARS competitive examination and undergoing a training for three months at the then Central Staff College for Agriculture (now known as NAARM), Hyderabad, I a bachelor, 25 years of age, joined Potato Experimental & Trial Centre (PE&TC), Babugarh- my first posting in the month of December. The PE&TC, which does not exist any more, was then a regional research station of CPRI and was situated about 11 km from Hapur on Delhi-Garh Mukhteshwar highway in the western UP. Hapur which is now part of district Ghaziabad was then a *Tehsil* under the district of Meerut. In a few months of my posting, the station was wound-up and closed forever. The entire personnel and moveable assets were shifted to a new place within the same district at Modipuram (about 70 km from PE&TC) and thus a new station, the Central Potato Research Station, Modipuram came into being in May-June 1977. During the intervening period I had a change in my marital status. Both these changes were for the better.

This new place at Modipuram was 8 km away from Meerut city on Delhi-Haridwar Highway. About 68 acres of land along with a small building (farm manager's office) comprising five small rooms, was handed over to CPRI authorities by the UP Government for establishing the CPRS, Modipuram. The place had acquired its name after a sprawling Modi-Continental Tyre Factory which then existed in the adjoining land.

This small building, without an overhead water supply and with a rural electric supply connection, cradled and nurtured the initial growth of the CPRS, Modipuram. The electric supply used to be generally during nights for 6-8 hours. There were a few residential quarters also at the farm.

We were stationed 8 km from the Meerut city and just a three hours journey from the national capital New Delhi, yet it was a completely rural setting for about first 6-8 years.

Public transport (buses) to city was not readily available even in the day hours. Only the horse-carts, which would carry the farmers along with their farm-produce (mostly vegetables) for disposal in the city, were available for us to commute between Meerut city and Modipuram. Eight long kilometers with the first two kilometers or so patch enveloped in darkness at nights for lack of street lights, made the thought of visit to city, should there be urgency, a nightmare.

Initially there were only three scientists. Mr. S.M. Verma, the Scientist-in-charge of the station was a potato breeder and preferred to reside in the city. Dr. B.N. Singh, the Junior Agronomist and myself, a Junior Biochemist along with some technical, administrative and supporting staff resided at the farm. With the passage of time, the staff strength grew and more scientists from the next lots of ARS joined the station. Dr. Bir Pal Singh (a pathologist, now Joint Director of this station), Dr. N.C. Upadhya (a soil scientist) were among those who joined the earliest. All these scientists chose to live in a sub-urban locality called 'Kankarkhera' aside

of Meerut Cantt. railway station. These scientists used to commute daily by passenger trains plying between Meerut Cantt. railway station and 'Palehra' railway station- half a kilometer from CPRS Modipuram. Incidently, the timings of local passenger trains were in consonance with the duty hours.

Prior to the establishment of CPRS, Modipuram, a Potato Breeders Seed Production Station already existed in Meerut district at Daurala, a place about 12 km away from the CPRS, Modipuram but much in the interiors (about 4 km off Delhi-Haridwar highway). Soon this unit was amalgamated with the CPRS, Modipuram with Dr. S.M. Verma as the overall in-charge and Shri Prem Singh, Scientist Seed Production; Dr. Aqbal Singh, Jr. Geneticist, Dr. M.L. Jeswani, Jr. Pathologist and Dr. B.C. Sood, Jr. Breeder were also included in the team of scientists at the station. Subsequently, more scientists joined and by the time I left CPRS in 1988, the strength had grown to about 20 scientists as I vaguely remember.

Since it was a regional centre, most instructions, both administrative and scientific came from the headquarters of the CPRI at Shimla. At that time, Dr. B.B. Nagaich used to be the Director of CPRI. In those times, the mode of the communication used to be surface mail and telegrams being operated by the Indian Post and Telegraph Department. STD facilities on phones were not available and in case of dire needs, a trunk-call was facilitated by the telephone exchange on prior booking. Computers did not exist, e-mail and fax not heard of and mobiles and internet unimaginable.

There was a lot of input needed to have a proper establishment as there was no proper laboratory or office building, no proper electric supply nor proper residential facilities. It took several years before the new lab building was constructed and equipped with some of the equipments that had been purchased in the meantime and those purchased subsequently. We, the new comers and mostly youngsters, worked as a team under the seasoned and experienced leadership of Mr. S.M. Verma.

Our collective efforts bore fruits and eventually we had a well equipped laboratory building, several sheds, a glass house and a new residential colony and above all a proper electric transmission line. And thus, a working agricultural research station was in shape, although the library was 'weak' and continued to be so and also the electric supply was never satisfactory- not till I left the station in 1988.

I was a born urbanite and had all my schooling and higher education in urban areas and on top of my post-graduate degree from the Lucknow University (a traditional university), I hardly had any exposure to agricultural practices and the role that science was to play in improving the farm productivity. The years spent by me at CPRS, Modipuram were very thrillingly educative for me as they gave me not only an insight into how I could use my knowledge of biochemistry for the improvement of quality of agricultural crops in general and potato crop in particular but also the skills of writing, speaking and presenting my scientific and non-scientific work related to the establishment and development of CPRS, Modipuram. Under the tutelage of Mr. S.M. Verma, I interacted with the local revenue authorities, CPWD authorities, various suppliers of equipments and consumables and the likes. While pursuing my scientific work, I gradually realised the importance of plant breeding around which other scientific disciplines are to generally provide a supportive role for developing new crop varieties and technologies. At that time, the importance of genetic engineering and transformation were not recognized. Once, I do not now exactly remember the year, the workshop of All India Coordinated Research Project on Potato was organized at CPRS, Modipuram. By participating

in the workshop, I had the first exposure to this excellent project which synergized the efforts made by SAUs and CPRI for enhancing potato productivity in the country. It was in this workshop the culture E 3797, developed by Sh. S.M. Verma and his associates, was recommended for release as Kufri Bahar.

As far as my scientific research work is concerned, initially I found it very difficult to take up any work that could be termed biochemistry due to lack of equipments. I did not have even an analytical balance. Gradually, however, the facilities started developing. I still remember the thrill and happiness of having my first *Klett Summerson* colorimeter. I had started my work with determination of dry matter in the tuber samples of potato varieties and gradually extended my work to include reducing sugars, total sugars, sucrose and phenolic contents. I also started my work on enzymes of sucrose metabolism of developing potato tubers. Studies on the effect of storage on the quality attributes of potato tubers were also taken up. Due to poor library facilities, I could not however, publish my work in a reasonable time as I had to depend on the library of IARI, New Delhi for consulting literature. Later after joining, NRCG, Junagadh in March 1988, I had access to the campus library of the Gujarat Agricultural University, Junagadh. I was able to publish most of the work done by me at CPRS, Modipuram in both national and international journals.

I can never forget those 11 years of my life that I spent at CPRS, Modipuram. What a time it was!

The time we worked at all odd hours-depending on electric supply (which was for a short but at unpredicted time) needed to run equipments.

The time that gave us a first hand experience of the old kerosene lantern days- with dark silent nights lying in the open, admiring the star studded sky till sleep overtook us in the back yard of our residential quarters in the rural set up.

The time when we relearned the importance of water for every drop we used was from the hand pump, which thankfully was in the compound of each house.

The time my first child was born, and her baby years, her childhood and her early schooling in that memorable place.

The time my second child was born, and his initial un-forgetful years of pranks and fun.

Housed in the initial years in the buildings/establishments leased by the state government, we were there with no medical help-dispensary or chemist, no grocery or to sum up no proper living place for the urbanites.

And then it was slowly transformed.

Eventually the office building came up. Then the residences-houses with better facilities with water from taps, a proper kitchen and a small play ground and roads.

The Modi Tyre Factory was a great help especially their dispensary that they opened for us too and a school that they later set up.

Today the place is a much changed one. But the days I spent there when we were isolated from the rest of the word yet we were together with others there and had time for each other, time to sit together, to laugh and joke, to celebrate all festivals, planning dinners and other activities, learning from and about each other. And of course searching and eliminating in torchlight the dreaded anopheles species that found their ways into the mosquito nets in the

dark. And not to mention the peace, the silence and the pollution free environment that it offered.

Almost ten years later the place was live worthy. The transport facilities to the city improved, the electricity lighted the houses at night and the fan blades spread cool air blowing away the heat accumulated over the years.

But no fans or air conditioners can blow away the memories of those good old days. Never!

They were more like olden days yet they were good.

They were my years of learning to cope up with all odds.

They were my years of enthusiasm and of using energy in helping set up a station.

They were my years which are a part of me now and shall always be.

And of course when I look back at those years of my youth, there are so many people that I want to thank. Although the list could be a long one, but some names that stand out in the help and guidance they provided, are Mr. S.M. Verma, the Scientist-in-charge, CPRS, Modipuram and at the CPRI headquarters at Shimla Dr. S.C. Verma, Head, Biochemistry and Physiology Division. These persons nurtured and guided the scientist in me. I think I owe them much more than just thanks. Initially Dr. B.N. Singh and later Mr. I.P. Chaube and Dr. S.V. Singh were more of family friends than colleagues.

The very name 'CPRS' even today rings bells in my ears and brings a twinkle in my eye as it browses though the RAM in my brains.

Memories of CPRI

PC Gaur
Ex Head, Division of Crop Improvement
CPRI, Shimla

Thirty eight years' association with a single organization can not be uneventful. I have had my share of good and bad experiences. To relive pleasant moments again will be a blessing. To live the bad ones even once was bad enough, hence I would avoid touching on them.

Mr. M.L. Khanna, the then Botanist at CPRI was the Chairman of the Selection Committee that interviewed me for the post of Research Assistant (RA) way back in 1962. Formal interview over, all the candidates were asked to assemble in conference hall to meet the Director Dr. Pushkarnath. The meeting was introductory and short with only a few informal questions asked. Dr. Pushkarnath appeared an energetic, intelligent but shrewd person who would command attention in any gathering. In subsequent years, there were very few occasions when I interacted with him, except at the monthly meetings held regularly to review the progress of work. In these meetings Dr. Pushkarnath would often pull Heads of sections and the senior staff for various short comings. Experience at these meetings, however, created a fear psychosis amongst staff members so much so that the moment news of his arrival at Shimla railway station reached CPRI, there would be a hushed silence in the institute right up to the lower labs. Dr. Pushkarnath, however, never harmed anybody's career. I admired him for his clear vision and foresight. It was during his period that the "Seed plot technique" was developed and disease free seed production started in plains. Also, it was during his period that several high yielding potato varieties were released. For institute's achievements, Dr. Pushkarnath got all the credit but the success was no less due to sincere efforts and hard work of other stalwarts like Mr. M.L. Khanna responsible for breeding programme and Mr. M.J. Deshmukh looking after seed production, and many more.

Amidst thick forests of Deodar trees, in a clear patch not far from the main road stood a majestic building called Lister House, overlooking potato fields of Kufri and snow clad Himalayan ranges in distance. Not even in my wildest dreams did I ever imagine that I would come to stay at such a desolate place. Within a few days of my joining at CPRI in July, 1962, I along with five other RAs was transferred to Kufri to do the hybridization work. Kufri in those days was a dusty small place with no shops and few people around. There were no medical facilities and no transport available to reach Shimla. A small creaky bus plied between Shimla and Chail once a day and often even that skipped the trip. Often after waiting for the bus we would either return to Lister house, which remained our abode for nearly two months, or marched on foot up to Sanjauli from where we would hire a bicycle to reach up to the Ridge. In those days, the Winter Sports Club was located in main Kufri market but the Rights of Admission were reserved for members only. Since July was an off season for winter sports, the cook cum caretaker of the club, a nice middle aged man called Ram Bhaj, would provide us decent crunchy snacks and some times also the dinner to remind us of the blessings of city life. He was a cook par excellence. Despite various odds and hardships, we the five new faces in

CPRI enjoyed our stay there as we were young and we were in a group.

On the work front, Mr. G.T. Chhabaria, the then RA (Selection grade), under the directions of Mr. M.L. Khanna, would collect flowers of male parents in evening at Lower labs in Shimla and arrange to send these next morning through a labourer who walked all the way up to Kufri to reach there by 8.30 or 9 O'clock to deliver the flowers and the crossing plan that we would execute in the day. Once in a week or 10 days Mr. M.L. Khanna would visit us at Kufri, in an old station wagon, the only vehicle then available at the institute. My stay at Kufri gave me my first exposure to potato crop in field. After this, for several years I continued to go to Kufri during the crop period for laying out trials, attending hybridization work and over-looking other field operations but even today I feel deeply attached to the time spent there in 1962 and fondly cherish the memories of my first visit to Kufri.

