Number 32 July, 2005

From the Director's Desk

After assuming the charge of the Director to lead this institute, this is the first printed message being released through my desk. My interaction with potato, spanning more than three decades, has been quite fascinating, and equally fascinating is its genetics and recalcitrance to succumb, for genetical exploitation, to a breeder like me, who has spent most of his time compromising the crop in varietal improvement programme. No doubt that it is a fascinating food with equal culinary compatibility for both slow and fast consumption. But more fascinating is the crop in the field with its colourful flowers endowed with a multitude of reproductive barriers and an evolutionary liability to negotiate the ploidies. The cultivated tetraploid needs to be reconstructed with half of its chromosomes so that it can be genetically enriched by diploid semi-cultivated/ wild Solanum species. Therefore, dihaploid production constitutes the real strength in potato breeding against the evolutionary tide. In this issue, the thematic article is on androgenesis in tetraploid cultivated potatoes, and its scope for potato improvement. It is definitely not a new subject, rather too old. But its scope and potential for potato improvement is still overriding even after 30 years in this present-day genome-centric era. Anther culture for ploidy reduction through androgenesis is an effective technique, but enigmatic, I would say, in cultivated tetraploids even after 30 years of concerted research world-wide. Recently, we have been successful in this institute to induce androgenesis in some of the tetraploid Indian cultivars. Although the success is modest, but we have at least the means to extend it to other tetraploid cultivars in an attempt to generate their dihaploids without ambiguity. This would not only increase our capacity to strengthen the varietal improvement programme through both conventional and non-conventional means, but also help us in addressing some of the fundamental problems in this crop thriving for centuries to get rid of its evolutionary disadvantages. In subsequent issues of this News Letter, I believe, I will have more opportunities for expressing some of my views on this wonderful crop poised to sustain food and nutrition security in the country.

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RESEARCH HIGHLIGHTS

Indian Potato Vatieties have Narrow Matrilineal Pedigree

In crops like potato (*Solanum tuberosum* L. ssp. *tuberosum*) that are highly heterozygous auto-tetraploid, organelle, studies are expected to provide a better picture of available diversity. Nuclear genome based molecular markers, in most cases, fail to provide a clear picture on genetic diversity analysis of cultivated potato. Chilean (*S. tuberosum* L. ssp. *tuberosum*) and Andean potato (*S. tuberosum* ssp. *andigena*) can be distinguished from each other by photoperiod for tuberization, morphological traits and cytoplasmic genome (plastidal/ mitochondrial DNA). Chilean type has a very narrow genetic base mostly derived from old European variety Red Purple Chilli, while the latter are known for their wide diversity with origin in Andean America. Considering all these it becomes necessary to evaluate chloroplast type of all varieties as well as advanced breeding lines to know the divergence revealed by the organelle DNA. A study was conducted to analyse cytoplasm types of thirty-two Indian potato varieties and forty-three advanced hybrid lines developed at our institute.

Typically organelle genome are haploid, non-recombinant and maternally inherited, with a few exceptions. Heteroplasmy or recombination has not been observed in plastid genome unlike its mitochondrial counterpart, thereby making them an excellent tool for phylogenetic divergence studies. Earlier, organelle RFLP were used for such purpose, which were cumbersome. However, with availability of sequence data from tobacco, a closely related genus it has become possible to develop markers with high resolving power, based either on i) PCR amplification or ii) cleaved amplified polymorphic sequences (CAPS) of introns/intergenic regions and iii) plastid SSR (cpSSR).

PCR amplified H2 marker products after digestion with HaeIII

The present study included three markers (H1, H2, H3) based on deletion in chloroplast genome and four cpSSR markers, to investigate plastid genome type of Indian varieties and breeding material in advanced stages of evaluation. H1 is a simple PCR based assay to distinguish the T-type chloroplast DNA marked by a 241bp deletion in *ndhC/trnV* intergenic region. Most of the varieties having unique, T-type chloroplast DNA derived from Chilean cultivated potato. Two CAPS markers *i.e.* H2 and H3 marker involved PCR amplification of *rbc*L (H2 marker) and *ycf*4 + *ycf*10 (H3 marker) followed by restriction digestion with *Hae*III and *Dra*I respectively. Similarly plastid microsatellite flanking mononucleotide regions have been developed from *Nicotiana tabacum* chloroplast DNA (NTCP markers). Four NTCP markers (NTCP 6, 8, 9 and 14) reported of polymorphic nature in various studies were analysed by semi-automated capillary-based electrophoresis.

T-type chloroplast deletion typical of *tuberosum* type was found in all except 5 varieties (Kufri Jawahar, Kufri Megha, Kufri Chipsona-1, Kufri Chipsona-2) and 11 advanced lines (J/92-167, MS/ 95-1309, MS/97-621,MS/97-1606, MP/97-583, MP/97-625, MP/97-644, MP/97-921, EX/A 680-16, MP/98-71, SM/85-50). Those having T-type chloroplast were placed in same group in other analysis as well, while non-T-type showed 2 groups, Group-A (MS97-621 and its maternal parent EX/ A680-16) and Group-B (rest of non-T-type samples).

Results obtained were not as expected since most of the Indian varieties are considered to resemble *andigena* type, unlike

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DIRECTOR GENRAL, ICAR VISITS CPRI

Front view of new building inaugurated by the DG, ICAR

Dr. Mangala Rai inaugurated the new research lab-cum-administrative building on 11th July, 2005 during his visit to CPRI. The building has been recently constructed with all the modern infrastructure and the visiting dignitary gave a general appreciation to the construction design and the material used. He emphasized that some good labs should be shifted to the new building at the earliest, which will provide good ambience for better output.

During inauguration, Dr. G. Kalloo, DDG (H & CS), Vice Chancellors from six universities representing HP, Uttaranchal, J & K, and NE States besides several other invitees of the steering review committee, engineers from CPWD and all the staff members of the Institute were present. Dr. Rai also visited the Institute Campus and Laboratories and appreciated the work going on.

Dr. Mangala Rai, visited Kufri and Fagu farms of the Institute on 12th July. He was shown around the seed farm and the crops of stage I and II at Fagu by the Director. Dr. Anwar Alam, VC of SUKAST, Srinagar and Dr. Nagendra Sharma, VC of SUKAST, Jammu, accompanied the DG. Dr. Rai felt that there was an urgent need to review the seed production strategy of CPRI. Keeping in view the emerging IPR regime, efforts must be made to reduce the number of seed multiplication stages in the field and shift the focus to tissue culture based seed multiplication. He further emphasized that we should prepare ourselves to compete with other international agencies in the future, so that we are globally competitive in potato seed production. Dr Mangla Rai visited Shimla in connection of steering review committee meeting of Horticulture Technology Mission Mini Mission-1 held at CPRI, Shimla.

