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हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch

RESEARCH UPDATE

PROMISING TECHNOLOGIES

Garole x Malpura for mutton production

Garole (carrier of prolific gene *Fec B)* inheritance was introduced in the native Malpura sheep to evolve a prolific sheep.

In January 2009, Garole x Malpura (GM) female (ID 504) weighing 27.4 kg at lambing gave birth to triplets, two males and one female. Litter weight of 6.40 kg at birth, 36.40 kg at three months and 62.60 kg at six months of age was achieved. Subsequently, the litter weight of 95 kg was achieved at 12 months of age. It clearly indicates that the prolific sheep can be successfully reared in the semi-arid region.

Garole x Malpura dam with triplets

The Ewe Productivity Efficiency (EPE) achieved with GM is remarkable; this was not possible with any of the native sheep breeds.

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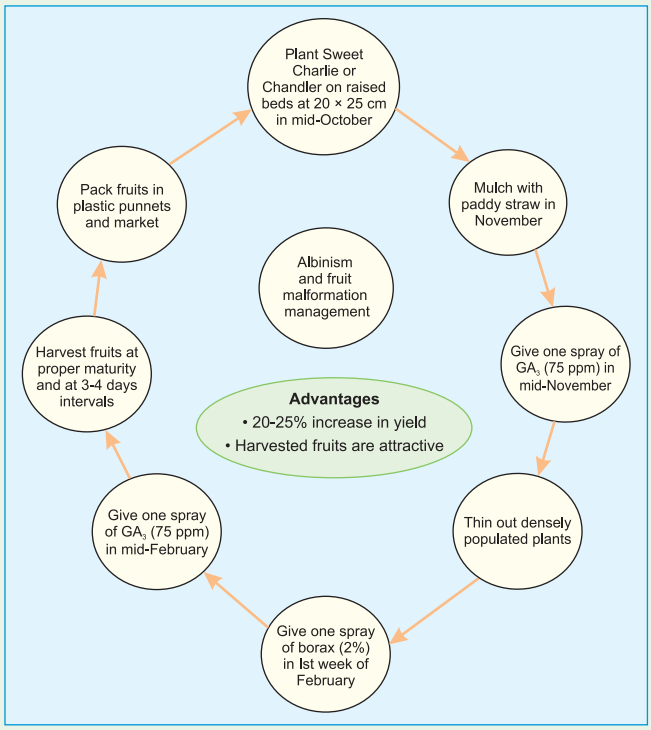
Management of albinism and fruit malformation in strawberry

Albinism and fruit malformation are two important disorders in strawberry. Fruits suffering from albinism appear bloated and develop white or pink areas on the surface. They are with poor flavour and tend to be more acidic. And they are susceptible to damage during harvesting and may become vulnerable to fruit-rot during storage. Malformed fruits are misshapen fruits, and they look cat-faced. These disorders reduce yield of strawberry by about 20-25%.

Causes of albinism: Higher planting density; excessive use of nitrogenous fertilizers; strawberry planting on sandy soils having low *p*H and/or high N, P, and K contents; strawberry growing in greenhouses or protected structures or closed tunnels; use of black polythene as mulch; growing of Elsanta Darselect, Eros, Idea, Darstella and Dukat varieties.

Reasons of fruit malformation: Vigorous plant growth due to excessive doses of nitrogenous fertilizers; feeding by insect-pests like lygus bug on flowers; boron deficiency in the growing medium; insufficient pollination.



Management Technology

Plant runners of Sweet Charlie or Chander variety of strawberry at a spacing of 20 cm x 25 cm on the raised beds during mid-October. Beds must be mulched with paddy straw in November after the proper establishment of plants. A spray of GA_3 (75 ppm) is given in the mid-November. And all the normal cultural practices are followed besides thinning. In addition, a spray of borax (2%) and a spray of GA_3 (75 ppm) are given in mid-February. Fruits start maturing by the end of February or first week of March. Harvest fully mature fruits. After sorting and grading, pack them in plastic punnets. By adopting this management strategy, a farmer can increase yield by about 20-25%.

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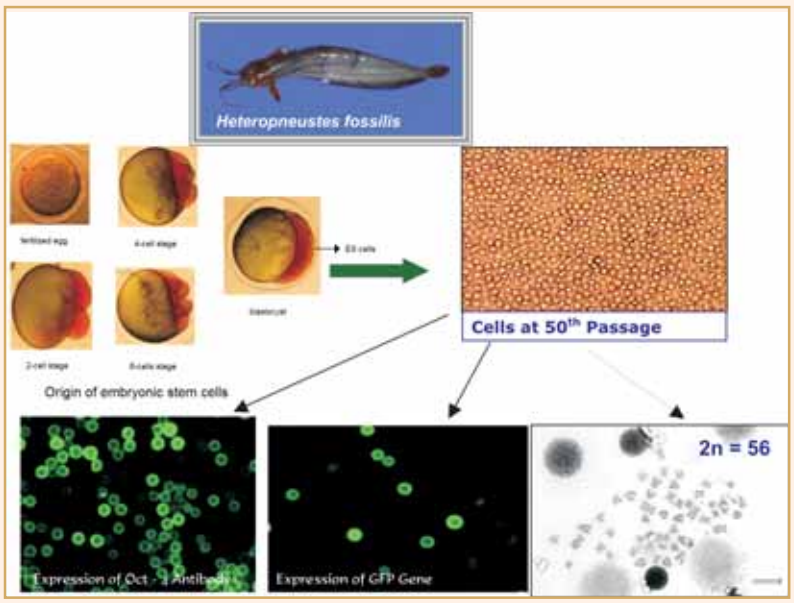
Pluripotent embryonic stem cell line from catfish