"Who wants quality? People want only quantity", this is what I was told when I proposed a project on improvement of quality characters in potato, way back in early 1980s. My plea that potato breeding is a long process hence we must think 8-10 years ahead of our time cut no ice. Some five to six years later, when Indian chipping industry pressed for suitable raw material and wanted to import in bulk, seed of exotic processing varieties for distribution to potato growers did the people sit up to take notice and looked for a suitable variety for processing. There was none, except for Kufri Jyoti to a very limited extent. It was then that I got what I wanted in 1980s, my dream project on "Development of potato varieties for processing purposes". However, the year now was 1990. I thought we were late by ten years. To help me in the project I had two very experienced scientists Dr. S.K. Pandey at Shimla and Dr. S.V. Singh at Modipuram. For next eight years we worked untiringly, developing new populations and evaluating thousands of seedlings every year. On the way, as the material developed, scientists from post-harvest technology and biochemistry also joined the team. Finally, the selected material was provided to chipping industry to get feed back on its acceptance. The outcome was never in doubt. We had developed outstanding varieties for processing, India's first processing varieties Kufri Chipsona-1 and Kufri Chipsona-2 were released for commercial cultivation in year 1998. These varieties possess excellent chip quality, give high quantity of finished product, are capable of being grown in entire Indo-Gangetic plains and are superior to any of the imported chipping variety. It was a major break through that gave fillip to the potato processing industry. Today, the variety Kufri Chipsona-1 occupies nearly a hundred thousand hectares in the country and is sold as a premium potato variety. I retired in January 2000, but look back to some of these milestones with immense satisfaction. It gives me immense pleasure to see that after I retired, my colleagues have not only taken the programme further but have also added several new dimensions to it and taken the programme to new heights.

My Reminiscences with CPRI

SM Verma
Ex. In-charge,
CPRI Campus, Modipuram, Meerut

Dr. S.K. Pandey, Director, Central Potato Research Institute Shimla & Chairman of the Organisation Committee of Global Conference on Potato 2008 has asked me to share my reminiscences and experiences at the Institute with which I remained associated for such a long period of time by way of writing about it in the souvenir proposed to be published on the occasion of the said conference. I feel honoured to do so. True, I claim to be the oldest member of the Institute which I joined at Patna in December, 1949 (the Institute was established at Patna in August, 1949 and later the Head Quarters were shifted to Shimla). I retired from the Institute on 30th November, 1985 from C.P.R.I. Campus Modipuram, Meerut (U.P.) as Principal Scientist where I had been in-charge for the past several years right from the time the U.P. Department of Agriculture handed over to the Institute open land with just one small building (between the period 1957 to 1963 I served the Department of Agriculture, H.P. Shimla, 5 years as Regional Potato Development Officer and one year as Officer-on-Special Duty, Himachal Agriculture College, Solan).

At Patna I had the proud privilege of working directly under Dr. S. Ramanujam, an eminent and renowned Scientist and Founder Director of the Institute. I say directly because since the Institute had just started, senior staff in-between joined much later (I was recruited by Dr. S. Ramanujam as Research Assistant (Botany)). Dr. S. Ramanujam was the first person to propound the idea that potato crop could also be raised commercially from potato true seed in certain areas besides through potato seed tubers, the conventional method. This would eliminate bulky storage and transport problem of seed tubers as also reduce cost of seed. To make the crop reasonably homozygous a few generations of inbreeding was needed. The main hurdle was breaking of dormancy in potato true seed in the plains. The work was started with Phulwa potato variety which flowers and sets berries profusely in the plains. The project of breaking dormancy was allotted to me. As per guidance from him I tried several chemical treatments including chilling in refrigerator. The chilling process worked. I packed the petridishes containing germinated potato true seeds in a bag and rushed straight to his office in Patna Secretariat Complex, about 4 km away, barged into his room and spread out the petridishes on his table. How happy he was I still remember. At the time of interview when he selected me to the post of Research Assistant (Botany) he asked me just one question, "you are posted at Farrukhabad - tell me what is Kalam seed". I answered it fluently and was asked to wait after the interview. I was working then as Botanical Assistant in the Department of Agriculture U.P., Potato Development Scheme since August, 1949 (worked for about 4 months prior to joining C.P.R.I. in December, 1949 -my thesis was also on potato in M.Sc. Agr. Bot., degree). Years later, while in C.P.R.I. service, I attended an interview for Senior Class-I post at C.P.R.I. In the interview board Dr. S. Ramanujam was one of the technical advisors. I reminded him of my initial induction by him -I should not have done that -I was selected. Dr. Mukhtar Singh, then Director, C.P.R.I. was in the board. At this juncture I would also like to narrate how

I was re-inducted to C.P.R.I. after a short stint in Himachal service as above. While in Himachal service I applied for Jr. Class-I Regional Botanist post of C.P.R.I. to U.P.S.C. Dr. Pushkarnath, then Director C.P.R.I. who was in the interview board, pointed out that the post of Potato Development Officer, H.P., also a Jr. Class-I post, was also being filled in this interview, and that whether I would prefer remaining in H.P. service. I pleaded I started my career with C.P.R.I. and would like to come back to my old Institute. I returned to C.P.R.I. thus.

How destiny played its role in my initial induction to C.P.R.I. as also in getting a post of my choice in C.P.R.I. I narrate two incidents. In the U.P. Deptt. of Agriculture, Potato Development Scheme, where I worked for about four months I was initially posted at Kanpur and after one month or so shifted to their Farrukhabad Potato Development Station. While at Kanpur I was housed in a room in the Research Station Campus of Economic Botanist (Rabi Cereals and potato). I was taking meals at the mess of the adjoining Agriculture College, Kanpur. One evening, while taking tea, I found a semi-torn newspaper page and looked at it casually. To my utter surprise I found an advertisement in this torn page -wanted for Central Potato Research Institute, Patna..... With this semi-torn page in hand I immediately rushed to the residence of the Economic Botanist, Dr. A.K. Mitra, requested him to allow me to go to Allahabad, my home town, same night, to bring my credentials such that I could apply for the post. He immediately agreed and forwarded my application. The other incident was when I was selected for the post of Scientist S-3 (seed Production) of C.P.R.I. I was posted at Modipuram, Meerut (C.P.R.I. Station) and started early to reach Delhi for interview same day. At Meerut bus stand I was informed that Delhi was cut-off due to floods and the only way to reach Delhi was either via Agra or via Bagpat where crossing a rivulet on a man's shoulder (trans-shipment) was involved. It seems the one hour bus service at Bagpat bus stand Meerut, trans-shipment labour at Bagpat, one hour bus service at the other end of the rivulet at Bagpat, as also the three wheeler scooter at Delhi were all waiting for my arrival as I availed the services, one after another, in quick succession. After overcoming all these hurdles I reached the place of interview at about 12:45 noon and sent words inside. I was called in -the Chairman remarked, 'we were just closing the interview'. At the end of the interview the chairman said, 'your file has come and you have already got S-3 (plant breeding) post through assessment, but the council wants your services as scientists S-3 (seed production). It was a great offer for me and I took no time in saying yes. Dr. B.B. Nagaich, the then Director C.P.R.I. was on the board.

The working atmosphere in the Institute was very congenial with facilities promptly being made available. I received several recognitions at the Institute for which I am grateful to all concerned. My love for potato and the Institute will always reign high in me. I am confident the Institute will continue to earn more and more fame. I also wish the present as also future staff to come all success and happiness both at work place and home.

Photo Memoirs of CPRI

Dr BP Pal, 1st DG of ICAR with Sh AP Jain, Minister for Food & Agriculture, GOI at CPRI

Dr Pushkarnath, Director CPRI, with Sh. AP Jain, Minister for Food and Agriculture, GOI at CPRI

Dr Pushkarnath, Director CPRI, receiving Rafi Ahmed Kidwai Award (1968) from PM Smt. Indira Gandhi at New Delhi

Dr Pushkarnath, Director CPRI, with Sh. AP Jain, Minister for Food and Agriculture, GOI at CPRI

Sh BB Bhandari, Lt. Governor of HP (Standing 4th from left) with the Director CPRI, Dr. Pushkarnath (5th from left at CPRI with other Scientists (1957)

Dr YS Parmar, CM of HP and Sh. Jagjiwan Ram, Food & Agriculture Minister on a visit to CPRI, Shimla (1976)

Agri. Minister, Sh. Nitish Kumar, HP Hort. Minister Sh. Narendra Bragta, DG, Dr RS Paroda and DDG (Hort) Dr SP Ghosh, seeing exhibition of HP farmers at CPRI, Shimla

HP Chief Minister, Prof. Prem Kumar Dhumal and Hort. Minister, Sh Narendra Bragta being briefed by Director CPRI, Dr GS Shekhawat

Study Group II of Parliamentry Standing Committee on Agriculture at CPRI, Shimla

US Ambassodor to India, Mr Richard Celeste with Director Dr. GS Shekhawat at CPRI, Shimla

DDG (Hort.), Dr KL Chadha releasing Institute publication at the concluding ceremoney of Golden Jubilee. at CPRI

MOS (Agriculture), Dr Devendra Pradhan visiting farmer's field (IVLP) at Shimla

DG, ICAR, Dr RS Paroda laying Foundation stone of Administrative Block at CPRI

HP Governor, Sh VS Kokje inaugurating Summer School at CPRI

HP Governor, Sh VS Kokje releasing Institute publication during Summer School

Mrs V Ramanujam releasing of Souvenir of Ramanujam Symposium at CPRI

DG, ICAR, Dr Mangala Rai planting a sapling at CPRS, Kufri

ASRB Chairman, Dr AS Paroda visiting Crop Improvement Lab

DG, ICAR, Dr Mangala Rai inaugurating Administrative Block Building at CPRI

DG, ICAR, Dr Mangala Rai and DDG (Hort), Dr G. Kalloo at Mini Mission-I meeting at CPRI

Dr Pamela Anderson, DG, CIP releasing a CPRI publication

Jharkhand Governor, Syed Sibtey Razi with Director CPRI, Dr SK Pandey at Institute Muscum

Parliamentary Committee on Hindi at CPRI with Director, Dr SK Pandey

Former President Dr APJ Abdul Kalam viewing Potato exhibition at CPRS, Kufri with Dr SK Pandey

Dr Pushkarnath, Director CPRI with Sh AP Jain, Minister for Food & Agriculture, GOI at CPRI

Former President Dr APJ Abdul Kalam planting a sapling at CPRS, Kufri

Impressions of Visiting Dignitaries

I was impressed to see the keen interest of the Director and the Scientists in environment. Potatoes play an important part in hill economy. I am sure the humanitarian scients of this Institute will succeed in making people conscious about the problems of potato cultivation. I offer my services as a field worker of the Institute for taking science to the masses am waiting for the day when they will establish their laboratories in the farms of the villagers. Science + Wisdom = Good for All

Sunder Lal Bahuguna, Environmentalist, Chipko Movement

I visited CPRI to participate in the 13th All India Conf. workshop on Potato and to Panel discussions on problems of potato cultivation in India organised by the Potato Association of India. I took the opportunity of visiting the Genetics, Potato Agr. & Physiology & Biochemistry Divisions of the Instt. It is always a pleasure to visit the work of the scientists and interact with them.

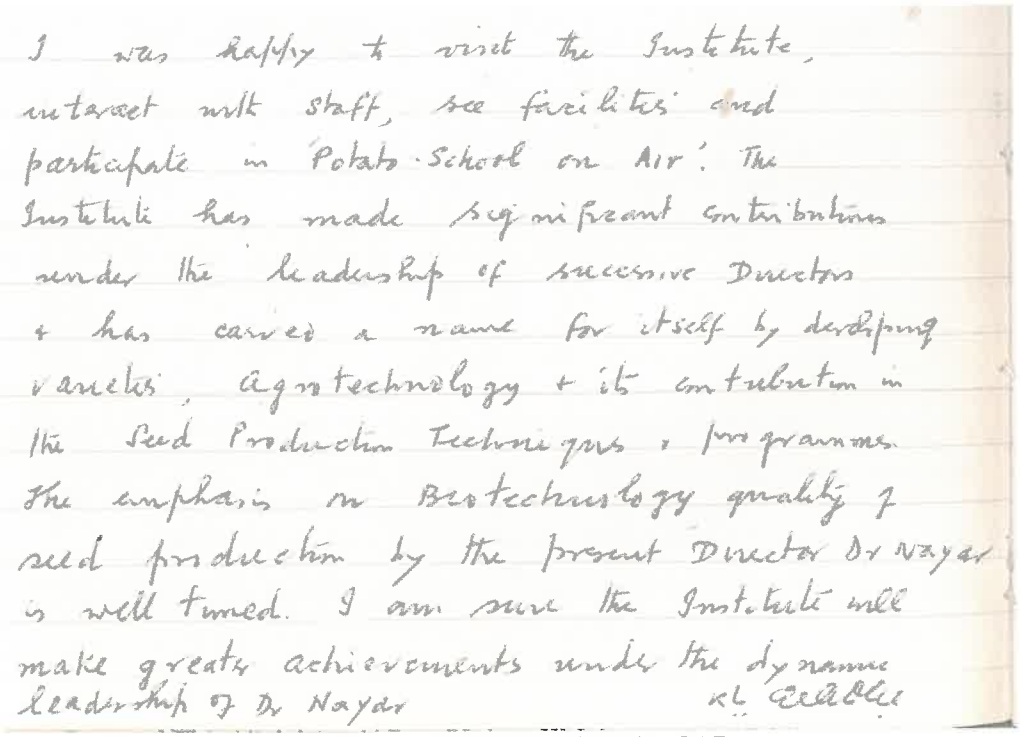
13/6/86.