Inauguration of building by DG

Planting of Chinar sapling by DG at Kufri

DG visiting potato seed farms

Contd....from Page 2

Europe where potato is grown under long day summer conditions. Combinations of breeding characters most suitable for higher yield in sub-tropical plains accounting for 85% of Indian potato area is more like that of *andigena* type than that of *tuberosum* type. Cytoplasm types studies using chloroplast markers pointed that divergence was observed only in few recently released varieties / advanced lines. Similar results were observed in European potato cultivars most of which have T-type cytoplasm. Further studies on mitochondrial genome types are in progress to get clearer picture on the cytoplasmic diversity status in Indian potato varieties/ advanced breeding lines.

–VP Chimote, D Pattanayak, SK Chakrabarti and PS Naik

Allelopathy and Potato Crop

Allelopathy, a comparatively new field of science deals with the biochemical interactions among plant species. According to the International Allelopathy Society (1994) 'Allelopathy refers to any process involving secondary metabolites produced by plants, microorganisms, viruses and fungi that influence the growth and development of agricultural and biological systems'.

The chemicals released by the plant species, specifically for affecting the neighboring plant species are mostly secondary metabolites and termed as allelochemicals. Their mode of action is selective; they play a vital role in chemical warfare among plants (as inhibitors) and sometimes act as growth stimulators. These chemicals occur in leaves, stem, roots and in reproductive parts and act through leaching, volatilization and as exudates. These allelochemicals mainly affect the cell division and elongation, phyto-hormone induced growth, membrane permeability, mineral uptake, photosynthesis, respiration, protein synthesis and inhibition or stimulation of specific enzymes etc.

The main focus of allelopathic research in potato crop, abroad, is on search of bio-control agents for weeds, pests and pathogens and sprout inhibitors apart from stimulatory allelochemicals for growth, productivity and tuber quality. *Brassica* sp. has been used for controlling annual weeds as green manure crop and for nematode control. Isoflavonoids have been tried as anti-fungal components and *Bacillus subtilis* and *Ttrichoderma* sp. have been evaluated for soil borne diseases. In pest control, allelochemically mediated host resistance and allelochemicals have been tried for Colorado potato beetle and aphid control. Jasmonic acid and Jasmonic methyl ester has been reported for controlling late blight disease and *Fluorescent Pseudomonas*, which produced several esters reportedly suppressed *Rhizoctonia* sp. Several essential oils have potential for their use as sprout inhibitors.

However, very scanty work has been carried out on potato allelopathy in India. The Indian Council of Agricultural Research is planning to initiate a network project in this direction. A proposal has also been developed at Central Potato Research Institute for this network project, to have a start in this direction with the objective of developing environmental friendly agro-technologies for potato production.

The pilot studies have been carried out at CPRI Campus, Modipuram on application of crop residues for their possible use in weed control and on varietal evaluation for probable weed inhibition. First study included the application of crop residues of sorghum, paddy, sugarcane and *Brassica sp.* as live mulch. Sorghum proved best for weed control by reducing weed dry weight per unit area by over 75% followed by paddy (54%) and sugarcane (45%), however, *Brassica* sp. as live mulch was not effective in controlling weeds due to poor growth caused by inter specific competition with potato crop. The potato yields (366-397 q/ha) were higher in treatments of crop residues of sorghum, paddy and sugarcane over control (344 q/ha), but the potato yields were low in live mulching of *Brassica sp.* (299-330 q/ha) due to weed infestation and inter crop competition.

In second study, 15 cultivars were evaluated with respect to weed control and cultivars K. Anand, K. Badshah and K. Chandramukhi were able to suppress weeds as compared to control. However, the possible allelopathic angle can only be proved after isolation, identification and characterization of biochemical components of potato crop.

The science of allelopathy has immense potential for developing environment friendly production technologies for potato crop. Many important aspects are needed to be investigated, like, improvement in

tuber yield and quality by including stimulatory crops in cropping and inter-cropping systems, yield improvement through use of isolated stimulants, weed control, pest and disease management through use of allelochemicals and search for a natural sprout inhibitor. Isolation of allelochemicals in potato plant is also equally important as this may give future direction in breeding weed, pest and disease resistant varieties.

– Sanjay Rawal, Parveen Kumar, MA Khan and SS Lal

Methodology Developed for Quantification of Tuber Shapes

Tuber-shape is an indispensable quality trait in potato improvement. Criteria for evaluation of tuber-shape have largely been qualitative and comparative. Authentic information regarding precise tuber shape and size plays key role in designing the harvesting and post-harvesting machines. Tuber shape not only attracts but also decides its clientele and/or regions of demands for ware, seed and processing depending upon the product specific requirements. For instance, round is most preferred shape for chips whereas long tubers are essential for French fries. In the absence of standard methodology or index for different shapes it is difficult to visualize the proximity of shape *per se* to its actual shape category. For example, if a given tuber is oval, then how much oval it is and if another tuber is round then what is the demarcation/ reference point of roundness and ovalness and so on. Deviations from desired tuber shapes would therefore, increase total losses at various stages of processing such as peeling, trimming, grading etc. Besides, the quality of finished products gets deteriorated. The most common shapes in commercial potato cultivars are round, oval, long etc. Quantitative categorization of various shapes is possible only when a shape index is developed and tested.

For the purpose scientists at CPRI have developed a methodology to quantify the tuber shapes in potatoes. It would help avoid ambiguity regarding various shapes often encountered by the potato researchers/users. For determining the shape index, tuber samples must be drawn from fully matured crop so as to get the actual shape of tuber from a particular cultivar. The maximum length, width and thickness representing three different planes of the tuber as depicted in orthographic view is measured (Fig.1) by using a simple potato gauge. The measured maximum value, across a particular plane may be fitted in the formula for obtaining potato shape index (PSI).

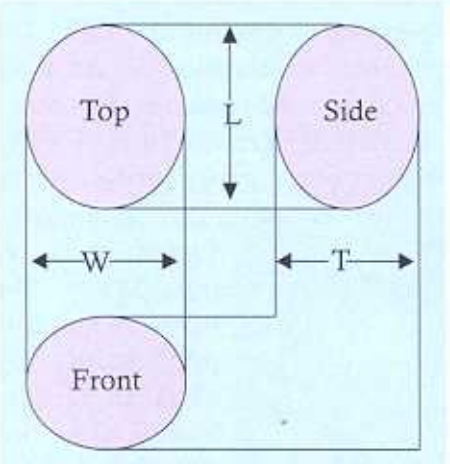

Fig. 1. Orthographic view of potato tuber depicting maximum length (L), maximum width (W) and thickness

$$PSI = \frac{L^2 \times 100}{W \times T}$$

Where, PSI = Potato shape index, L = Maximum length, W = Maximum width and T = Maximum thickness each in centimeter.

