

## Research Highlights

### Somatic hybridization: an alternative technique in potato improvement

Gene transfer is the basis for almost all crop improvement including potato. Conventionally, this is achieved through sexual hybridization; this rather limits the range of species from which gene flow can occur into a crop species. Wild species have contributed remarkably to the success of latter; they allowed the crops to retain their commercial status. As a result plant breeders have sought to utilize an increasing number of wild species as a source of valuable genes ranging from disease resistance to grain yield, and produce quality. But many sources of useful genes cannot be included in crop improvement programme primarily because of sexual incompatibilities. Genetic transformation, a focussed and direct gene transfer approach, requires identification, isolation and cloning of the concerned gene. Further it is expensive and technically most exacting, although it may represent the ultimate strategy. However, some characters of interest may be governed by two or more and yet unknown genes; transfer of such characters through genetic transformation may pose many difficulties. Finally transfer of cytoplasmic organelles, viz., chloroplast and mitochondria may often be desired objectives; this, however is not possible through genetic transformation, while it can readily achieved by somatic hybridization.

The wild *Solanum* spp. is reproductively isolated from cultivated potatoes and also not crossable due to difference in ploidy number and endosperm balance number (EBN). Hence, somatic hybridization is the technique which enables to transfer agronomically important traits by bypassing which such sexual barriers, besides the conventional and recombinant-DNA technologies approaches. Despite these crossing-barriers, many researchers have used this technique and subsequently produced somatic hybrids with cultivated potato. Production of hybrid plants through the fusion of protoplasts of two different plant species/varieties is called somatic hybridization, and such hybrids

are called somatic hybrids. Therefore, somatic hybridization can be resorted to only when the following two criteria are satisfied: i) isolation of protoplast in large quantity and ii) totipotency of the isolated protoplasts. The techniques of somatic hybridization involve the following four steps: i) isolation of protoplast, ii) fusion of protoplasts of desired species/varieties, iii) selection of somatic hybrid cells, and iv) culture of hybrid cells and regeneration of hybrid plants from them.

#### Examples of potato somatic hybrids

Fusion partners		Resistance trait transferred
Recipient (Common potato)	Donor (Wild spp.)	
<i>S. tuberosum</i> spp.	<i>S. acaule</i>	PVX, PVY
<i>tuberosum</i>	<i>S. berthaultii</i>	Frost, Soft rot, Late blight, PVY
	<i>S. brevidens</i>	
	<i>S. bulbocastanum</i>	
	<i>S. cardiophyllum</i>	
	<i>S. commersonii</i>	
	<i>S. etuberosum</i>	
	<i>S. nigrum</i>	
	<i>S. pinnatisectum</i>	
	<i>S. tarnii</i>	
	<i>S. verrucosum</i>	

#### Two new somatic hybrids developed at CPRI

Somatic hybrids *S. tuberosum* spp. *tuberosum* (+) *S. pinnatisectum*, and *S. tuberosum* spp. *tuberosum* (+) *S. etuberosum* have been produced at CPRI, Shimla.



Fig. 1. Somatic hybridization in potato

#### ISSUE HIGHLIGHTS

Research Highlights	1
Training & Technology Transfer	2
Important Meetings & Visitors	3
Human Resource	4
From the Director's Desk	4

## Advantages of somatic hybridization

- Somatic hybrids can be produced between species, which can not be hybridized sexually.
- Somatic hybrids can be readily used in breeding programme for transfer of resistance genes.
- Hybrids can be produced even between such clones, which are completely sterile.
- Cytoplasm transfer can be done in one year, while back crossing may take 5-6 years. Even where backcrossing is not applicable, cytoplasm transfer can be made using this approach.
- Mitochondria of one species can be combined with chloroplast of another species. This may be very important in some cases, and is not achievable by sexual means even between easily crossable species.
- Recombinant organelle genomes, especially of mitochondria, are generated in somatic hybrids. Some of these recombinant genomes may possess useful features.

## Limitation of somatic hybridization

- Techniques for protoplast isolation, culture and fusion are very complicated.
- In many cases, chromosome elimination occurs from somatic hybrids leading to asymmetric hybrids. Such hybrids may be useful, but there is no control on chromosome elimination.
- Many somatic hybrids show genetic instability, which may be an inherent feature of some species combinations.
- Many somatic hybrids either do not regenerate or give rise to sterile regenerants. Such hybrids are useful for crop improvement. All interfamily somatic hybrids are genetically unstable and/or morphologically abnormal, while intergeneric and intertribal hybrids are genetically stable, but produce abnormal and/or sterile plants.