M.V. Rao, Ex DDG(CS), ICAR

REMARKS

4.10.88

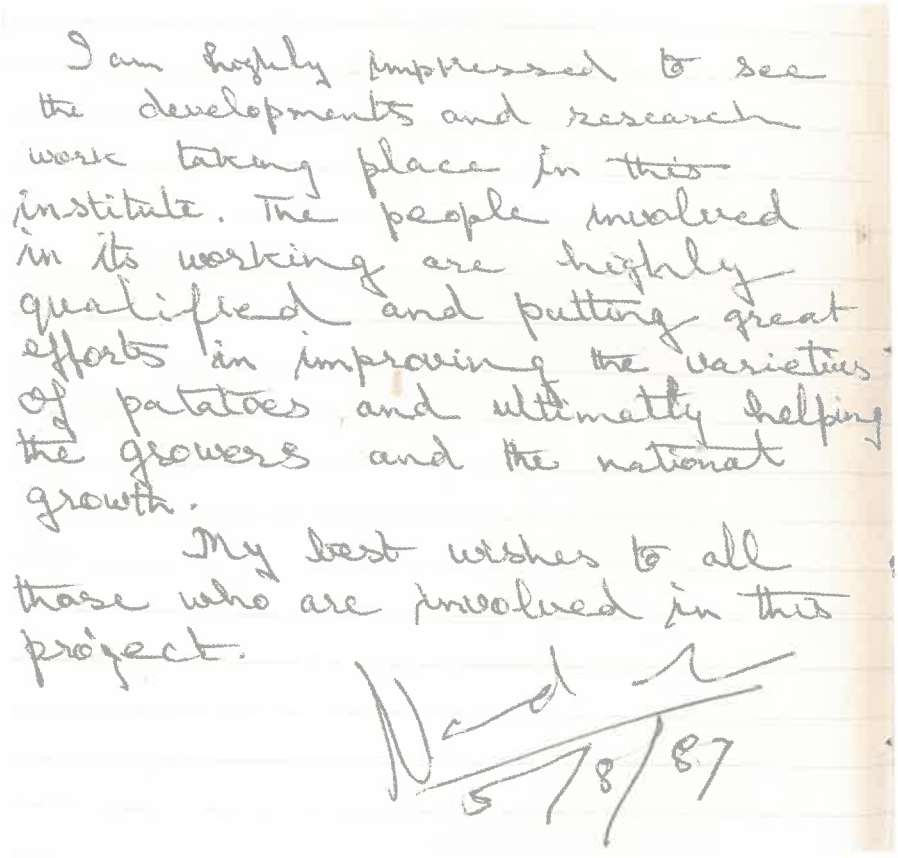
Bhajan Lal, Ex-Agriculture Minister, Govt. of India



I was happy to visit the Institute, interact with staff, see facilities and participate in 'Potato School on Air'. The Institute has made significant contributions under the leadership of successive Directors & has carved a name for itself by developing varieties, Agrotechnology & its contribution in the Seed Production Techniques & programmes. The emphasis on Biotechnology quality & seed production by the present Director Dr Nayar is well timed. I am sure the Institute will make greater achievements under the dynamic leadership of Dr Nayar

KL Chadha

KL Chadha, Ex-DDG(Hort), ICAR

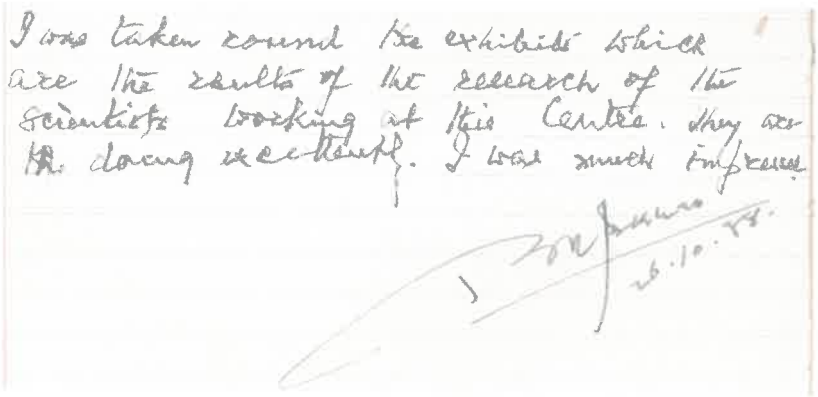


I am highly impressed to see the developments and research work taking place in this institute. The people involved in its working are highly qualified and putting great efforts in improving the varieties of potatoes and ultimately helping the growers and the national growth.

My best wishes to all those who are involved in this project.

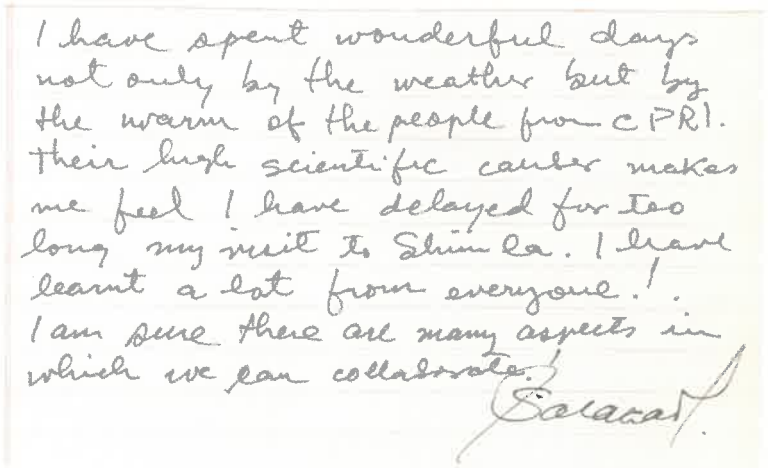
5/8/87

Baba Hardev Singh, Nirankari Saint


I was taken round the exhibits which are the results of the research of the Scientists working at this Centre. They are doing excellent. I had much impression.

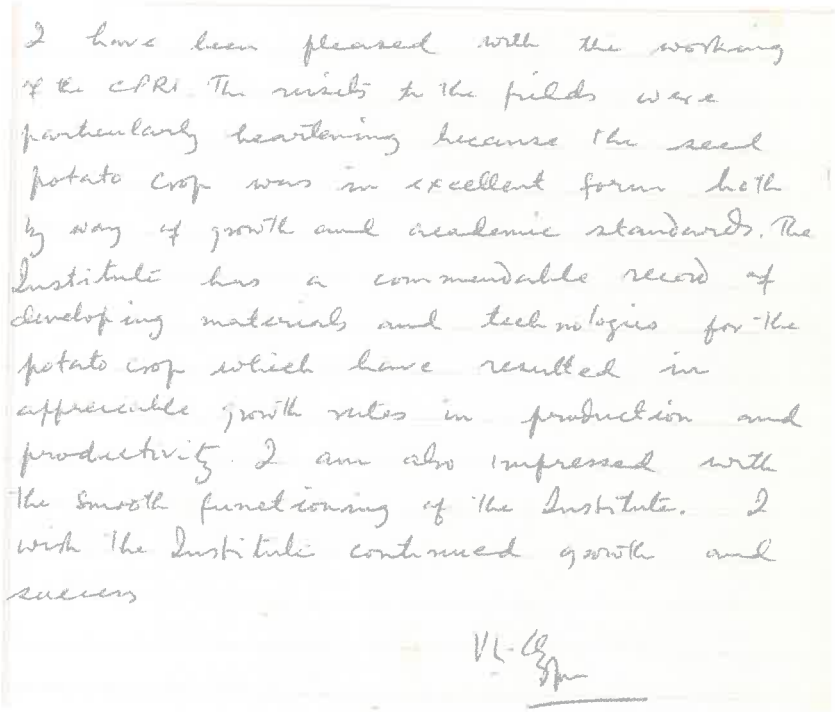
26.10.78

Balram Jakhar, Ex-Speaker, Lok Sabha


I have spent wonderful days not only by the weather but by the warm of the people from CPRI. their high scientific caliber makes me feel I have delayed for too long my visit to Shimla. I have learnt a lot from everyone!. I am sure there are many aspects in which we can collaborate.

Salazar

Luis F. Salazar, Virologist, CIP


I have been pleased with the working of the CPRI. The visits to the fields were particularly heartening because the seed potato crop was in excellent form both by way of growth and academic standards. The Institute has a commendable record of developing materials and technologies for the potato crop which have resulted in appreciable growth rates in production and productivity. I am also impressed with the smooth functioning of the Institute. I wish the Institute continued growth and success.

VL Chopra

VL Chopra, Ex-Director General, ICAR

I visited the Central Potato Research Institute in Simla in connection with the inaugural function of the intensive Training course on potato virology. I was not able to visit all the sections of the institute. But nevertheless the Staff has been able to serve the farmers in their research work and has been accredited with a pioneer work in finding out newer varieties with diseased free seed potatoes. If India has achieved a 5th place in the world in potato production. The credit goes to those hard and dedicated scientist for their untiring persons to give disease free seed potatoes. The institute has been doing excellent work. I wish all the best to the Director & his team of Scientists and the Staff.

B Rachaiah
7/5/90

B Rachaiah, Ex-Governor, Himachal Pradesh

25 The Central Potato Research Institute, Shimla has made great contribution in development of potato cultivation in India. India should be proud of such institute. The varieties developed here have reached every corner of India which shows the contribution of the Institute. The team of scientists under the able leadership of Dr. G. S. Shekhawat Director, are doing excellent research work which would go a long way in improving the productivity of this very important crop of India. I wish all success to them in their mission

[signature]
11/1995

Jayant Patel, Ex-Member, Planning Commission

I am extremely pleased to see the progress made by CPRI as an institute of excellence. My congratulations to the Director Dr. Lakhanpaul and his team of dedicated scientists, technicians, administration and supporting staff. Facilities are good and the research programmes well planned.

I wish the institute staff all the success in their endeavour to make CPRI as one of the finest institutions in ICAR System.

28/6/95

RS Paroda, Ex-Director General, ICAR

I was delighted to visit CPRI and learn of the outstanding work being done by the dedicated scientists of this world class potato institute. Congratulations to the Director and his team for the service they are providing to the science and society. The Institute has made unparalled contributions in the field of potato research, technology and production. Future of this important crop is indeed more than assured in the hands of this Institute and its dedicated scientists. I wish them well.

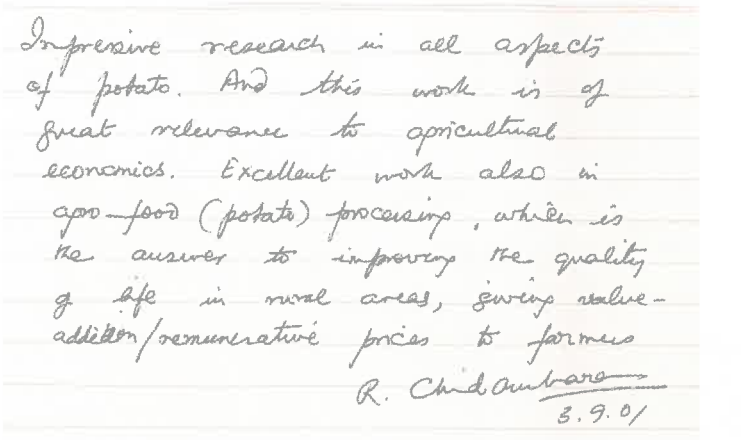
RB Singh

RB Singh, Ex-Director, IARI

CPRI obviously represents a high quality, well-rounded and integrated research program on potatoes. It is impressively well equipped with up to date equipment and the scientific staff are highly qualified. It has an exciting set of research activities to increase the success of potato in India!