PSI values have been confirmed for most common shapes viz. round (100 to 160), oval (161 to 240), long (241 to 340) and very long (>340) and a PSI scale has been developed. Potato shape index (PSI) would provide more precise information for intended use of potatoes particularly where tuber shape has specific role.

– Devendra Kumar, B.P. Singh and Sukhwinder Singh

Comparative Efficacy of Two Formulations of Imidacloprid for White Fly Control

White fly, *Bemisia tabaci*, is one of the most damaging insects in world of agriculture because of its direct feeding, contamination of plant products and ability to transmit plant viruses. In recent years, it is being considered as a vector of Gemini virus which results in outward expression of symptoms as apical leaf curl in potato. Because management of this pest is difficult and management strategies have to take into consideration of insect biology, behaviour, natural enemies, even development on different hosts and response to chemicals may differ in different populations. The result obtained by spraying the seed crop of potato showed that there was some difference in mortality values of two chemicals against white fly, made by two different companies, claiming same percentage of active ingredient.

Variety Kufri Sutlej was planted on 23.10.2004 at CPRIC Modipuram and the population of white fly was monitored regularly as this variety suffers heavy losses due to apical leaf curl virus. Plots were selected and sprayed with Imidacloprid 0.02% concentration of two different Companies, Confidor 200SL of M/s Bayer India Ltd. and Confidence 555 of M/s Jaishree Agro, Nathupur (Haryana) on 3.12.2004. Observations were taken on the mortality of white fly after 24 hrs. Imidacloprid Confidor (200SL) gave approximately 88% mortality and dead white flies were found glued to the leaves of the plants, while in case of Confidence 555, live white flies were wandering in the plots and mortality was certainly lower (20%) than the Confidor 200SL. Therefore, it is desirable that when similar chemicals are manufactured by two or more firms, their efficacies must be compared before their recommendation.

– *Kamlesh Malik and B.P. Singh*

Technology Transfer

KISAN MELA

Central Potato Research Institute Campus (CPRIC), Modipuram and the All India Radio (AIR), New Delhi jointly organized a three and half month long "Potato School on AIR" starting from 27th September, 2004. The School was sponsored by Krishak Bharati Co-operative Limited (Kribhco), Noida, UP. The objective of the Programme was to educate the masses about the scientific cultivation of potato. In this regard AIR has come out with the new concept of " Agricultural Schools" on various themes through which a curriculum was developed on a particular subject and the same was dealt by experts in their respective field through AIR. 'Potato School on AIR' was one such exercise.

Farmer's gathering at *Kisan Mela*

The structure of the programme included registration of the farmers, airing of 28 talks on potato cultivation, storage, processing and marketing by potato specialists drawn from CPRI; interactive programme with farmers including their assessment based on 'performance test' specifically designed for the purpose and publication of book in Hindi, based on the compilation of the lectures. During concluding function of the on-going "Potato School on AIR" a Kisan Mela was organized at CPRIC, Modipuram, Meerut-250 110 (UP) on 15th January, 2005. Dr. G. Kalloo, Deputy Director General (Horticulture and Crop Science), ICAR, New Delhi was the chief guest of the function and inaugurated the Kisan Mela.

Release of Hindi Book at Farmers' Mela

A total of 1200 farmers drawn from 12 states had registered for the Potato School on AIR and majority of them attended this *Mela*. In total, more than 1500 visitors attended this *Kisan Mela*. Highlights of the *Kisan Mela* included an exhibition on all aspects of agriculture including potato and prizes were given to farmers who performed better in sending their answers to the questions asked on radio during the Potato School on AIR. About 50 organizations and firms put up their stalls in exhibition to highlight their activities and/products for benefit of the farmers.

Trainning in North East

Two-day training courses on potato production, protection and storage for the farmers of NEH region were organized during May, 2005 at Bomdila (Arunachal Pradesh), Jharnapani (Nagaland), Regional Potato Farm, Mao (Manipur) and Shillong (Meghalaya) under Central Sector Scheme for Integrated

Field training at Mao farms

Development of Horticulture in North-Eastern states including Sikkim (MM-I). In all, 110 farmers including 33 female farmers actively participated in these trainings. These trainings were organized by CPRI under leadership of Dr. PH Singh, Nodal Officer for CPRS, Shillong

Farmers training at Nagaland

in cooperation with District Agriculture Officer, West Kameng District, Bomdila, Joint Director, ICAR Research Complex for NEH Region, Nagaland Centre, Jharnapani; Director of Horticulture and Soil Conservation, Govt. of Manipur and the Head, Central Potato Research Station, Shillong.

Besides, a two-day training on the same aspects was also organized at Shillong for the Agriculture/ Horticulture/Extension officers of all the 8 states. A total of 18 officers; 3 each from Arunachal Pradesh, Manipur, Meghalaya and Sikkim and 2 each from Mizoram, Nagaland and Tripura attended this programme. Resource persons deputed from CPRI for both the trainings were Drs. PH Singh, AK Somani, Ram Kishore and KC Thakur. Besides class room lectures on various aspects of potato cultivation, each training followed practical and field demonstrations.

Field Demonstrations for Technology Dissemination

Field demonstrations on fertilizer, late blight and white grub management in potato are being conducted by the Division of Social Sciences at Kufri, Galoo, Talai and Bekhalti villages of Shimla district for technology dissemination with active involvement of CPRI scientists. The crop in the demonstration plots are in good vigour and relatively free from diseases and insect-pests as compared to the crops raised with farmers' practice. The final results will be obtained after harvesting in October, 2005.

Awareness Camp at Palampur

The Division of Social Sciences conducted an awareness camp at Malan *panchayat* of district Kangra on June 7, 2005 for technology dissemination to make the farmers aware of the latest technologies to control the infestation of Potato Tuber Moth in the field and during storage. The programme was divided into two sessions. In the first session, Dr. VK Chandla, Dr. RS Chandel, Dr. Brajesh Singh and Dr. Anil Kumar delivered lectures on different aspects of potato cultivation including PTM control measures.