## Conclusion

Somatic hybridization allows transfer of cytoplasmic organelle in a single generation and offer unique opportunities for combining mitochondria of one species and chloroplast of another species in a single hybrid. This capability may permit improvement of characteristics in certain cytoplasmic male sterile line, which may lead to their commercial exploitation. In addition, even non-flowering and non-tuber bearing species can be utilized in breeding programme. The transfer of gene governing resistance to biotic and abiotic stresses is an important objective. In potato, this technique is already being used in commercial breeding programme of the Netherlands and Germany. In general, somatic hybrids have low pollen fertility, but they can often be used as female parents in backcrossing with one of fusion parents. It is likely that the approach of somatic hybridization will find greater applications in potato improvement for enabling transfer of useful genes from sexually incompatible species. In this context, it is important that the DNA segment carrying the desired gene from wild species is introgressed into the genome of cultivated potato and stable inherited. The possible mechanism for such introgression is homologous pairing leading to crossing over, and intergenomic translocation. An understanding of the gene introgression mechanism may enable their enhancement using suitable treatment; this, in turn will enhance the opportunities for utilization of somatic hybrids in potato improvement.

**Jagesh K. Tiwari, Poonam, S. Sundaresha, Vinay Bhardwaj, VU Patil and BP Singh**

## White Grub Damage in Potato

White grub, as the name suggests, is white in colour except head portion and being polyphagous feeds on number of plants. It is the third instar grub which is most damaging one. Root grubs damage the plant parts which are under ground. White grubs are favoured by light soils, fibrous rooted plants and high organic matter content and are not favoured by water-logged, compacted and stony soils. The light trap developed by VPKAS Almora was placed at CPRIC, Modipuram to capture the adult beetles. Number of adults captured in light trap from the month of June 2011 to first week of September 2011 indicated presence of two major Genus - *Anomala dimidiata* (182) Hope and *Holotrichia* sp.(217). Even after capturing these beetles the damage on potato crop could be recorded. In cropping system maize- potato – onion, tuber damage by white grub was recorded. The percentage of tuber damage was 21% in organically produced potatoes as compared 11% in inorganically raised potatoes as against to 9% in control plots.



White grub



Potato tubers eaten by white grub

**Kamlesh Malin, M.A. Khan, N.C. Upadhyay and Avinash Chandr.**

## Training & Technology Transfer

### Training Programmes Organised at CPRI and Regional Stations

- CPRI Organized 3-day training programme sponsored by Uttarakhand Livelihood Improvement Project for Himalaya (ULPIH) for 24 farmers of Tehri Garhwal district of Uttarakhand from October 11-13, 2011. Another 3-day training was organized under the sponsorship of Agricultural Technology Management Agency (ATMA), Madhepura for 20 farmers of Madhepura district of Bihar from Nov. 24-26, 2011. These trainings were given on the topic "Modern techniques for quality seed and table potato production". These farmers were trained in different aspects of seed and table potato cultivation.
- The Division of Social Sciences organized 8-day Model Training Course on "Healthy Seed Potato Production: Conventional vs High Tech" from 14-21 October, 2011 at CPRI, Shimla. This training was sponsored by Directorate of Extension, Govt. of India, New Delhi. The main objective of this training was to improve the knowledge and skills of extension officers of state agriculture/horticulture departments regarding healthy seed potato production through conventional and high tech methods like tissue culture technique. A total of 13 extension functionaries from 6 states participated in this training.
- A 5-day training on "Seed Potato Production and Marketing" was organized for agriculture/ horticulture officer of Uttar Pradesh from 29 Nov. to 3 Dec., 2011 in which 20 participants participated. The training was sponsored by SAMETI, Lucknow (UP).
- Division of Social Sciences organized 3-day training



programme for M/s Pepsico India Holdings Pvt. Ltd. from Dec. 20-22, 2011 on “Techniques for Quality Seed and Processing Potato Production”. The major focus was on processing aspect of potato production wherein 15 participants participated.