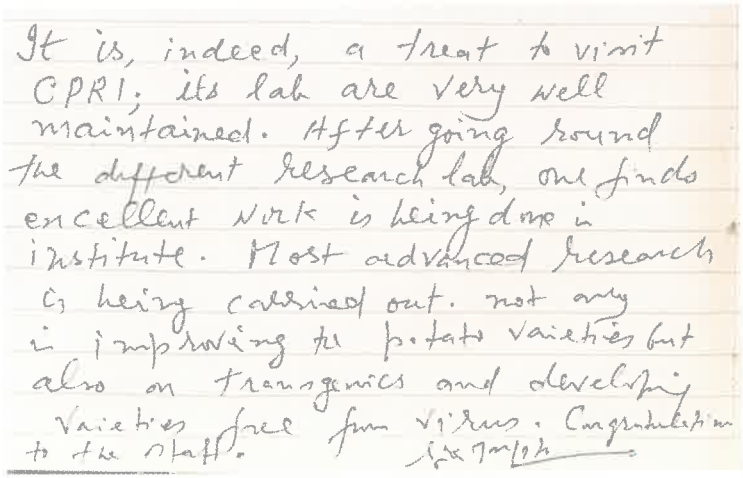
Wanda W Collins

Wanda W Collins, Ex-Director General, CIP


Impressive research in all aspects of potato. And this work is of great relevance to agricultural economics. Excellent work also in agro-food (potato) processing, which is the answer to improving the quality of life in rural areas, giving value-addition/remunerative prices to farmers

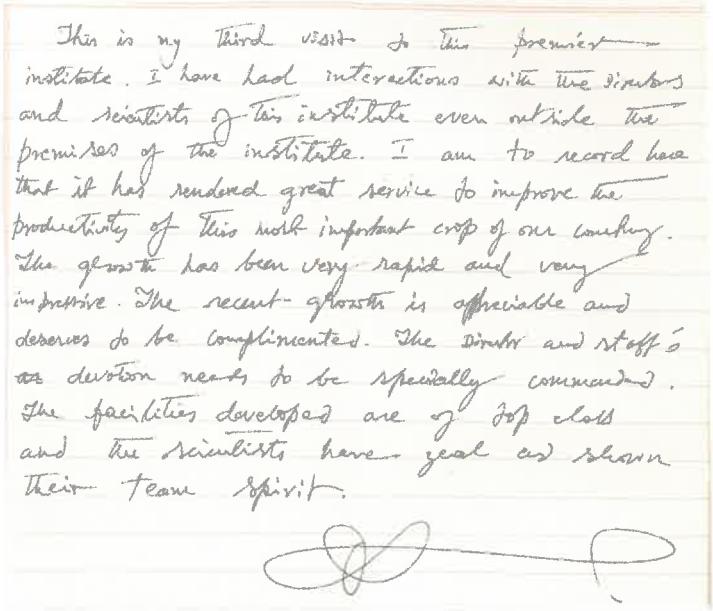
R. Chidambaram
3.9.01

R Chidambaram, Ex-Professor, BARC, DAE

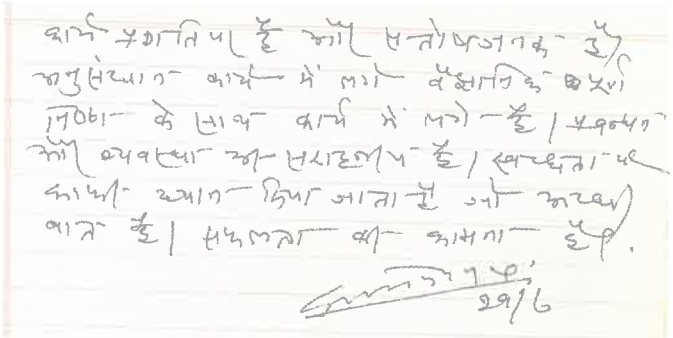

It is, indeed, a treat to visit CPRI; its lab are very well maintained. After going round the different research lab, one finds excellent work is being done in institute. Most advanced research is being carried out. not only in improving the potato varieties but also on transgenics and developing varieties free from virus. Congratulations to the staff.

SK Gupta

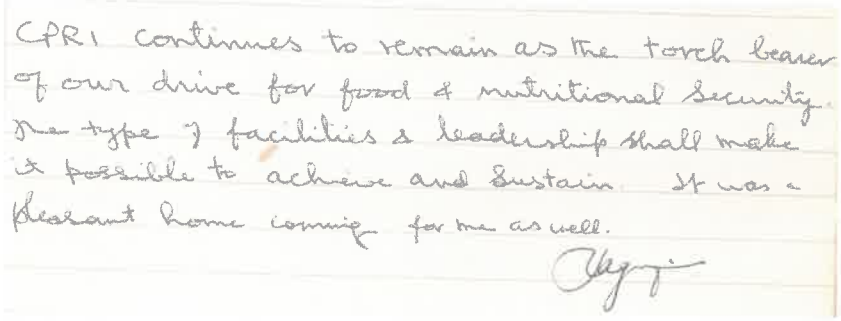
SK Gupta, Ex-VC, HP University, Shimla


This is my third visit to this premier institute. I have had interactions with the directors and scientists of this institute even outside the premises of the institute. I am to record here that it has rendered great service to improve the productivity of this most important crop of our country. The growth has been very rapid and very impressive. The recent growth is appreciable and deserves to be complimented. The Director and staff's dedication needs to be specially commended. The facilities developed are of top class and the scientists have zeal and shown their team spirit.

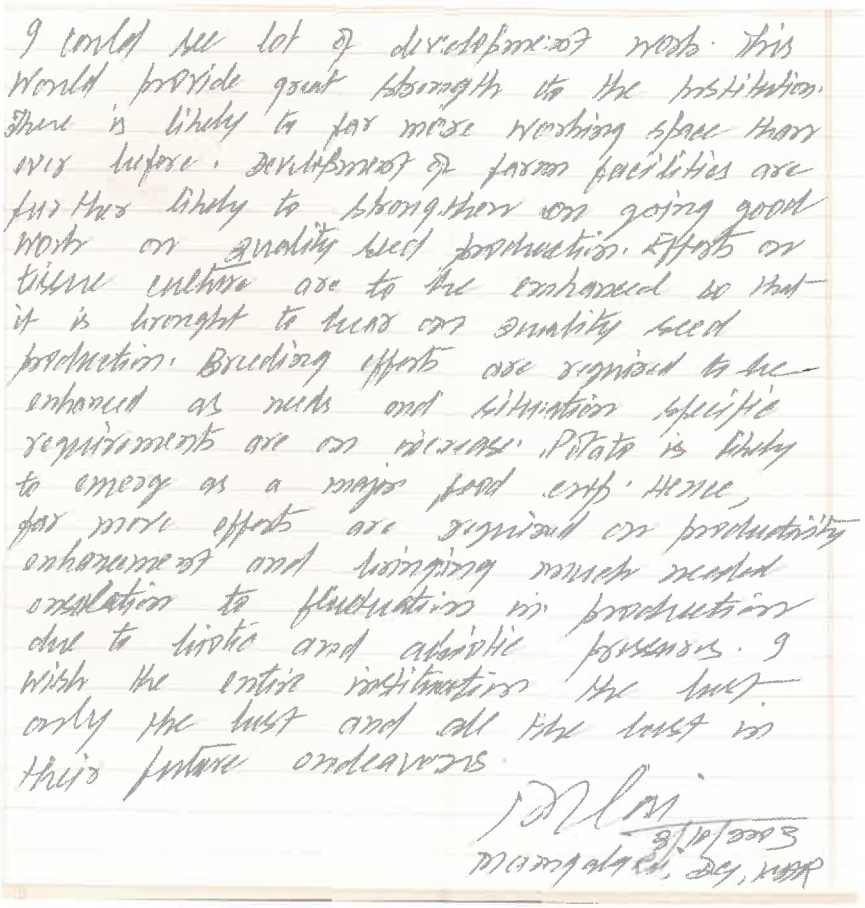
M Mahadevappa, Ex-Chairman, ASRB



Hukumdev Narayan Yadav, Ex-MOS, Agriculture, GOI



S Nagarajan, Ex-Director, IARI



Mangala Rai, Director General, ICAR & Secy., DARE

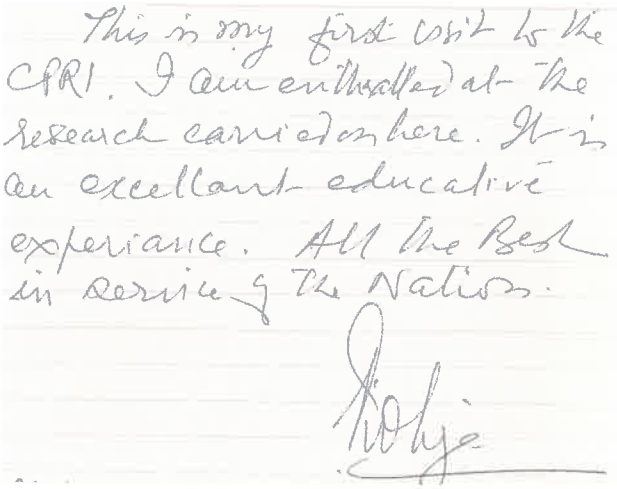
I have been visiting this institute since 1962 when I took over as Vegetable specialist in J&K Srinagar starting my association with potato research. I have been keenly watching the developments in potato research and the contributions made by this institute constituting its Directors and other scientists and workers. The institute has grown up in its stature and made excellent contributions by developing high yielding varieties, disease resistant material, seed plot technique and other technologies which have brought revolution and changed the lot of potato growers. Remarkable changes have been during recent years by creating facilities in terms of building, equipments etc. I congratulate Dr. S.M. Paul Khurana for his dynamic leadership and other scientists and workers for their sincere and dedicated. I wish still brighter future for this great institution

Singh 3.10.03

Kirti Singh, Ex-Chairman, ASRB

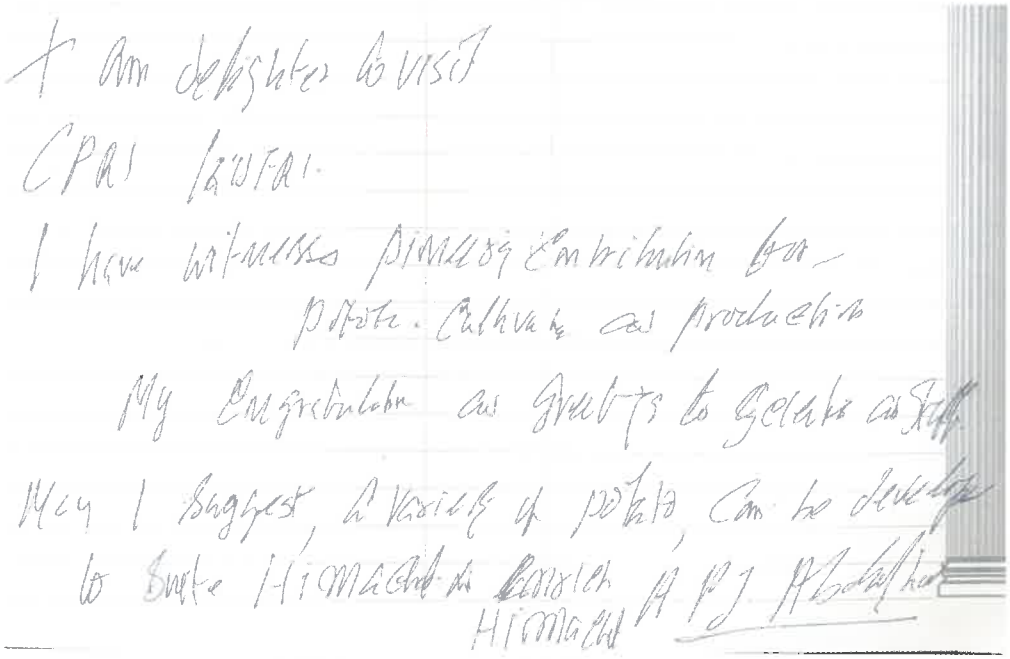
Potato is an extremely important crop for food security and also nutritional security. CPRI is our National asset and gateway to the above security. It is a very strategic Institute that needs to be given all facility to achieve the potentials. IHBT values its relationship with CPRI.

PS Ahuja, Director, IHBT, Palampur


This is my first visit to the CPRI. I am enthralled at the research carried on here. It is an excellent educative experience. All the Best in serving the Nation.

Kokje

VS Kokje, Ex-Governor, Himachal Pradesh


I am delighted to visit CPRI Shimla.

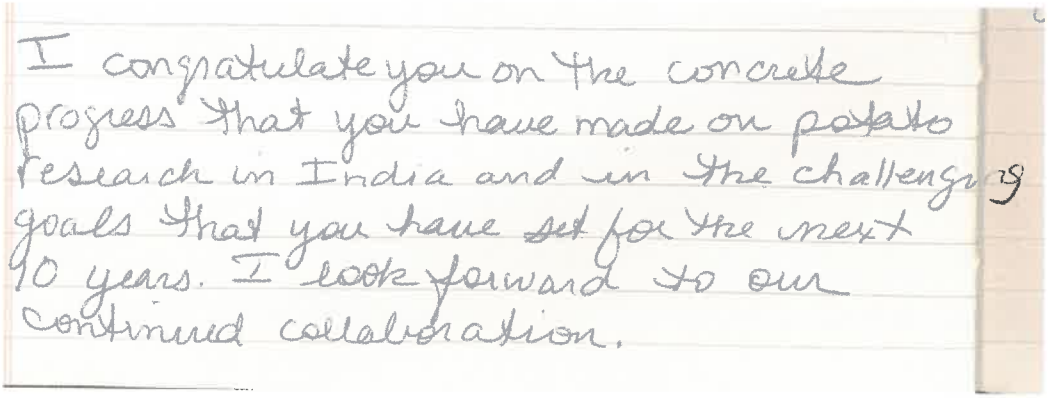
I have witnessed pioneering contribution for potato cultivation as production

My Congratulations and greetings to Scientific staff.