Interaction of farmers and scientists

A total of 105 farmers including *Pradhans* of Malan, Ambari and Lakhamandal *panchayats* attended the camp. Exhibits were also put up to depict the recent potato production technologies. The farmers raised their problems and the scientists suggested solutions to those problems.

After this session, CIPC treatment was demonstrated in the potato stores of 10 selected farmers of the three

Field demonstration at Fagu

Practical demonstration of PTM control

panchayats. It has been found that besides suppressing the sprout growth of tubers in the stores, CIPC also reduces the incidence of PTM in storage. These demonstrations were done to validate this finding.

Field Orientation Programme on Potato at CPRS, Muthorai

Central Potato Research Station, Muthorai, The Nilgiris organized a one day **"Field orientation program on Potato Production technologies"** on 13th July, 2005 at it's farm, for Horticultural officers from Directorate of Horticulture Tamil Nadu and Karnataka. In addition to 16 Horticultural officials, four Agricultural managers each from State Bank of India, Canara Bank, Syndicate Bank, and Nilgiris District Central Cooperative Bank Ooty, also took part along with two participants from potato industry. The programme was inaugurated at 10.30 a.m by Sh. S.J. Chiru, Project Director of Hill Area Development Programme of Nilgiris district.

At the outset, Dr.Krishna Prasad, Head of the station explained the present scenario of potato production in India as well as in Nilgiris. Talking about the history of potato research in India, he informed that initially Potato Development Centre was started at Nanjanad village in Nilgiris and then a potato development project was started by then government in 1931. In 1939, Central Potato Research Institute was established in Patna and then in 1956 it was shifted to Shimla. At present India is in third position with respect to potato production after China and Russia. He also touched upon the marketing aspects of Nilgiri potatoes saying that Mettupalayam market is the most stable one when compared with that of North Indian markets. He also informed that in Mettupalayam about 75 crore rupees turn over was recorded from Nilgiri potatoes alone indicates that the area under potato in Nilgiris is around 3500ha.

Sh. Chiru in his inaugural address appreciated the work being carried out by the scientists of the station in improving the potato production in the area. Mentioning that potato is the staple food in most of the countries, he expressed the need for development of its marketing needs for the benefit of farmers. He wished that during the course of deliberations the expectations of the delegates will be fulfilled.

Sh. Bellie, Deputy Director of Horticulture, presiding over the inaugural function, felt that such type of programmes need to be organized frequently, so that the research findings can be well informed to the farmers through extension wing. He also participated in the programme as a participant. In his speech, he informed the gathering that in 1970's Directorate of Horticulture has promoted tea cultivation due to plant protection problems in potato. But, now the tea prices are fluctuating very much, making the farmers to destroy the tea gardens and go for traditional potato cultivation. He urged the

Horticulture officers from Tamilnadu and Karnataka being shown potato fields at CPRS, Muthorai

scientists to develop short duration varieties with pest and disease resistance, and to supply optimum size seed tubers for further distribution to the farmers.

After the inaugural session, the trainees were taken to museum by Dr.T.A.Joseph, Senior Scientist, where he explained about the objectives of the station, present research programmes, future area of interest etc. During field visit, he also explained the varieties that are suitable for the locality, their merits and demerits etc. He also took the participants to demonstration plots where various varieties released by Central Potato Research Institute are grown. Dr.K.Manorama, Senior Scientist, informed the participants about the improved cultural practices in potato cultivation. She also explained the suitable crop rotations; inter cropping systems and also the importance of integrated nutrient management. Dr.Krishna Prasad has explained about the biology and life cycle of Potato Cyst Nematodes, its field symptoms and its management measures. Dr.Ravichandran briefed about the late blight management and also the method of quality seed production. Dr.Muthuraj demonstrated the method of using sprouts for planting through scooping method to reduce cost on seed.

The plenary session started at 4.30 p.m, was chaired by, Sh.R.Ramanujam, the Assistant General Manager, State Bank of India, who distributed the certificates and exhorted the delegates to transfer the technologies developed at the station to the farmers. The representatives from various Departments gave their feed back to improve the potato cultivation in Nilgiris. Officials from Directorate of Horticulture expressed the need for development of a system to increase the production of quality seed potatoes to meet the demands of the farmers. Bank officials explained about the banking facilities and crop insurance available for potato cultivation. They also urged that, this information need to be passed on to the farmers by other extension agencies.

– K.S. Krishna Prasad

Important Meetings

Steering Review Committee Meeting of the Mini Mission-I

Steering Review Committee meeting of the Mini Mission-I of "Technology Mission on Integrated Development of Horticulture" in NE States, Sikkim, J & K, HP and Uttaranchal was held in CPRI, Shimla on 11th July, 2005 for appraisal of the on going projects and approval of new projects. Dr. Mangala Rai, Secretary (DARE) and DG, ICAR chaired the meeting which was attended by Deputy Director General (Hort. and Crop Science), Dr. G. Kalloo, Vice-Chancellors of State Agriculture Universities, Secretaries and Directors of State Department of Agriculture/Horticulture, Nodal Officers of the 4 regions and other high level dignitaries. The meeting witnessed the presence of 6 Vice-Chancellors viz. Dr. PL Gautam of GBPUA& T, Pantnagar, Dr. SN Puri of CAU, Imphal, Dr. Nagendra Sharma of SUKAST, Jammu, Dr. Jagmohan Singh Chauhan of YS Parmar UHF, Solan, Dr. DS Rathore of CSKHPKVV, Palampur and Dr. Anwar Alam of SUKAST, Srinagar. Dr. SN Pandey, ADG Horticulture and Member Secretary of the meeting welcomed the participants to the meeting. Dr. G. Kalloo, DDG (Hort) emphasized the basic objectives of the mission:

(i) to improve and enhance the planting material of vegetables, fruits, flowers and mushroom,

(ii) refinement of production and protection technologies and

(iii) training of the farmers/ agriculture officers/ trainers.

DG addressing the steering committee

Dr. Mangala Rai, DG, ICAR in his opening remarks emphasized the need for right planting material for long term benefits reminded the target of doubling the horticultural production in India from the current level of 150 million

tonnes to 300 million tonnes by 2012. This target could be achieved through upgradation of the orchards and by providing new varieties and their planting materials. Dr. Mangala Rai also emphasized the need to promote tissue culture to provide basic seed/planting material on large scale. He told that there are countries where 100% planting material in horticulture crops goes through tissue culture. In India also this could be done by building necessary infrastructure and toning up the development departments.