- On-farm training for potato growers was conducted during 11-12 November, 2011 under the project “Training entrepreneurial skills of farmer in potato based farming system of Himachal Pradesh”. A total of 20 farmers attended this training programme at KVK, Una. Another training under this project was organized at Gohar, Mandi from 28 to 29<sup>th</sup> Dec., 2011, where 23 farmers were trained.
- CPRI Campus, Modipuram organised two-day training programme on “Potato seed production technique in hills” for farmers of Uttarakhand during 14-15 October, 2011. This training programme was sponsored by Himalayan Action Research Centre, Dehradun (Uttarakhand). Twenty farmers participated in this training and were trained on different aspects of seed production.
- One day training programme on “High tech potato production” under Farmers participating action research programme (Funded by Ministry of Water Resources, GOI, New Delhi) was also organized on 17 October, 2011. This training programme was sponsored by M/s Jain Irrigations. Twenty five selected farmers participated in this training and were provided with sprinklers. Four-day training programme on “Micro-propagation techniques in potato seed production” for officers of Himalayan Action Research Centre, Dehradun (Uttarakhand) was conducted during 19-22 October, 2011. Seven officers participated in this training and were trained on different aspects of potato seed micro-propagation.



- Two-day training programme on “Improved technologies for potato production in UP” for the farmers of Uttar Pradesh was organized at CPRIC, Modipuram during 14-15 December, 2011 wherein 120 farmers of 12 districts participated.



- CPRS, Patna organized 11 training programmes on various aspects of potato production for the farmers of Bihar state during October-December, 2011. A total of 691 farmers were trained.
- Training was organized on “Potato seed technology” at CPRS, Jalandhar on 19 November, 2011 wherein 120 farmers of Punjab, Haryana, Himachal Pradesh and Gujarat participated. Besides, training on “Seed certification” was also organized to Seed Inspectors of Punjab Seed Certification Authority on 12 December, 2011 in which 29 seed inspectors participated.
- A farmers training was conducted on “Improved potato production technology” on 18-19 November, 2011 at CPRS, Shillong premises wherein 75 farmers' from nearby villages participated. Besides, training on “Harvesting, post harvest care and storing of potato” was also conducted on 7-8 December, 2011 wherein 80 farmers' participated.

### Live Phone-in Programmes

Several scientists of CPRI, Shimla participated in the Live-phone in programmes on Doordarshan and All India Radio (AIR) from October to December, 2011 as given below:

Month	Title/Topics
October	Field preparation and planting of potato in lower hills of HP - Drs. SS Lal and Ashwani Kumar
November	Fertilizer application in potato in lower hills of HP- Dr VK Dua
December	Live phone in programme on Doordarshan on Disease and Pest management in potato in lower hills of HP- Drs. Sanjeev Sharma and VK Chandla

### Important Meetings & Visitors

#### Stakeholders' meeting on potato research and development held at Jalandhar

A stakeholders' meet on potato research and development was organized at CPRS, Jalandhar on 20<sup>th</sup> Nov 2011 with the objective to fine tune the research objectives of the institute keeping in view the expectations of all stakeholders involved in potato production, processing and marketing. The meeting was chaired by Dr Bir Pal Singh, Director, Central Potato Research Institute, Shimla, Joint Director, Dr S.K. Kaushik, and Head, CPRS, Jalandhar, were also present on the occasion. The meeting was attended by the scientists of the institute and representatives from the various companies, firms, associations related to the potato industry in India. The major participants being Pepsico, McCain Foods,

Technico, Mahindra and Mahindra, Merino, ITC, Jalandhar Potato Growers Association, POSCON, cold store owners and seed farmers. Interactive discussions were held on various topics and decisions were taken addressing the interests of the stakeholders and mandate of the institute. Major decisions were taken regarding organizing of the world potato congress in India by the Indian Potato Association and the associated stakeholders, development of suitable machinery by the institute, carrying out of organoleptic tests of released varieties for better consumer acceptance, development of specific agronomy for each variety, steps for seed certification for potato export, development of specific varieties etc. In view of the successful interactions in the meeting among scientists and the stakeholders it was also decided that the meeting of stakeholders would be held every year.

### International conference on life science research for agricultural development organized at Patna

The 4th International Conference on Life Science Research for Agricultural Development (ICLRAD-2011) was organized at CPRS, Patna during 27-29 December, 2011. The conference was inaugurated by Hon'ble Minister Sh. Giriraj Singh, Animal and Fisheries Resources, Government of Bihar. A large number of scientists and dignitaries participated in the conference. Hon'ble Director, CPRI, Dr. B. P. Singh also blessed the occasion and delivered a keynote address.