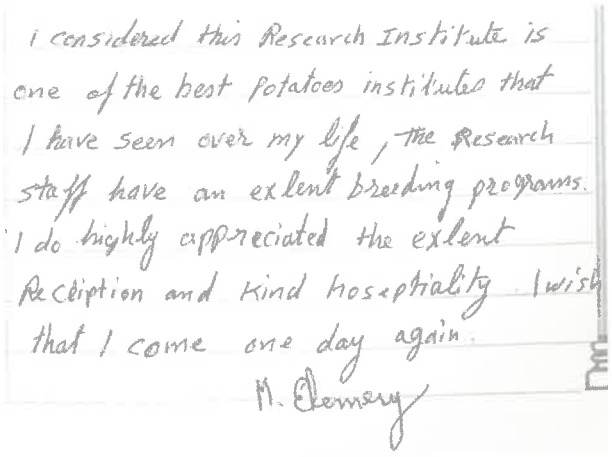
May I suggest, a Vision of potato, can be developed to make Himachal the potato bowl of India

APJ Kalam
Himachal

APJ Abdul Kalam, Former President of India

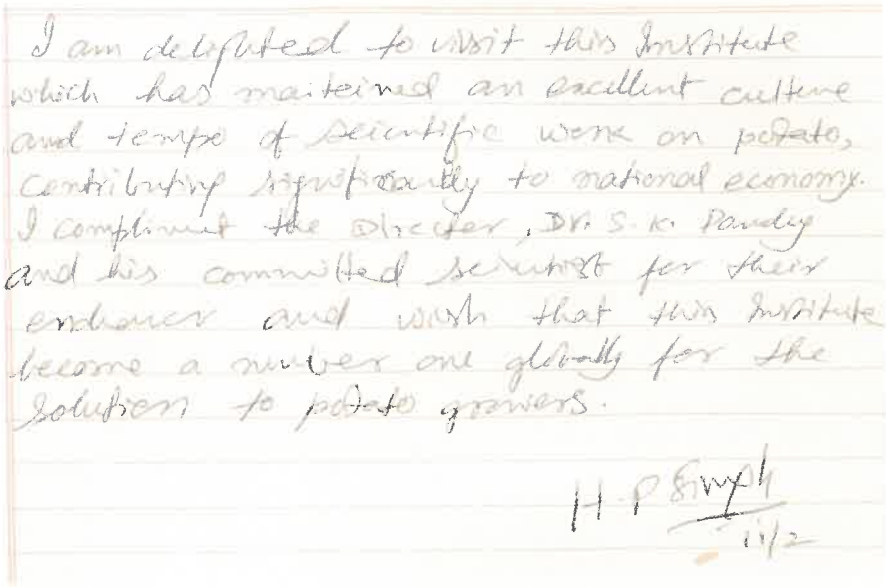

I congratulate you on the concrete progress that you have made on potato research in India and in the challenging goals that you have set for the next 10 years. I look forward to our continued collaboration.

Pamela Anderson, Director General, CIP


I considered this Research Institute is one of the best potatoes institutes that I have seen over my life, the Research staff have an exlent breeding programs. I do highly appreciated the exlent Reception and kind hoseptiality I wish that I come one day again.

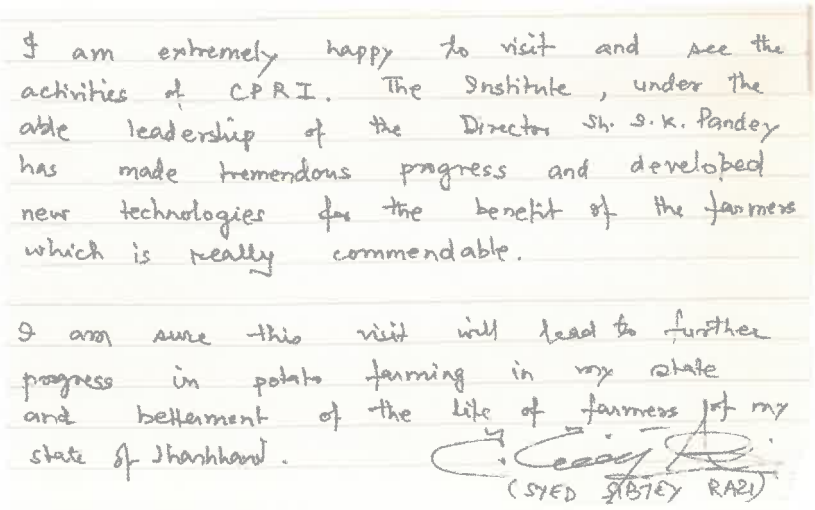
M. Elemery

MI Elemery, Director of Field Crops Insitute, Egypt


I am delighted to visit this Institute which has maiteined an excellent culture and tempo of scientific work on potato, contributing significantly to national economy. I compliment the Director, Dr. S.K. Pandey and his committed scientist for their endeavour and wish that this Institute become a number one globally for the solution to potato growers.

H.P Singh
11/2

HP Singh, DDG(Hort.), ICAR


I am extremely happy to visit and see the activities of CPRI. The Institute, under the able leadership of the Director Sh. S.K. Pandey has made tremendous progress and developed new technologies for the benefit of the farmers which is really commendable.

I am sure this visit will lead to further progress in potato farming in my state and betterment of the life of farmers of my state of Jharkhand.

(SYED SIBTEY RAZI)

Syed Sibtey Razi, Governor, Jharkhand

It has been a learning visit to CPRI. I am highly impressed with the work being done at this premier institute dealing with one of the most important crop. I am conscious of the fact that food and nutrition security of the people, particularly of the poor and marginal people, to a large extent depend on potao production. The programmes being undertaken at this institute, will probably help us achieve one of the millenium development goals. The management of the institute is very effective and efficient.

I wish the faculty and staff of this institute a great success

NKTyagi
14/9/07

NK Tyagi, Member, ASRB

The first crop I ever took as a farmer in 1977 was chandramukhi Potato. since then I have been hearing about the CPRI Shimla. It was the realization of a dream to be able to visit the Institute and interact with persons who have made history. I would recommend CPRI for the next World food Prize

Sharad Joshi
22-5-06

Sharad Joshi, Member of Parliament, India

Awards Bagged by CPRI Scientists

Year	Name of Award	Name of Awardees
1968	Rafi Ahmed Kidwai Award	Dr Pushkarnath
1979	Guinness Award	Drs BB Nagaich, AK Singh, KP Sharma and LC Sikka
1992	Phosphate Potash Institute of Canada FAI Award	Dr UC Sharma
1993	Phosphate Potash Institute of Canada FAI Award	Drs JS Grewal, RC Sharma, SS Lal, SP Trehan, JP Singh, VS Kushwah, MC Sood, KC Sud and NC Upadhayay
1993	Fertilizer Association of India-Silver Jublee Award	Dr JP Singh
1995	Fakhruddin Ali Ahmed Award	Drs UC Sharma and Kamla Singh
1995	Rafi Ahmed Kidwai Memorial Award	Dr Lakshman Lal
1995	NS Randhawa Medal	Dr. Jai Gopal
1996	Sardar Patel Outstanding Agricultural Institution Award (1995)	Central Potato Research Institute
1997	ICAR Young Scientist Award	Dr D Sarkar
1997	Jawahar Lal Nehru Award for Best Ph.D Thesis	Dr (Mrs.) SK Sandhu
1997	Dr GA Dastane Gold Medal & IARI Merit Medal	Dr Parveen Kumar
1997	Jawahar Lal Nehru Award for Best Ph.D Thesis	Dr Jai Gopal
1998	Dr Anand Prakash Award of AZRA	Dr SS Misra
1998	Hari Om Ashram Trust Award	Dr PS Naik and D Sarkar
1999	ICAR Team Research Award	Drs PC Gaur, SV Singh, SK Pandey, Dinesh Kumar, DevendraKumar and RS Marwaha
2000	ICAR Team Research Award	Drs HC Sharma, Shiv Kumar, VK Chandla, NK Pandey and Sh Anil Kumar
2000	Rafi Ahmed Kidwai Award	Dr GS Shekhawat
2001	ICAR Team Research Award	Drs Sarjeet Singh, GS Kang, VS Khushwa, PS Naik, RP Rai, AK Sharma, Ram Kishore and Shiv Kumar
2001	ICAR Young Scientist Award	Dr. D Pattanayak
2002	Best Scientist of the Year Award (NESA)	Dr SM Paul Khurana
2003	Bharat Excellence Award for International Cooperation	Dr SM Paul Khurana
2003	Dr.S Ramanujam Award	Dr SM Paul Khurana
2004	Young Scientist Award-SVBPUAT, Meerut	Dr AK Shukla
2005	Dr. JC Anand Gold Medal, Hort. Society of India	Dr SK Pandey
2005	Hari Om Ashram Trust Award (2003-04)	Dr. B.P. Singh, S. Roy, and P.H. Singh
2006	LC Sikka Endowment Award	Dr SK Pandey
2006	Chaudhary Devi Lal Outstanding All India Coordinated Research Project Award (2005)	AICRP (Potato)
2007	Rafi Ahmed Kidwai Award	Dr SK Pandey
2007	Dr. S Ramanujam Award	Drs. SV Singh, SK Pandey, RS Marwaha, BP Singh, Dinesh Kumar, and Praveen Kumar
2008	Fellowship of National Academy of Sciences, Allahabad, India	Dr. SK Pandey

Roll of Honours for CPRI Scientists

Sl. No.	Name of Scientist	Last position held at CPRI	Position to which elevated
1.	Dr. LC Sikka	Project Coordinator, AICRP (Potato) and Chief Seed Production Officer	Principal Scientist, CIP, Lima, Peru
2.	Dr. MD Upadyaya	Head, Division of Genetics & Plant Breeding	Principal Scientist, CIP, Lima, Peru
3.	Dr. Hari Kishore	Head, Division of Genetics & Plant Breeding	Regional Representative, SWA Region, CIP, New Delhi
4.	Dr. SM Paul Khurana	Director	VC, Rani Durgavati University, Jabalpur (MP)
5.	Dr. KR Dhiman	Head, CPRS, Kufri	VC, Dr. YS Parmar University of Horticulture & Forestry, Nauni, Solan (HP)
6.	Dr. NM Nayar	Director	DST Emeritus Scientist, Tropical Botanical Garden Research Institute, Trivendrum (Kerala)
7.	Dr. SP Tiwari	Scientist	DDG (Education), ICAR, New Delhi
8.	Dr. KC Garg	Sr. Scientist	ADG (Hort.), ICAR, New Delhi
9.	Dr. TP Trivedi	Sr. Scientist	Project Director, DIPA & ADG (ARIS), ICAR, New Delhi
10.	Dr. TP Rajendran	Sr. Scientist	ADG (plant Protection), ICAR, New Delhi
11.	Dr. JB Mishra	Sr. Scientist	Actg. Director, NRC for Groundnut, Junagarh
12.	Dr. SK Sharma	Scientist	Director, NBPGR, New Delhi
13.	Dr. OM Bombawale	Sr. Scientist	Director, NCIPM, New Delhi
14.	Dr. HS Gupta	Sr. Scientist	Director, VPKAS, Almora

SPONSORS' PROFILES

Highlights

- Pepsico
- Syngenta
- ITC India Limited
- Technico
- Mahindra ShubhLabh Services Limited
- KF Bioplants Private Limited
- Sathguru Management Consultants
- DuPont™ - The Miracles of Science™
- Ceres Beeja Research Private Limited.
- POSCON
- Coromandel Fertilisers Limited
- BASF
- Bejo Sheetal Seeds Private Limited
- United Phosphorus Limited
- Haldiram's
- National Horticulture Board
- National Seeds Corporation Limited
- MAHYCO
- Merino Industries Limited
- KF Biotech Private Limited

About PepsiCo

PepsiCo is one of the world's largest food and beverage company, with annual revenues of more than US $39 billion in 2007. The Company employs approximately 185,000 people worldwide, and its products are sold in about 200 countries. Its principal businesses include: Frito-Lay snacks, Pepsi-Cola beverages, Gatorade sports drinks, Tropicana juices and Quaker foods. The PepsiCo portfolio includes 17 brands that rate $1 billion or more each in annual retail sales.

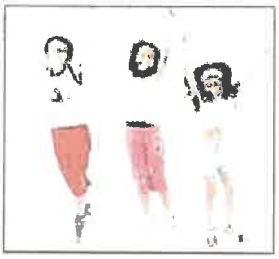
PepsiCo entered India in 1989 and has grown to become the country's largest selling food and beverage company. One of the largest multinational investors in the country, PepsiCo has established a business which aims to serve the long term dynamic needs of consumers in India. PepsiCo India and its partners have invested more than US $1 billion since the company was established in the country. PepsiCo provides direct and indirect employment to 150,000 people including suppliers and distributors. The group has built an expansive food and beverage business and to support the operations are 3 state-of-the-art plants of the foods division - Frito Lay, and the group's 43 beverage bottling plants in India. PepsiCo's business is based on its sustainability vision of making tomorrow better than today. PepsiCo India's commitment to living by this vision every day is visible in its contribution to the country, consumers, farmers and people.

Performance With Purpose

Replenishing Water

Waste To Wealth

Partnership With Farmers



Healthy Kids

Performance with Purpose articulates PepsiCo India's belief that its businesses are intrinsically connected to the community and world that surrounds it. To deliver on this commitment, PepsiCo continues to build on its strong foundation of achievements and scale up its initiatives while focusing on the following 4 critical areas that are linked to its business and where it can have the most impact - Replenishing Water, Partnerships with Farmers, Waste To Wealth and Healthy Kids.

PepsiCo India continues to *replenish water* and aims to achieve positive water balance by 2009, which means it is committed to saving and recharging more water than it uses in its

beverage plants. PepsiCo India's Agri-partnerships **with** farmers help more than 20,000 farmers across the country earn **more.** PepsiCo India continues to convert *Waste to Wealth,* to make cities cleaner. This award winning initiative has established Zero Solid Waste centres that benefit more than 2,00,000 community members throughout the country. PepsiCo India stays committed to the *health and well-being of kids.* It will continue to provide children with a diverse, healthful and fun portfolio, while encouraging active lifestyles by expanding its Get-Active programme for school going children.