Dr. SK Pandey, Director, CPRI, Shimla, Dr. RC Upadhayay, Director, NRC on Orchids, Sikkim, Dr. HS Gupta, Director, VPKAS, Almora and Dr. AA Sofi, Director, CITH, Srinagar presented the progress report of Mini Mission-I for HP, Sikkim and NE States, Uttaranchal and J&K state, respectively, in this meeting. Besides taking stock of progress of on-going projects, several new projects were approved in this meeting, which ended with vote of thanks proposed by Dr. SK Pandey.

INSOPP Symposium at Shimla

CPRI, Shimla organized annual meeting of Indian Society of Plant Pathologists (INSOPP) and Centenary Symposium on Plant Pathology during April 7-8, 2005 at Shimla under the auspices of INSOPP. Over 70 plant pathologists from different parts of the country participated. A special session on potato entitled, "Developments in Production and Protection Technology of Potato-Future Needs" was arranged. The Symposium was inaugurated by Dr. CD Mayee, Chairman, ASRB, New Delhi.

Research Advisory Committee (RAC) Meeting : Research Advisory Committee (RAC) of CPRI met at CPRI, Shimla on 25-26 July, 2005 under the chairmanship of Dr. Kirti Singh. The progress made in the 21 programmes was presented by the respective programme leaders before the RAC. RAC reviewed each programme critically.

Staff Research Council (SRC) Meeting : SRC of CPRI met after RAC on 28-30 July, 2005 at CPRI Shimla. The suggestions and recommendations given by the RAC were discussed and research programmes were framed or modified accordingly.

Trainings

Bhutan Scientists trained : Two scientist from Bhutan sponsored by the International Potato Center (CIP) New Delhi office have received a week training in ELISA and other aspects of potato seed prodection at CPRI Shimla during 9-14 May, 2005.

- One day training programme on seed production for the District Horticultural Officers and Assistant Seed Production Officers of Bihar was organized on 11.08.2004 at CPRS, Patna. A total of 15 Districts Horticultural Officers from different districts of Bihar participated in the programme.
- A group of 15 Horticulture Officer and Farm Management specialists sponsored by State Govt. of Meghalaya were imparted one-day training on R and D activities on Potato at CPRS, Patna on 26.10.2004.
- A three-week training on "Seed Potato Production Technology, Virology and Biotechnology" was organized at CPRIC, Modipuram for agricultural officers of Govt. of Manipur. The trainees were given hands on training on seed potato production and disease and pest management.

Invited Lectures and Visitors

- Professor Mohammed M. Anwar, Principal Scientist, NAARM, Hyderabad gave a lecture on "Human Resources Management – Management

Meghalaya Govt. officers getting training at CPRS Patna

of self and others" on 28.4.2005.

- Dr. DK Pandey, Head, Deptt. of Geology, Rajasthan University, Jaipur delivered his talk on "Geologicals aspects of Tsunami" on 16.6.2005.
- Dr. Prajneshu, Principal Scientist, IASRI, New Delhi delivered a lecture on "Non linear models" on 8.6.2005.
- Professor Bernard Paul, University of Burgundy, France delivered a talk on " Biological control of vineyard diseases in France" on 27.6.2005.
- 137 students and 100 farmers visited CPRI during January to June 2005. These visitors were escorted by senior faculty members/trainers and were mainly from U.P., Maharashtra, A.P., Karnataka, New Delhi and Pondicherry. The visitors were shown the Institute museum, ATIC museum, video film on potato, tissue culture labs and Kufri farm. Different resource persons of the Institute also delivered lectures and relevant literature was supplied to the visitors. Besides, 6 scientists from the ministry of Science and Technology also visited the Institute on 9th June under the foundation-training programme of Indian Institute of Public Administration, New Delhi.

Farmers' reading CPRI literature

Human Resource

Appointment

Dr. SK Pandey, Head, Division of Crop Improvement, CPRI, Shimla appointed as Director, CPRI, Shimla and took the charge on 20.5.2005.

Dr. P.S. Naik, Principal Scientist was appointed Project Co-ordinator All India Co-ordinated Research Research Project (Potato) by the ICAR. He has taken-over the charge in July 05.

Promotions

Name	From	To
	Scientific	
Dr. YK Sharma	Scientist, SS	Sr. Scientist
Dr. Brajesh Singh	Scientist, SS	Sr. Scientist
Dr. Dinesh Kumar	Scientist, SS	Sr. Scientist
Dr. K. Manorama	Scientist, SS	Sr. Scientist
Dr. SP Singh	Scientist, SS	Sr. Scientist
Dr. Yash Gupta	Scientist, SS	Sr. Scientist
Dr. Anil Kumar	Scientist	Scientist, SS
Dr. V Bhardwaj	Scientist	Scientist, SS
Dr. MA Khan	Scientist	Scientist, SS
Dr. RK Singh	Scientist	Scientist, SS
Dr. VK Gupta	Scientist	Scientist, SS
Dr. Shantanu	Scientist	Scientist, SS
Dr. R. Muthu Raj	Scientist	Scientist, SS
Dr. Barsati Lal	Scientist	Scientist, SS
Dr. Uma Sah	Scientist	Scientist, SS
	Technical	
15 persons	T-1	T-2
1 person	T-2	T-3
7 persons	T-3	T-4
2 persons	T-4	T-5
1 person	T-5	T-6
2 persons	T-6	T(7-8)
Sh. Gurmail Singh	T(7-8)	Next grade
Sh. AMR Sawale	T(7-8)	Next grade
	Administrative	
Sh. RL Verma	PA	Next Scale
Sh. DP Azad	Sr. Clerk	Next Scale
Sh. SD Chaturvedi	Sr. Clerk	Next Scale
Sh. RS Yadav	Asstt.	AAO
Sh. AS Keprate	Asstt.	AAO
Sh. IS Negi	Asstt.	AAO
Mrs. Chandni	Jr. Clerk	Sr. Clerk
Sh. JS Thakur	Sr. Clerk	Assistant
	Supporting	
6 persons	SS Gr. III	SS Gr. IV
9 persons	SS Gr. II	SS Gr. III

Transfers

Name	From	To
Dr. RS Meena	Shimla	NRCSS, Ajmer
Dr. RK Singh	Gwalior	do
Sh. Subhash Chand	Shimla	Modipuram
Sh. Suresh Kumar	Gwalior	Kufri
Sh. JS Thakur	Shimla	Modipuram
4 Supporting posts	(Rajgurunagar)	NRC Onion & Garlic

Retirements

Name	Post	Retired on
Sh. Nand Lal	AAO	30.4.2005
Sh. YP Gupta	AAO	31.3.2005
Sh. Doman Dass	SS Gr. II	31.5.2005

Demises

Name	Post	Expired on
Sh. Bhaskra Nand	T-3	22.1.2005
Sh. Tek Bahadur	SS Gr. II	27.2.2005
Sh. Suba Ram	SS Gr. IV	8.3.2005

Awards

- Drs. BP Singh, S Roy and PH Singh bagged Hari Om Ashram Trust Award for the biennium 2003-2004 in the field of Horticulture for their contribution in basic and applied research on potato late blight disease epidemiology and control.
- Dr. Anil Kumar, Scientist (SS) of the Division of Social Sciences was awarded the degree of Doctor of Philosophy in Extension Education by the Banaras Hindu University, Varanasi in its annual convocation held on March 12, 2005.
- Shri Vinod Kumar, Scientist (Seed Technology), CPRS, Gwalior was awarded provisional Ph.D. Degree by UAS, Dharwad.