## Human Resource

### NEW JOINING/APPOINTMENTS

Name	Post	Joined on
Dr. Raj Kumar	Scientist (SS), Seed Technology at CPRS, Patna	15.10.2011
Sh. Vallapu Venkateswarlu	Scientist, Agri, Entomology at CPRI, Shimla	26.12.2011
Sh. Sridhar Jandrajupalli	Scientist, Agri, Entomology at CPRI, Shimla	26.12.2011

### PROMOTIONS

Name	To	Date
<b>Administrative</b>		
Sh. Surinder Singh, UDC	Assistant	18.11.2011
Financial upgradation granted to 10 administrative staff under MACP scheme on different dates. These are: Sh. Khem Chand, Sh. Dakur Sah, Sh. Ram Babu Rai, Sh. Ram Babu, Sh. Mohan Lal, Sh. Hari Singh, Ms. Munni Devi, Ms. Indira Devi, Sh. Mansha Ram and Ms. Vimla Devi.		

<b>Supporting Staff</b>		
Sh. Rajbir Singh	SSS at CPRIC, Modipuram	12.12.2011
Sh. Raj Kumar	SSS at CPRIC, Modipuram	12.12.2011
Sh. Sudesh Pal	SSS at CPRIC, Modipuram	12.12.2011
Sh. Tejveer Singh	SSS at CPRIC, Modipuram	12.12.2011
Sh. Gyanender Kumar	SSS at CPRIC, Modipuram	12.12.2011
Sh. Rishi Pal	SSS at CPRIC, Modipuram	12.12.2011

### TRANSFERS/SELECTIONS

Name	From	To
Dr. Anuj Bhatnagar, Sr. Scientist	CPRS, Gwalior	CPRIC, Modipuram
<b>Administrative</b>		
Sh. Suresh Kumar Verma, Steno	CPRI, Shimla	CPRS, Jalandhar
Sh. Ashish Kalyan, LDC	CPRI, Kufri	CPRS, Jalandhar
Sh. Devender Kumar, Assistant	CPRI, Shimla	CPRS, Kufri

### RETIREMENTS

Name	Post	Retired on
Sh. Joginder Prasad	Assistant, CPRS, Patna	31.12.2011
Sh. Pradeep Thapliyal	Technical Officer, CPRIC, Modipuram	30.11.2011
Sh. Prem Lal	T-4	31.12.2011
Sh. Kopil Dey	Technical Officer	31.12.2011

### DEMISE

Name	Post	Date
Sh. Shiv Narayan	SSS, CPRS, Gwalior	17.10.2011

## From the Director's Desk

Many useful genes housed in wild relatives cannot be transferred through conventional techniques because of sexual incompatibility which is primarily due to differences in ploidy and endosperm balance number (EBN). It is extremely difficult to cross 1 EBN wild species directly with common cultivated 4 EBN potatoes. Limited success has been obtained by utilizing bridging species but the incompatibility of 1 EBN wild species has generally prevented the use of valuable traits. However, modern research and new techniques have made it possible to utilize the wild relatives in potato improvement. Somatic hybridization, which removes prezygotic and some postzygotic barriers, can likewise surmount the barrier between cultivated and wild species. Somatic hybridization can provide a means of bypassing sexual incompatibility between *Solanum* species, leading to fertile plants that can be used directly in breeding programmes. Accordingly, gene prospecting of potato through somatic hybridization has become reality. CPRI has developed two interspecific somatic hybrids of potato *Solanum tuberosum* dihaploid C-13 (+) *S. etuberosum*, and C-13 (+) *S. pinnatisectum* resistant to Potato Virus Y and late blight through somatic hybridization to overcome the sexual barriers imposed by differences in ploidy and EBN. These somatic hybrids would provide platform for expanding the genetic base of cultivated potato. The potential of somatic hybridization can be further exploited for variety of purposes that include haploid breeding and development of homozygous lines that may improve the potential of TPS as an alternative source of seed. CPRI is well poised to take advantage of this technology.

Compiled and edited by: Brajesh Singh, Sanjeev Sharma, S. Sundaresha and Praveen Chandla

Published by: Director, Central Potato Research Institute, Shimla 171 001, HP, India Phone: 0177-2625073, Fax: 011-2624460,

E-mail: directorcpri@gmail.com, Website: cpri.ernet.in

Printed at : Azad Offset Printers (P) Ltd., 144, Press Site, Indl. Area-1, Chandigarh, Tel: 0172-2021253-54, 4611489