Partnership With Farmers

PepsiCo India also continues to strengthen its partnerships with farmers across the country to boost their productivity and income. The company has been a pioneer in contract farming over the last two decades and now works with more than 20,000 potato, paddy and barley farmers. The company's vision maps the road for change to create a cost-effective, localized agri-base in India by leveraging farmers' access to world class agricultural practices while working closely with farmers and state governments to improve agri sustainability, crop diversification and to raise farmer incomes. PepsiCo India is committed to helping farmers refine their farming techniques and raise farm productivity and customising solutions to suit specific geographies and locations.

PepsiCo has introduced world-class, top quality, high-yielding potato varieties and has partnered with more than 11,000 farmers working across Punjab, U.P., Karnataka, Jharkhand, West Bengal, Leh in Kashmir, and Maharashtra for the supply of world class chip-grade potatoes. High yield potato seeds have enabled farmers to produce world class potatoes and procure higher returns.

The package of practices offered by PepsiCo, such as proper use of agronomy, fertilizers and chemicals, has improved yield, quality and reliability. The company interfaces with CPRI (Central Potato Research Institute), the Thapar Institute of Technology, State Bank of India and potato experts from across the world. PepsiCo India helps facilitate crop insurance and bank financing for farmers at competitive interest rates.

About syngenta

Syngenta is a world-leading agribusiness committed to sustainable agriculture through innovative research and technology. The company is a leader in crop protection, and ranks third in the high-value commercial seeds market. Sales in 2007 were approximately $9.2 billion. Syngenta employs over 21,000 people in more than 90 countries.

Global Presence

Syngenta is a global agribusiness company headquartered in Basel, Switzerland. It has a large number of Research and Development facilities and Production sites all over the world.

Research & Development

We invested about $800 million in research and development (R&D) in 2007. Of our 21,000 employees, some 4,000 are involved in research, technology and development. We have hundreds of collaborations with external research partners and universities. We provide sustainable solutions to help farmers grow and protect the world's crops.

Businesses & Markets- More Food from Less Land

Syngenta meets growers' needs for higher productivity through continuous innovation, resulting in more food and fiber produced from limited arable acres. Without the use of crop protection products, around 40 percent of the world's crops would be lost to pests and diseases. About 600 million hectares of land – three times the arable land in the USA – would be needed to compensate that loss. Without Syngenta products, around 80 million tonnes of corn and 40 million tonnes of cereals would be lost to insects, weeds and disease each year.

Partnering With Growers

Syngenta has a long-standing tradition of partnership with farmers for their prosperity. Syngenta supports farmers in many ways. Its products help growers to meet the increasing demand for food, feed and fiber by reducing losses to pests and making irrigation more effective. Syngenta has a comprehensive portfolio to meet this demand. The total crop solutions consist of Seeds, Seed Care, Crop Protection & Public Health. In addition, Syngenta contributes to preserving the existing arable land by researching and promoting methods of sustainable agriculture. The company acts in accordance with its Code of Conduct and its Health, Safety and Environmental Policy, which embrace internationally accepted regulations and the highest scientific standards.

ITC Limited

ITC India Limited

ITC Limited (www.itcportal.com) is one of India's foremost business conglomerates with a market capitalization of nearly US $18 billion and a turnover of over US $5.1 billion and employing over 25,000 people at more than 60 locations across India. ITC has a diversified presence in Cigarettes, Hotels, Paper boards and Specialty Papers, Information Technology, FMCG and Agribusiness.

ITC's Agribusiness has one of India's largest rural network, led by the flagship *e-Choupal* initiative, enabling Indian agriculture significantly to enhance its competitiveness and empowering Indian farmers for sustainable rural development. This network is expected progressively to create for ITC a deep distribution infrastructure, significantly enhancing the company's market reach in rural India. As part of its Foods business, ITC launched 'BINGO' salty-snack-foods in March, 2007. Bingo's portfolio includes an array of products in both potato chips and finger snacks segment. Presently, the company is producing BINGO at Haridwar (Uttarakhand) and Ranjangaon (Maharashtra).

To secure long-term access to high quality chip grade potato seeds and internationally benchmarked best practices in agronomy, ITC acquired Technico, an Australia headquartered agri-biotech company in August 2007. Technico's global operations include the Indian arm Technico Agri Sciences Ltd., with a state of the art potato tissue culture facility in Baddi (Himachal Pradesh) to produce TECHNITUBER®, and also a widespread contract farmers' network in Punjab to multiply them into early generation high quality potato seed tubers as per the standards laid down by the Central Seed Committee, Govt of India. Presently, Technico Agri Sciences Ltd. is a leading potato seed tuber supplier in India providing a strong synergy to the potato-based value chain, enhancing farmer capabilities through access to high quality seeds. TECHNITUBER® enables rapid multiplication of seed potatoes from pathogen tested plantlets in controlled environments, to provide improved and consistent yields to farmers. This is in line with ITC's abiding philosophy to contribute to the development of the agriculture-based rural economy and secure competitiveness of the value-chains created by the Company through its agri and foods businesses.

As one of India's most valuable and respected corporations, ITC is widely perceived to be dedicatedly nation-oriented with its time-tested core competencies: unmatched distribution reach, superior brand building capabilities, effective supply chain management, acknowledged service skill in hoteliering and agri-business transformation through the globally recognized *e-Choupal* network.

ITC continuously endeavors to enhance its wealth generating capabilities in globalizing environment to consistently reward its 377,000 shareholders, fulfill the aspirations of its stakeholders and meet societal expectations.

TECHNICO

Technico - A Profile

Technico is an Australian Agri-Biotech Company involved in the business of producing and selling 'Early Generation' high vigour seed potatoes. It has developed an award-winning TECHNITUBER® Seed Technology which is revolutionising the global seed potato industry. Technico is leading the world in the category of Early Generation seed potato production and provides the entire supply chain solution from the initiating seed piece right up to the commercial crop.

The Company has manufacturing facilities and field presence in several countries such as Canada, China, India, Turkey, Saudi Arabia, Egypt, *etc.*

TECHNITUBER® Production Facility, Manpura, India

TECHNITUBER® Production Facility, Kunming, China

The **TECHNITUBER®** Seed technology enables the Company to produce mass volumes of **TECHNITUBER®** seed at an affordable cost. These **TECHNITUBER®** seeds are planted in a limited field multiplication program to produce 'Early Generation' Seed Potatoes. Feedback from Technico's customers has confirmed the following benefits:

a) Vigorous high yielding seed potatoes

b) Rapid introduction of new/improved varieties

c) Lower disease levels

d) Economical cost

e) Round the year availability. **TECHNITUBER®** Seed is grown in a controlled environments allowing for delivery of seed to any location for any planting season in a field ready condition.

f) At a planting rate of less than 40kg per acre, they can start a seed program with substantial savings in freight and storage.

Technico and its global partners together produce more than 50,000 MT of early generation seed every year.

Mahindra ShubhLabh Services Limited

Mahindra ShubhLabh Services Limited (MSSL) is part of the US $ 6.7 billion Mahindra Group (M&M). Mahindra & Mahindra has a significant presence in key sectors of the Indian economy. A consistently high performer, M&M is one of the most respected companies in the country.

Set up in 1945 to make general-purpose utility vehicles for the Indian market, M&M soon branched out into manufacturing agricultural tractors and light commercial vehicles (LCVs). The company later expanded its operations from automobiles and tractors to secure a significant presence in many more important sectors. The Company has, over the years, transformed itself into a Group that caters to the Indian and overseas markets with a presence in vehicles, farm equipment, information technology, trade and finance related services, and infrastructure development.

M&M has two main operating divisions:

The **Automotive Division** manufactures utility vehicles, light commercial vehicles and three wheelers.

The **Tractor (Farm Equipment) Division** makes agricultural tractors and implements that are used in conjunction with tractors, and has also ventured into manufacturing of industrial engines. The Tractor Division has **won the coveted Deming Application Prize 2003 and the Japan Quality Medal in 2007**, making it the only tractor manufacturing company in the world to secure these awards.

Mahindra Shubhlabh Services Ltd. (MSSL) is an Agri-business Company of the Mahindra & Mahindra group with an equity stake of International Finance Corporation (IFC, Washington). MSSL aims to integrate the agriculture & food chain, from Agri-inputs right through to Agri commodities.

Scope of Operations

Since its inception in April 2000, MSSL was primarily focusing on the standard field crops such as Basmati, Maize, Barley, Cotton, Moong, Soybeans, Durum, Hyola and oilseeds such as Sunflower & Mustard. Within the agri-inputs area, MSSL has taken a direct initiative in launching its brand of seed potato, seeds of cereal and vegetables, as well as a range of Crop Care products.

SEED POTATO: The Seed Potato Division produces Minituber derived early generation seed potato of Indian and other varieties to cater to the seed requirements of the processed foods industry as well as the table market segment in the country. Currently, MSSL operations are spread over 1300 acres in the state of Punjab.

MSSL has recently concluded its agreement with a leading Seed Potato producing company of the world to bring in the best production practices to deliver a 'high health & high quality' seed product to not only the Indian domestic markets but would also cater to the demands of the surrounding SAARC countries to begin with.

KF Bioplants PVT. LTD.
A KUMAR – FLORIST (HOLLAND) JOINT VENTURE

KF Bioplants Private Limited

KF Bioplants Pvt. Ltd. is India's largest plant biotech company. A **joint venture** of **Kumar Properties and Florist de Kwakel B.V., Holland**, it is a global provider of quality plants of Gerbera, Carnation and Anthurium, supplying 20 million plants annually for commercial cultivation all over India and to 25 countries around the world. Backed by 15 years' experience, it is associated with leading companies around the world under joint venture and licensee arrangements. **KF Bioplants** is located at Pune, 150 km from Mumbai, India's commercial capital.

Mission Statement

Continuously exploring new frontiers for meeting rapidly changing needs, building relationships through value creation for all, rigorously maintaining adherence to well-defined internal processes and norms, KF Bioplants is a service organization delivering long-lasting products that transform people's lives.

Infrastructure/Facilities

KF Bioplants represents a perfect blend of smooth functioning & sophistication.

- It has a 60,000 sq.ft. state-of-the-art laboratory with separate initiation rooms to safeguard the quarantine status of the main facility.
- Eighteen fully monitored growth rooms to hold over 9 million plants at one time.
- It also has 4 hectare completely controlled greenhouses manned by highly qualified and experienced personnel to produce quality plants post *in-vitro* production.
- Cold storage units and world class logistic facilities enable the company to meet domestic and global demand on time, with highest quality.

Products

KF Bioplants offers plants *in-vitro* or hardened young plants of the following commercially successful crops: 1. Gerbera, 2. Carnation, 3. Anthurium, 4. Lilium, 5. Limonium, 6. Zantedeschia, 7. Phaelonopsis, 8. Gypsophila, 9. Potato. Ninety Percent of the domestic floriculture market is provided planting material by our company. The farmers are provided on-line technical assistance comprising of guidance on cultivation practices, fertigation program, plant protection measures, post-harvest management and marketing of flowers.

Potato Program

The Company started its potato program in year 2002 and successfully established *in-vitro* protocols for initiation, multiplication, rooting and *post-vitro* hardening and minituber production. The tubers are tested for various viruses during initiation. The company has 100% controlled and closed polyhouses to produce minitubers under hygienic conditions which can prevent infestation of viruses via insect carrier. The Company has planned to launch it's 100% virus free seed potato (both ware potato varieties & processing varieties) in Indian market from 2009-2010.

Sathguru Consultants Pvt. Ltd.

Sathguru Management Consultants

Sathguru is a strategic global advisory consulting firm with key focus on agribusiness, life sciences and technology management, with vast experience and knowledge of global markets. Our services include creating and managing globally relevant research consortiums aimed at research-based solutions for mitigating food and healthcare issues. Sathguru harnesses global technologies and provides a platform for licensing technologies for public good and private sector commercial application.

Sathguru's services include strategic advisory, financial advisory, sector growth assessment, technology management and information technology solutions for the agribusiness and development sectors. The clients of Sathguru include international public organizations, international academic institutions, national government bodies, private and transnational enterprises, multilateral and bilateral donor agencies and non-profit organizations.

Today, Sathguru

- Offers comprehensive strategic planning, performance engineering and program management in agri-biotechnology for the private and public sector.
- Provides cutting edge services in technology and intellectual property management (IPM) in emerging areas of translational sciences.
- Offers customized tried and tested industry specific ERP solutions.
- Creates unique linkages between public, private and non-profit organizations for public good.

For a better tomorrow, Sathguru

- Approaches problems through ingenuity and creativity, and strives to use global approaches in providing unique custom solutions at the local level.
- Engages with key central research organizations in capacity building and setting priorities for agricultural and biotech research.

Sathguru's international success stories include

- Managing the South Asia segment of USAID-funded Agricultural Biotechnology Support Project II (ABSPII) that focuses on the safe and effective development and commercialization of bio-engineered crops. Visit www.sathguru.com/absp2
- Guiding the World Bank-funded National Agricultural Innovation Project (NAIP), an initiative by ICAR to promote agricultural innovations.
- Carrying out licensing from global leaders to over 25 organizations in developing countries for public good applications in food and healthcare.
- Carrying out for-profit licensing for key traits to private enterprises in food and healthcare.
- Providing support to key clients, through complex 4 to 6 life cycles, from conceptualization to successful commercialization of technologies.