Future Activities

Trainng Programme on Potato

The Institute is going to organize 8 days model training course on "Seed Potato Production, Handling and Marketing" during August 17-24, 2005. The training course is sponsored by the Directorate of Extension, Ministry of Agriculture, Govt. of India and is meant for upgrading the knowledge and skill of the state agricultural/ extension officers. A total of 25 participants from different potato growing states of India will be admitted for the course. Division of Social Science will coordinate this training course.

Farmers Day

A farmers' day will be organized at Central Potato Research Station, Gwalior on 13th January, 2006. During this farmers' day, farmers will be acquainted with recent developments in potato research and development and with the new technologies available for adoption at their end.

National Conference on IPR and Management of Agricultural Research

The conference will be held at NASC Auditorium, Pusa, New Delhi from August 27-29, 2005 and is being organized by ICAR and Indian Potato Association, Shimla. Major issues that concern IPR in agricultural research, patents and *sui generis* IPR protection system and their management strategies will be deliberated in this conference.

Symposium on Current Perspectives in Potoato Research and AICPIP workshop

The symposium will be held on September 11, 2005 at Rajasthan College of Agriculture, MP University of Agriculture and Technology, Udaipur. It is being organized by Indian Potato Association and CPRI and will address issues relating to potato research and sustaining potato revolution in the country. Technical sessions will include topics on potato production, plant protection, potato breeding and biotechnology, post harvest technology and marketing.

All India Coordinated Potato Improvement project (AICPIP) will also hold its workshop at the same venue during 8-10 september 2005.

Potato Facts

Potato Could Help Weight Loss

Recent clinical data shows that what's inside the potato could help many people lose weight and keep

it less. After twenty years of research, scientists have successfully extracted a protein molecule from potatoes. A protein that tells your brain that you're full, meaning you eat less and lose weight. The particular protein called Proteinase Inhibitor 2, when consumed will cause the release of Cholecystokin in one's stomach, which makes you feel full sooner before you've actually consumed the calories.

Potato Derivative used to Stop Bleeding

Fire department in Davis County, USA are using a novel derivative from potato to save the lives of accident victims. A powder preparation of potato instantly stops traumatic bleeding at the site of wounds.

According to Guido Smith, Asst. Chief, Clinton City Fire Department: "It works as a sponge, removing the water properties of the blood, allowing the blood to become concentrated with the important ingredients that actually help blood to clot". The powder not only stops bleeding, but could also reduce the need for blood transfusions later on. It's bio inert, so it does not react with the body.

Articles on Potato

Androgenesis revisited in Indian Cultivated Potato and its Implications in Varietal Improvement

The cultivated potato (*Solanum tuberosum* L.) is a tetraploid (2n=4*x*=48) and its haploids are usually known as dihaploids (2n=2*x*=24) in order to distinguish it from monohaploids (2n=1*x*=12) produced by further haploidization. Since the tetraploid potato displays complex tetrasomic inheritance, most of the classical genetical studies as well as analysis of present-day Quantitative Trait Locus (QTL) are performed at the diploid vis-à-vis dihaploid level, where the inheritance profile is disomic (as in other important food crops) and thus much simpler. Therefore, the production of dihaploids of cultivated tetraploids has always been an attractive proposition for improvement and fundamental studies in potato.

There are two methods available for the production of dihaploids from tetraploids: the conventional method utilizing 2n gametes by pollination of tetraploids with selected clones of diploid (2n=2*x*=24) *S. phureja* (through essentially parthenogenesis) and anther culture followed by regeneration of dihaploid plants through androgenesis. Although the former method is used routinely in many countries, there is an increasing doubt of the true parthenogenetic origin of the dihaploids so produced. In addition, parthenogenetic dihaploid production is very laborious because of the absence of triploid-block lethality of the normal hybrids in 4*x* × 2*x* crosses. Therefore, anther culture followed by induction of androgenesis is the most reliable method for dihaploid production in potato. Moreover, in comparison to parthenogenetic method, anther or microspore culture is a better option because a large number of dihaploid genotypes can be recovered as the number of microspores is much higher than the number of ovules in an ovary. However, successful induction of androgenesis in tetraploid potatoes followed by regeneration of dihaploid plants has always eluded the researchers world-wide. There are very few studiestill date reporting the successful induction of androgenesis in tetraploid potatoes. The recalcitrance of tetraploid potatoes to androgenesis may accrue from i) unmasking of recessive lethal genes at the 2*x* level following haploidization of the 4*x* parent and ii) selective genotypic competence to androgenic medium or anther/ microspore culture conditions.

At CPRI, the Indian tetraploid potato cultivars have been proved to be extremely recalcitrant to androgenesis over the past 30 years or so. However, recently we have been successful in inducing androgenesis in some of the Indian tetraploid potato cultivars and TPS parental lines. Using 10 Indian tetraploid cultivars and 3 TPS parental lines, we initiated large-scale anther culture employing 14 different nutrient media. Flower buds harvested from all the genotypes grown in the experimental field of Shimla were used for aseptic anther isolation. The isolated anthers of different maturity stages were cultured on various media under a 16-h photoperiod (approximately 20-30 mmol m^{-2} s^{-1} light intensity) at 28 °C. A total of 30,000 anthers of 13 different genotypes were inoculated within a period of two months during the peak flowering period between June and July at Shimla.