DuPont™ – The Miracles of Science™

DuPont™ India is a wholly owned subsidiary of E I du Pont de Nemours and Company. DuPont™ association with India is since 1802, when first shipment of raw material for black powder for explosive was imported from India into the US. Today, DuPont™ India markets a wide range of products in varied market segments including agriculture, food and nutrition, healthcare, home and construction, electronics, safety and protection, and transportation and infrastructure bringing to life its powerful philosophy of *The miracle of Science™* to create a better world for all. DuPont™ employs more than 900 people in the country and provides indirect employment to more than 2500 people. DuPont India is growing at an annual average of 25% for the last five years. In 2007, DuPont™ sales in India exceeded US $439 million. Our largest business in India is Agriculture and Nutrition. Crop Protection Business is the part of this platform.

DuPont™ Vision : Our vision is to be the world's most dynamic science company, creating sustainable solutions essential for a better, safer and healthier life for people everywhere.

DuPont™ Mission : Our mission is sustainable growth: increasing share holder and societal value while reducing our environmental footprint throughout the value chain in which we operate.

DuPont™ Crop Protection: One of the businesses under Agriculture and Nutrition platform, which provide sustainable solutions to farmers and help optimize their crop yields by effective insect-pests, diseases and weed management. Some of the key offerings from DuPont Crop Protection are – DuPont™ Algrip™ herbicide for broad leaf weed control in wheat, DuPont™ Almix™ a herbicide for broad leaf and sedge weed control in rice, DuPont™ Kloben® active herbicide for soybean weed control, DuPont™ Curzate® M8, a fungicide used primarily on grape, potato and tomato, DuPont™ Avaunt™ latest technology insecticide for major insect pest control and DuPont™ Lannate® broad spectrum insecticide.

When it comes to crop protection in potato, DuPont™ Crop Protection has given a lasting solution for potato growers for the control of late blight of potato. Late blight in potato has become a real challenge since the last few years and farmers are finding it very difficult to control it with the old traditional fungicides. DuPont™ Curzate® M8, which not only takes care of these anxieties but also exhibits a lot of other benefits making it a perfect fungicide for potato crop. Curzate® M8 is a systemic fungicide meant for control of Potato late blight. It is a unique mixture of cymoxanil and mancozeb. It provides an affordable solution to strengthen the late blight management program.

(Curzate M8 inhibits spores production)

CERES BEEJA RESEARCH PVT. LTD.

Ceres Beeja Research Private Limited

Ceres Beeja Research Pvt. Ltd. derives its name from the Roman goddess Ceres who was worshiped as goddess of agriculture. Ceres positions itself in this realm of holistic rural development through developing robust seed economy by forging partnership with agrarian communities and its institutions, where scientific knowledge would blend with local wisdom. CERES is working with a goal to facilitate proactively the growth of agricultural seed industry and sustainable agriculture in India and abroad.

Product range

CERES is currently purusing two categories of products, one is fundamental food basket which includes Rice (OP & Hybrid), Pulses, and oilseeds. The other category is subsidiary food basket which includes Potato, Sweet Potato, and Yam.

Infrastructure

- Dedicated 20 hectare state of the art R&D facility with green houses, tissue culture facility, seed care facility and *in-situ* gene bank.
- Three modern seed processing units for rice, pulses and oilseeds.
- Dedicated processing and cold storage unit for seed potato.
- Farmers training centre.

Programs

The Company is currently executing three programs *viz.*,

Bhumiputra

CERES has rolled out its flagship program to develop Seed Entrepreneurs with educated unemployed youths. The Company will train educated unemployed youths for seed production and will arrange 100% buyback arrangement of the quality produce.

Formation of Seed Growers' Producer Company

CERES has initiated a dedicated program with a group of farmers in a watershed in Jharkhand to grow quality pulse seed. The growers will be continuously trained on business development and organization development with the intention to form a producers' company in 3 years. CERES will then have an exclusive arrangement with the producers' company for marketing of seeds.

Corporate-Cooperative Partnership

Four fairly large Primary Agricultural Cooperatives of West Bengal, India has come under this program, where CERES has been enhancing the core competence of these institutions in the field of quality seed production. The technical support has been given to them and necessary R&D infrastructure are being developed for the benefits of the member farmers.

POSCON

Confederation of Potato Seed Farmers

India requires a massive quantity of quality potato seed to satisfy an area of 1.4 million hectares under crop. An informal system of production and supply of seed from Punjab to other states is now firmly established. The system has paid rich dividends to suppliers and the end users. It is, however now increasingly felt that the system necessarily needs better organization.

To unify and channelize the unorganized individual efforts, an attempt was effected to bring Punjab potato seed farmers under one umbrella which resulted in the establishment of Confederation of Potato Seed Farmers (POSCON). The objectives of the Confederation, *inter alia*, are to promote, develop and propagate seed potato production in the state ensuring quality, initially through internal audit. Subsequently, advanced and state of the art technology is proposed to be integrated into the system to produce world standard potato seed. One of the goals of the association is also to ensure that gains so accrued are evenly distributed amongst the farming community of the country.

POSCON is a voluntary non-government organization which has been created for the collective benefit of the seed potato growers of Punjab. The Governing body of POSCON comprises of members elected from the seed potato growers' community of the State. It is a registered society under the statute. Presently, about 165 elite seed potato growers of Punjab constitute the General House of the POSCON which is the supreme body of POSCON. The general house meets once in a month and discusses common issues relating to the interest of POSCON.

The total area under the members of POSCON in the year 2007-08 was 23,600 acres producing about 0.15 million tonnes of potato seeds. The POSCON members produce and market between 50% to 60% seed requirements of India. They generally rely on those varieties which have been approved by Government of India. The total turnover of POSCON members was about US $50 millions in the year 2007-08.

The POSCON is in liaison with model agencies for adoption of GLOBAL GAP requirements so that potato produced under its auspices finds acceptability in foreign lands. As the suitability of Punjab state for quality seed production is now a universally acknowledged fact, POSCON also looks forward to build symbiotic relationships with central and state Government bodies for sorting out issues related to potato seed export. POSCON on its part is ready with the requisite inputs on the issue and expects necessary support from the concerned departments. It intends to participate in mutually beneficial ventures with international groups having common interests and identical objectives. The POSCON has also developed strong linkages with potato equipment and machinery manufacturers and other corporate bodies to provide comprehensive support to seed farmers.

As a symbol of quality in potato seed, POSCON feels immense pleasure in associating itself with Global Potato Conference 2008 being staged at New Delhi (INDIA). It is hoped that through deliberations, the conference will further the cause of potato. POSCON wishes the event all success.

Coromandel Fertilisers Limited

Coromandel Fertilisers Limited (CFL), a part of the US $ 2.15 billion Murugappa Group, is a leading company in India manufacturing a wide range of fertilizers, specialty nutrients and pesticides with a turnover of US $ 1 billion. CFL is in the service of the Indian farming community for more than 40 years and is the largest private player in the complex fertilizer manufacturing in India.

CFL markets around 2.5 Million MTs of Phosphatic Fertilisers making it a leader in its addressable markets. It has 8 production facilities and markets its products all over India. The Company also has a significant global presence.

CFL is a leader in Phospho-gypsum, Bentonite Sulphur pastilles, Water Soluble Fertilisers and other micro-nutrients. The Plant Protection Chemicals portfolio covers over 45 types of insecticides, fungicides, herbicides, and plant growth regulators (PGRs).

CFL has forayed into rural retail and already has more than 100 outlets in place providing a great convenience to the rural customers by offering a range of farm and daily needs at convenient locations.

Over the years CFL has turned itself into a **Complete Plant Nutrition Solution Company** offering all types of Fertilisers to increase farm productivity and **Complete Plant Protection Company** saving the farmers' wealth from harmful pests.

BASF
The Chemical Company

About BASF

BASF is the world's leading chemical company. Its portfolio ranges from chemicals, plastics, performance products, agricultural products and fine chemicals to crude oil and natural gas. As a reliable partner to virtually all industries, BASF's high-value products and intelligent system solutions help its customers to be more successful. BASF develops new technologies and uses them to meet the challenges of the future and open up additional market opportunities. It combines economic success with environmental protection and social responsibility, thus contributing to a better future. BASF has approximately 95,000 employees and posted sales of US $58 billion in 2007.

India beckoned BASF way back in 1943. The company has been partnering India's progress with its vast knowledge in the field of chemistry and high quality products that cater to a wide range of industries. With a strong manufacturing and R&D base, the BASF Group in India is represented by more than 1300 employees having multi-location production sites and an R&D centre, which is part of the BASF Global Technology Platform.

In view of India's growing need for innovation, BASF had envisaged the growth potential of the Indian agro-chemical industry and embarked on its plan to be a notable player in this market with its high technological products. The Crop Protection Division in BASF operates with a vision to be the world's leading innovator, optimizing agricultural production, improving nutrition and enhancing the quality of life. Its mission is, with their highly motivated staff, to deliver products and services that meet the needs of customers and contribute to the sustainability of agriculture.

Globally, crop protection began for BASF in 1946 when it introduced the herbicide U 46 onto the market, a product for fighting weeds in grain crops. Today the company covers all the important fields of application with its wide range of herbicides, fungicides, insecticides and growth regulators. Products like Bavistin, Acrobat, Polyram, Intrepid, Stomp, Pursuit and Lihocin are ruling the roost in Indian market.

In addition to the above, BASF also has in its pipeline a new strobilurin chemistry product – **Cabrio Top**, a benchmark product in the fungicide market and a new generation insecticide – **Verismo** for Lepidoptera pests in vegetables, cotton and chilli.

The agricultural products division aims to sustain its role as a leading innovator by continuing significant research and development activities focusing on fungicides, insecticides and selected herbicides, where it expects further market growth and high demand for innovations.

Bejo Sheetal Seeds Private Limited

With the vision and far sightedness, Bejo Sheetal Seeds Pvt. Ltd. (BSS) was formed in 1986, as a joint venture with M/s Bejo Zaden b.v. of Holland. Bejo Sheetal Seeds started research activities in tropical crops *viz.*, Tomato, Chilli, Capsicum, Onion (short day) Okra, Watermelon, Muskmelon, Gourds, Eggplant, Cucumber, Pumpkin and True Potato Seeds. In the last 22 years, BSS successfully released over 800 hybrids of all the above crops. Gradually, the company became No. 1 in Chilli market of India and has also extended its marketing network in all SAARC countries.

At present, the company is having 160 ha land, along with 8 ha of poly-house and 1 ha of temperature controlled green houses, which are all used for breeding purpose. The company is also having regional research stations at Varanasi, Bangalore, Guntur, Solan, Khajuraho, Bhubaneshwar and Krishnanagar for zone-specific research. BSS has established most modern Gene transformation laboratory, Molecular Biology laboratory and Tissue Culture laboratory under Biotechnology department, along with Plant Pathology and Entomology laboratories. A group of 70 hard working agricultural scientists is totally devoted for the research of vegetable seeds.

True Potato Seed

In India Bejo Sheetal is only private company working for commercial production of TPS. Every year about 150-200 Kg TPS is produced in company's own farm. Now it is the only company which exports TPS to different African and Asian countries for their Potato production. However, to transfer the technology commercially in India, a new subsidiary company 'True Potato Seeds Private Limited' has been set up in 2007. The main work of the company is to produce seedling tubers from TPS and market it to potato growing area where reach of seed tuber variety is difficult.

GM Crops

Bejo Sheetal Seeds started working on Bt Brinjal and drought tolerant Tomato in which bio-safety & regulatory processes are carried out.

Exports

As a partner of Bejo Zaden bv, Bejo Sheetal is entrusted for export marketing of hybrid vegetable seeds in SAARC countries like Bangladesh, Pakistan, Sri Lanka, Nepal, Bhutan, Maldives & Afghanistan. However, True Potato Seeds is exported around the world, with very good response and demand from the African countries and Asian countries.

Joint Venture

The motto of BSS is to work for the betterment of farming community. So, to serve the farmers more efficiently, BSS made Joint Venture with the Government in India and with private sector in other countries. In India, BSS made joint venture company with Government of West Bengal, to cater to the need of small and marginal farmers of North East states of India, as well as neighbouring countries. In China also BSS formed a joint venture company for seed production.

United Phosphorous Ltd.

DECCO
WE CREATE SMART PROTECTION

United Phosphorus Limited

United Phosphorus limited (UPL), incorporated in 1969, is a leading global producer of crop protection products, intermediaries, specialty chemicals, industrial chemical, post-harvest products and range of farm machinery. Total turnover of the company is more than Rs.4000 crore.

Under our acquisition strategy we have recently acquired number of companies worldwide: SEQUISA – Spain, REPOSO - UK, ADVANTA (Seed division) – Netherlands, Unicorn Seeds, Golden Seeds, CEREXAGRI – (Pre & Post-harvest division) USA, ICONA – Argentina, with few products from DOW Agro, DuPont and BAYER Crop Science.

The magnitude of post-harvest losses in fresh fruits and vegetables is estimated to be 25–30% depending upon the commodity and the technological level of post-harvest operations. The growing importance of fruits and vegetables in commerce has led to development of various protective coatings with and without fungicides, bactericides, growth regulators, *etc.* Coating of fresh fruit and vegetables; has great potential in the storage and transportation of fresh produce.

Decco, a post-harvest division of UPL has worldwide presence and it is a leading company in Europe and USA in post-harvest segment. DECCO means (DECay COntrol) of fruits and vegetables. DECCO range is of high quality and used as a coating on fruits and vegetables. DECCO range is approved by FDA (US), European regulation and PFA (India) as food grade material.

Decco Portfolio includes Detergent, Fungicide/Disinfectant, Anti Scald (apples/pears), Coatings, Anti Sprout for Potato, Equipment (Machines), and Services (in selective countries).

Haldiram's - A Profile

Vision & Mission

Global presence as food & beverage company through innovation, professionalisation, expansion, strategic approach and business acquisition.

Background

Haldiram group of companies is in the business of packaged food, processing & selling branded namkeens, snacks, sweets, papad, syrups, ready to eats & bakery products to the retail and wholesale markets. Currently, it has the multilocational plants with a processing capability of 50,000 MT per annum. Haldiram has eleven restaurant-cum-showrooms at premium locations of Delhi and NCR with plan to open various outlets in northern India.

Haldiram story began over seventy years ago in Bikaner, a town in Rajasthan where it started a small family business selling namkeens & sweets out of a non-descript shop. The company is promoted by two first generation entrepreneurs having more than 30 years of experience in this line of business. What began as a small-time enterprise in India is today a global phenomena. Haldiram is now a way of life for Indians, no matter which country they live in. Besides India, Haldiram has business presence in USA, UK, Germany, France, Spain, Italy and 38 other countries of the world. Its products are available in world's top supermarkets like Tesco, Sommerfield, Spinneys, Carrefour, etc.

Quality Checks

There is a strong emphasis on international standards of manufacturing and quality control. Our products taste like they have arrived fresh out of granny's kitchen. We have regular laboratory check to ensure that the quality parameters of FDA, USA and Safety Act, UK are met at every level – raw materials to finished products. We also have advanced in-house facilities for aflatoxin, pesticides, Sudan colours and other microbiological tests.

Recognition

On account of maintaining international standards for the quality of its food products, Haldiram has bagged several awards like International Award for Food & Beverages (1994), Kashalkar Mamorial Award (1996), Brand Equity Award (1998), APEDA Export Award (2001-02), MERA Delhi Award (2004) and Amity Leadership Award (2008).

National Horticulture Board

National Horticulture Board (NHB) was set up by the Government of India in 1984 as an autonomous society under the Societies Registration Act, 1860 with a mandate to promote integrated development in horticulture, to help in coordinating, stimulating and sustaining the production and processing of fruits and vegetables and to establish a sound infrastructure in the field of production, processing and marketing with a focus on post-harvest management to reduce losses. The Managing Director is the Principal executive of NHB.

Objectives of NHB

The broad objectives are to :

- Develop high quality horticultural farms in identified belts and make such areas vibrant with horticultural activity which, in turn, will act as hubs for developing commercial horticulture.
- Develop post-harvest management infrastructure
- Strengthen Market Information System and horticulture database
- Assist R&D programmes to develop products suited for specific varieties with improved methods and horticulture technology
- Provide training and education to farmers and processing industry personnel for improving agronomic practices and new technologies
- Promote consumption of fruits/vegetables in fresh and processed form, etc.

Organisational Structure

An apex body known as Board of Directors supervises the Management of National Horticulture Board, which is headed by Union Agriculture Minister as its President and Union Minister of State for Agriculture as its Vice-President. The other members of the Board are as under:-

1. Secretary, Dept. of Agriculture & Co-operation
2. Director General, Indian Council of Agricultural Research
3. Horticulture Commissioner, Department of Agriculture & Cooperation
4. Financial Advisor, Department of Agriculture & Cooperation
5. Chairman, Agriculture & Processed Food Products Export Development Authority (APEDA)
6. Executive Director, National Horticulture Board (Ex-Officio)
7. Eight representatives in Horticulture Industry representing the interests of Cooperative ocieties, leading horticulturists and leading exporters of horticulture produce. (nominated by State Govt.)
8. A representative each of Food Processing Industry, Ministry of Shipping and Transport, Ministry of Railways, Ministry of Civil Aviation and Tourism or any other Ministry who may be invited specially with the consent of the President

National Seeds Corporation Limited

National Seeds Corporation (NSC) was established in 1963 as an undertaking under the Ministry of Agriculture, Govt. of India to organize the development of a sound seed industry in India. The establishment of NSC led to the advent of a seed revolution in the country which was the major driving force behind the Green Revolution.

NSC has a mission to contribute to the prosperity of farmers through supply of quality seeds and other agro inputs/services and works with the vision to lead the Indian Seed Industry by producing and marketing of quality seeds of wide range of crop, varieties and hybrids. NSC undertakes production of breeder, foundation and certified seed through 8500 dedicated contract growers and distribute the seed all over the country through a network of 2800 dealers and distributors. In its endeavour to reach the poorest farmers in the country in remotest places, NSC has been marketing 20% of its total volume in hilly, remote and un-accessible areas.

The Corporate office is located at New Delhi with 12 Regional Offices and 81 Area Offices spread over the whole country. NSC has established 43 seed processing plants with a processing capacity of 6.5 lakh q, 38 seed storage having a storage capacity of 3.89 lakh q per season. Two highly equipped packing centers exclusively for vegetable seed packing have also been established by the Corporation. The company has been awarded ISO 9001-2000 Certificate for Quality Management.

A NSC Potato Seed Production

NSC produces quality seeds covering about 80 crops and 800 varieties. The annual production is about 8 lakh quintals. The seed potato produced by NSC are sold right from the Southern part of the country i.e. Karnataka to the Eastern part of the country like State of Assam and Tripura. Besides the production and distribution of seeds, sale of planting materials like grafts, bulbs and tubers of ornamental plants, *etc.* are also undertaken by the Corporation. Apart from meeting the demand of the local farmers, by virtue of its diverse product range, NSC's seeds are also exported particularly to South, South Eastern Asia, African and Middle East countries.

NSC is supported by the Public Research System like Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUs) which undertakes continuous crops improvement programme and release new varieties. NSC's product base is composed of superior and high yielding varieties/hybrids released by ICAR and SAUs. NSC also functions as the nodal agency for implementation of various schemes of GOI. It also plays a key role in making the quality seeds available to the farmers under various Govt. of India schemes like Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize (ISOPOM) and National Food Security Mission (NFSM).

MAHYCO - India's Largest Diverse Seed Company

Maharashtra Hybrid Seeds Company Limited (commonly referred to as "Mahyco") is India's largest and most diverse private sector seed business. Founded in 1964 by an entrepreneur with a farming background, Mahyco has since inception, focused on the production of high quality OP/hybrid seeds and has been a pioneer in this respect. Strict adherence to the company's motto, "Quality Seed - Mahyco Seed" has led to its sustained growth and earned it the trust of farmers across the country.

Mahyco is currently engaged in the research, development, production, processing and marketing of 115 products in 30 crop species, including cereals, oilseeds, fibre crops and vegetables. It has to its credit 21 notified varieties. Meeting the diverse needs of farmers in a subcontinent with widely varying soil and agronomic conditions has been a challenging task, successfully accomplished by the strong research base and its seed production, processing, and marketing infrastructure. This has also been possible because of MAHYCO's timely and appropriate collaborations with academia and industry, both national and international, enabling it to keep pace with new developments across the spectrum and retaining its pioneer thrust.

Adherence to International Quality Standards

MAHYCO products are known across South Asia and in other Asian and African countries for their consistently high quality. The Mahyco logo is the symbol of trust and quality to farmers everywhere. In 1997, Mahyco was awarded the ISO-9001 certification for product development, production and processing.

Awards for Excellence

These efforts have been recognized and rewarded over the years:

- In 1989, Mahyco was the first agriculture-based company to receive the prestigious National Award for Research and Development presented by the Indian Ministry of Science and Technology.
- In 1990, Mahyco received awards from the International Seeds and Science Technology (ISST) organization and the Federation of Indian Chambers of Commerce and Industries (FICCI) for noteworthy contributions to the Indian seed industry.
- In 1996, the company's founder and Chairman, B.R. Barwale, was named Honorary Life Member of the International Seed Trade Federation (FIS) for his pivotal role in the development of the private sector seed industry in India, and for his dedicated service to national and international seed trade organizations.
- In 1998, Mr. Barwale was honored with the prestigious World Food Prize, considered the equivalent of the Nobel Prize in agriculture.
- In 2001, Mr. Barwale was conferred the "Padma Bhushan" by the President of India in recognition of his services to the country in the agriculture sector.

vegit
Potato Specialities

Merino Industries Limited

About the Group

- Merino group started its first operation in 1968 with cold storages of potato.
- It further diversified into panel product line and today it is Asia's largest manufacturer and India's largest exporter of high pressure decorative laminates.
- The brand Merino is known in the panel industry for providing integrated solutions from raw material to customized and modular furniture.

Going by the same philosophy, Merino has integrated its activities in agro operations like:

- Tissue Culture Labs for development and multiplication of seeds
- Contract Farming
- CIPC treated cold storages
- Potato flake plant for processing of potatoes to dehydrated form, thus, bringing convenience, hygiene and uniform taste to the food industry.

Merino and Potato

Potato Seed Development and Multiplication

Tissue Culture Laboratory has been established at Bhimtal (Uttarakhand) and Hapur (UP) for development and multiplication of potato seeds and other crop seeds.

Contract Farming for producing selected variety of potatoes.




CIPC Treated Cold Storages

- Merino has upgraded its cold storages to CIPC treated ones.
- CIPC treatment ensures availability of farm fresh potatoes throughout the year with controlled sugar.

Potato Processing

Merino has imported an entire line of automated plant from Europe for manufacturing dehydrated potato flakes.

KF Biotech Private Limited

High quality seed is essential for the production of profitable potato crops. It involves complex operations and conformity with numerous seed potato norms. We at KF Biotech Pvt Ltd (promoted by Kapur Farms) are all set to produce the best quality early generation seed potatoes in the country.

We have in-house:

1. **Advanced plant tissue culture lab:** It is just 20 km from Bangalore International Airport. Total covered area is about 12,500 sq. ft. The bio-clean area consists of 4 Plant Inoculation Rooms (PIR) of class 10,000 sterility level. The highly efficient laminar airflow workstations in PIR ensures complete bio-load free working environment with class 100 US FED STD 209 E. Total 4 PIR rooms with 39 no. of LAF stations are installed where 156 technicians may transfer 1.50 lakh plant cultures in 2 shifts per day.
2. **Advanced green houses:** It is specially designed for the production of TISSUE TUBERS (Minitubers or Generation 0) round the year in Bangalore under stringent quality control measures. Our hygienic cold storage and post-harvest handling facility add the quality of the product and bound to deliver field ready TISSUE TUBERS ensuring their rapid and uniform emergence in the field.
3. **Field agronomy:** Kapur Farms have been in business of field multiplication of seed potato in its prime place- Jalandhar, Punjab since 1970. Their in-house management of suitable land and other infrastructures such as advanced tractors, harrows, cultivators, seed planters and harvesters assure completion of operations in stipulated time for the production of early generation seed potato viz., G1, G2 and G3.
4. **Marketing network:** Our regional sale officers in Jalandhar, Bangalore, West Bengal and Gujarat offer best services to the farmers on their doorstep. Our transport facilitates rapid delivery of quality seeds at destinations across the country. Experienced staffs, moreover, render agronomy services to the growers on need basis.

As such, **we offer total supply solutions under one roof to the potato industry.**

Micropropagation of pathogen-free potato plants

Field ready Tissue Tubers ready for dispatch

Field planting of Tissue Tubers in Jalandhar

Scientific Pursuits of Indian Potato Association

Inauguration of Global Conference on Potato, 1999 by Dr MS Swaminathan

Delegates of Global Conference on Potato, 1999

Delegates attending the Global Conference on Potato, 1999

Mrs. V. Ramanujam inaugurating the Ramanujam Symposium, 2003 at Shimla

Dignitaries of Ramanujam Symposium, 2003 at Shimla

Dignitaries of National Conference on IPR, 2005 at New Delhi

Dignitaries of National Symposium, 2005 at Udaipur

Dr SK Pandey deliberating at National Symposium, 2005 Udaipur

Delegates of National Symposium, 2005 at Udaipur

Inauguration of National Symposium, 2007 at Ooty

Dignitaries of National Symposium, 2007 at Ooty

Annual General Body Meeting, 2007 of Indian Potato Association

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CERES BEEJA RESEARCH PVT. LTD.

Confederation of POSCON Potato Seed Farmers

BASF The Chemical Company

WBCSF

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KF BIOTECH KAPUR FARMS

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Dept. of Biotechnology
Ministry of Science and Technology
Govt. of India

Haldiram's

Partners

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NATIONAL HORTICULTURE BOARD

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CENTRO INTERNACIONAL DE LA PAPA
CIP