Of 14 different media, androgenesis could occur only on two culture media which were based on Murashige and Skoog's

(MS) basal salt mixtures supplemented with 2.0 mgl^{-1} D-calcium pantothenate, 0.5 mM cysteine, 1.0 mM ascorbic acid, 0.5 % activated charcoal, 60.0 gl^{-1} sucrose, 2.0 gl^{-1} gelrite and 8.87 mM N^6-benzyladenine (BA) or 17.74 mM BA plus 60.0 gl^{-1} starch. However, the anthers of only 4 cultivars, viz., Kufri Badshah, Kufri Chipsona-1, Kufri Chipsona-2 and Kufri Lalima, and 1 TPS parental line, viz., JTH/C-107 could be induced to foster androgenesis (Fig.1). The androgenic events were, however, different in all these responding genotypes. A typical direct androgenesis leading to complete differentiation of the embryoid was obtained in cv. Kufri Chipsona-2, when the anthers were cultured on above basal medium supplemented with 17.74 mM BA plus 60.0 gl^{-1} starch (Fig.2). This embryoid subsequently grew into a complete plant when cultured on MS medium supplemented with 20 gl^{-1} sucrose plus 2.0 gl^{-1} gelrite. The direct androgenic pattern was more or less similar in cv. Kufri Lalima, except that accompanied without root differentiation, when the anthers were cultured on above basal medium supplemented with 8.87 mM BA. However, the converted anthers could not be grown into complete plantlets despite rigorous efforts. In contrast, both direct and indirect androgenesis occurred in TPS parental line JTH/C-107 on medium containing 8.87 mM BA. But in this TPS parental line embryo conversion vis-à-vis regeneration could rarely occur in the same induction medium. Interestingly, even the converted embryoids could not be grown into plantlets when cultured on standard propagation medium as detailed above. Embryoids of JTH/C-107 induced through indirect androgenesis could be regenerated into plantlets over concerted efforts when cultured on MS medium supplemented with 20.0 gl^{-1} sucrose, 2.0 mgl^{-1} zeatin riboside, 1.0 mgl^{-1} GA_3 and 2.0 gl^{-1} gelrite followed by multiplication on standard propagation medium containing 20.0 gl^{-1} sucrose. The androgenic embryoids of cvs Kufri Badshah and Kufri Chipsona-1 could not be converted and/ or regenerated into plantlets.

Figure 1. Androgenesis and subsequent regeneration/ multiplication of androgenic plants in tetraploid TPS parental line JTH/C-107.

Figure 2. Androgenesis and subsequent regeneration/ multiplication of androgenic plants in Indian potato cv. Kufri Chipsona-2.

This study shows that it is possible, although difficult, to induce androgenesis and regenerate androgenic plants in selected tetraploid Indian potato cultivars. Though the regeneration vis-à-vis conversion efficiency of the responding genotypes as obtained in this study is extremely low (< 1 %), the present protocol (and media) fosters induction of androgenesis and successful regeneration of androgenic plants in highly recalcitrant tetraploid Indian potato cultivars and TPS parental lines. Over the last five or six months, we have generated thousands of plants of 17 androgenic clones of cv. Kufri Chipsona-2 and TPS parental line JTH-C/107 *in vitro*. These clones are presently being characterized for confirming their dihaploidization competence. The study also shows that there exists an enormous scope for improving the androgenic competence, especially in terms of culture medium composition, culture conditions and pre-treatment of source plants, in tetraploid Indian potatoes.

One of the major advantages of using (androgenic) dihaploids is

the feasibility of direct gene transfer from the wild and semi-cultivated diploid tuber-bearing *Solanum* species to cultivated potatoes. Unfortunately, most of the reported dihaploids are male-sterile, and if in rare cases found to be male-fertile, they turns out to be self-incompatible. But this problem can be overcome through somatic (protoplast) fusion. Androgenic dihaploids of selected tetraploid potato cultivars can be somatically (symmetrically or asymmetrically) fused with diploid semi-cultivated or wild *Solanum* species to reconstruct the somatic hybrids/ cybrids at the tetraploid level. These synthetic populations can be integrated directly into breeding programme at the tetraploid level. As compared to the dihaploids, reconstructed tetraploids following somatic hybridization are frequently male-fertile, possibly through favourable nuclear as well as plasmonic complementation (somatic) between the participating fusion parents. Most importantly, as a rule, the dihaploids of tetraploid potatoes are 2 EBN (endosperm balance number) with the consequence that they are not as such crossable with diploid 1 EBN *Solanum* species. Therefore, somatic hybridization is also the most effective technique till date to overcome this inter-EBN crossability barrier. This has a much significance in potato breeding because most of the important diploid wild *Solanum* species having desirable biotic and abiotic resistance attributes and agronomic features are 1 EBN.

In Indian potato varietal improvement programme, the genetic bases of 38 potato varieties developed so far over the past 55 years can be traced to hardly 50 parents or so. Interestingly, most of these parents represent tetraploid potato cultivars with negligible representation of exotic diploid wild species. This categorically indicates the extent and magnitude of narrow genetic bases of Indian potato varieties vis-à-vis under-exploitation of diploid wild species in varietal improvement programme. The recent availability of androgenic plants would aid in introgression of *Solanum* wild/ semi-cultivated species, especially the 1 EBN ones, in potato varietal improvement programme at the tetraploid level.

– Debabrata Sarkar, Sushruti Sharma, Suman Kumar Pandey and S. M. Paul Khurana

Rain ruin Potato in hills : This year excess rains during July in Himachal Pradesh and Uttaranchal are likely to affect potato crop. Congenial conditions for late blight appearance was created by the monsoon in the first week of July, 05.

भूख से लड़ाई में आलू का योगदान

वर्ष 2005 के लिए भारत की अनुमानित जनसंख्या एक अरब 9 करोड़ और 88 लाख है जबकि आज भी 28 करोड़ 57 लाख लोग गरीबी रेखा से नीचे रहते हैं। यानि एक बहुत बड़े जनसमूह को पेट भर खाना नहीं मिलता है। जैसें-जैसे आर्थिक प्रगति के प्रभाव इन लोगों तक पहुंचेगा वैसें-वैसे अनाज की मांग और बढ़ेगी। इसके अतिरिक्ति वर्ष 2020 में भारत की अनुमानित जनसंख्या एक अरब 36 करोड़ और 29 लाख के आंकड़े को छू जायेगी। यदि इस जनसंख्या को भर पेट पौष्टिक खाना उपलब्ध करवाना हो तो हम निश्चित रूप से अपने खाद्य भण्डारों या अनाजों पर निर्भर नहीं रह सकते। अतः खाद्य सुरक्षा भारत के लिए इक्कीसवीं शताब्दी की एक महत्वपूर्ण चुनौती रहेगी और कई कारणों से भूख से इस लड़ाई में आलू एक बहुत ही महत्वपूर्ण योगदान निभाएगा।

सम्भावनाएं

खाद्य सुरक्षा सुनिश्चित करने की दिशा में आलू के निम्नलिखित गुण बहुत महत्वपूर्ण हैं।

अधिकतम सम्भव पैदावार : आलू एक छोटी अवधि व उच्च पैदावार वाली फसल है। वैज्ञानिकों के अनुसार आलू की अधिकतम सम्भव पैदावार लगभग 120 टन प्रति हैक्टयर है जो कि 30 टन प्रति हैक्टेयर अनाज के बराबर है। यह पैदावार प्रमुख अनाजों की अधिकतम सम्भव पैदावार से दुगनी है। इस प्रकार आलू अनाजों की तुलना में कम अवधि में भी दुगने लोगों का पेट भरने का सामर्थ्य रखता है।

अंतः खेती व तीसरी फसल : आलू अंतः खेती के लिए उपयुक्त फसल है जो छोटे व सीमांत किसानों की विविध आवश्यकताओं को देखते हुए पारिवारिक निर्वाह के लिए की जाने वाली खेती में भी बड़ी भूमिका निभाता है। इसके अतिरिक्त गहन खेती के अंतर्गत किसानों को आलू वार्षिक फसल प्रणाली में तीसरी फसल का एक लाभदायक अवसर प्रदान करता है। भारत जैसे जनसंख्या बहुल देश में इस प्रकार के अवसर की नीति निर्धारण स्तर पर सदैव खोज रहती है।

वर्ष भर उपलब्धता : हलांकि भारत में आलू सर्दियों में ही पैदा होता है परन्तु शीतगृहों की सहायता से इसकी उपलब्धता वर्ष भर बनी रहती है। केन्द्रीय आलू अनुसंधान संस्थान अधिक

गर्मी सहन कर पाने वाली किस्म जारी करने के बहुत नजदीक है और इससे आलू पैदा करने के मौसम में विस्तार होगा और बे मौसमी आलू के मूल्यों में भी कमी आएगी। इस प्रकार आलू भूख और कुपोषण को दूर करने में और अधिक कारगर सिद्ध होगा।

रोजगार सम्भावनाएं : आलू की खेती एक रोजगार प्रधान गतिविधि है। एक अनुमान के अनुसार आलू की खेती से प्रतिवर्ष 3 करोड़ दिवस रोजगार उत्पन्न होता है जिससे लाखों लोगों को प्रत्येक वर्ष निर्धनता से उबरने का अवसर मिलता है।

आलू के विभिन्न उत्पादों के रूप में विधायन उद्योग भारत में धीरे-धीरे प्रगति पर है। इस क्षेत्र में रोजगार की संभावनाओं के साथ-साथ निर्यात की भी असीम संभावनायें हैं।

पौष्टिकता

आम धारण के विपरीत आलू एक पौष्टिक एवं सम्पूर्ण भोजन है और इस क्षेत्र में निम्नलिखित गुण उल्लेखनीय हैं :

उच्च गुणवत्ता के प्रोटीन : आलू में लगभग 2 प्रोटीन पाए जाते हैं। इस में सभी 10 अवश्यक अमीनों अम्ल अच्छी मात्र में पाये जाते हैं और आलू के प्रोटीन गुणवत्ता में अण्डें, दूध और मांस के प्रोटीन की तुलना के होते हैं।

खनिज पदार्थ और विटामिन : आलू के कुल भार का लगभग एक प्रतिशत हिस्सा खनिज पदार्थ का होता है। आलू में वैसे तो बहुत से खनिज होते है परन्तु इसमें कैल्शियम, लोहा, मैगनिशियम, पोटाशियम और फॉसफोरस बहुत अच्छी मात्रा में पाए जाते हैं। इसके अतिरित आलू में विटामिन 'ए' (पीले गूदे वाले आलूओं में), 'बी' समूह और 'सी' अधिक मात्र में होते हैं।

भोज्य रेशा : आलू का छिलका आलू के भोज्य रेशे का बहुत बड़ा हिस्सा होता है। आलू का रेशा भोज्य रेशे के रूप में गेहूं के रेशे से अच्छा होता है। यदि आलू छिलके के साथ खाया जाए तो यह कॉलेस्ट्राल स्तर को कम करने में भी सहायता करता है।

प्रति हैक्टेयर पौष्टिक तत्वों का उत्पादन : प्रति हैक्टेयर, प्रतिदिन भेज्य प्रोटीन, खनीज पदार्थ, कार्बोहाइड्रेट, रेशे और विटामिन की पैदावार में आलू अनाजों (गेंहू, चावल और मक्का) से बहुत आगे रहता है। इस प्रकार आलू न केवल पेट भर भरने में बल्कि निर्धन लोगों को पौष्टिक भोजन प्रदान करने में भी एक बड़ी भूमिका निभाता है।

निष्कर्ष : खाद्य सुरक्षा की दृष्टि से आलू अनेक गुणों से सम्पन्न है और इस के साथ-साथ यह एक पौष्टिक भेजन का भी बहुत अच्छा स्त्रेत है। आलू को लेकर आम आदमी में अनेक भ्रांतियां है जैसे आलू खाने से मोटापा बढ़ता है ओर आलू एक निम्न पोष्टिकता का भोज्य पदार्थ है। जबकि सत्य यह है कि आलू एक सम्पूर्ण भोजन है और लगातार आलू खाकर भी हम लम्बे समय तक स्वस्थ रह सकते हैं। आलू में वसा आवश्यकता से भी कम मात्रा में पाई जाती है और मोटापे की अंशका का कोई आधार नहीं है। तलने की प्रक्रिया में आलू बहुत अधिक मात्रा में तेल सोख लेता है इसलिए आलू की गलत उपभोग पद्धति ही माटापे के लिए उत्तरदायी है। आलू के इन पहलुओं पर जानकारी का समुचित प्रचार-प्रसार करके हम आलू की भूख और कुपोषण से लड़नें की क्षमताओं का अधिक अच्छे ढंग से दोहन कर सकते हैं।

एक पौष्टिक भोजन के साथ आलू कई औषिधीय गुणों से भी सम्पन्न है, मसलन आलू के छिलकों से जलने के बाद बने घावों को ठीक करने की क्षमता का परीक्षण देश विदेश में हो चुका है।

- राजेश कुमार राणा व नरेन्द्र कुमार पाण्डेय

सी. पी. आर. आई. न्यूजलैटर में आलू अनुसंधान व विकास सम्बधित मौलिक लेख हिन्दी या अंग्रेजी में प्रकाशनार्थ भेजे जा सकते हैं।

— सम्पादक मण्डल

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