A continuous cell line has been established from the blastula stage embryos of catfish, *Heteropneustes fossilis* (Singhi), for the first time in India. Embryonic cells were maintained in the Leibovitz's L-15 supplemented with 15% fetal bovine serum. The cell line was subcultured for more than 75 passages over one and half years. Small, round cells grew well between 25 and 35°C, with an optimum temperature of 28°C. They were successfully cryopreserved at –196°C and thawed after a storage of 7 days, 3 months, 5 months and a year. Revived cells formed embroids, indicating their viability. Their chromosome analysis revealed normal diploid karyotype with 2n=56, and mtDNA sequences, 16S, Cytochrome b, gene cytochrome oxidase subunit I also confirmed identity of cells from



H. fossilis. *In-vitro* test by the alkaline phosphatase staining and *Oct4* gene expression confirmed pluripotency of cells. The genetic manipulation of ES cells via homologous recombination allows site directed integration of foreign gene into host genome. Expression of *GFP reporter* gene by transfection with phMGFP vector demonstrated that the cell line can be useful for expressing foreign genes. These results will have applications in genome manipulation and germplasm conservation.

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Decision support system for leaf quality evaluation in flue-cured tobacco

To quantify complex phenomenon of leaf quality in FCV tobacco, a software has been developed using Relational Database Management System with Dot Net Technology using physical, chemical, manufacturing and smoke parameters. Database consists of various cured leaf attributes: colour, size, maturity, body and burn in physical; total nitrogen, nicotine, reducing sugars, potassium and chlorides in chemical; shatter ability index, pore volume, filling value and EMC in manufacturing, and tar, nicotine, CO and TSNA in smoke. A query builder has also been designed to evaluate quality of leaf produced in the given agroclimatic zone as poor, average and good. Using this software package, one can precisely evaluate intrinsic value of leaf quality in characterizing quality of FCV tobacco that will be useful for both producer and buyer.

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Trichosanthes — collection and conservation

Trichosanthes is the largest genus of the family Cucurbitacecae. In India, the genus is represented by 26 taxa (four being infraspecific), with maximum species diversity found in the North-east India, followed by southern India, including five endemic species. Economically, this genus has two taxa cultivated as vegetable, i.e. *T. cucumerina* var. *anguina* (snake-gourd) and *T. dioica* (pointed-gourd), and five other species with medicinal value.

Trichosanthes cucumerina with slender fruits

The genus is poorly worked out especially for delimitation of taxa (e.g. *T. cucumerina* vs *T. lobata*; *T. nervifolia* vs *T. cuspidata*; *T. wallichiana* vs *T. lepiniana* vs *T. tricuspidata*); the difficulty arose mainly due to prevalence of dioecy (except *T. cucumerina*) and inadequate ecogeographical information.

A total of 41 samples of the genus were collected representing four taxa from 2 explorations undertaken in different parts of Madhya Pradesh and Uttar Pradesh during October 2009. Not much variability was observed in snake-gourd, which was mostly confined to homestead cultivation. Rich variability however, was

T. diocia under cultivation as border crop at Pali (inside thatched hut betel-vine plantation)

noticed for progenitor taxa (*T. cucumerina* var. *cucumerina*) for fruit shape, fruit length, stripes over the fruit, seed morphology and leaf lobations. In Chhatarpur and Shivpuri districts of Madhya Pradesh, populations with long fruits and prominent leaf lobes were collected, which were similar to *T. lobata*. In pointed-gourd, variabilities in fruit shape, stripes over the fruit and fruit size were collected from northern and central Uttar Pradesh, where it was a common vegetable-crop. At Pali (Lalitpur district, Uttar Pradesh), this crop along with ivy-gourd was being grown as subsidiary crop in grass-thatched borders of betel-vine plantations. In *T. tricuspidata*, two distinct fruit types were collected from Trethanathsinghpur (Pilibhit district) and Godamva Churaha (Basti district) of Uttar Pradesh.

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The balance of nature is achieved and regulated by the functions of the forest. So the survival of the forest is essential to the survival of siladhamma (harmony) and our environment. It's all interdependent. When we protect the forest we protect the world. When we destroy the forest we destroy that balance.

Phra Ajahn Pongsak Techathammo,
Abbot of Wat Palad, Northern Thailand

Identification and characterization of swamp-buffalo population

Manipuri buffaloes are essentially reared for draught and meat purposes. As per the livestock census (2003), population of Manipuri buffaloes was estimated at around 0.77 lakh, and there has been a noticeable decline of about 45% in the last 20 years.

Based on the habitat, the buffaloes are classified into Hill type: "*Tamgi-eroi*" and Valley type: "*Chingi-eroi*". Morphometric data collected from 56 adult-buffaloes revealed differences in body measurements. Hill-type animals are found comparatively shorter as reflected in their mean body length and height at withers. However, they are stouter with higher heart girth. Two white stripes one at the neck and another slightly above the brisket are found in majority of the buffaloes.

Cytogenetic and mt DNA analysis. Forty blood samples of both sexes (7 males and 33 females) were collected from varying locations. Cytogenetic analysis of all revealed diploid chromosome count of 48; twenty-three pairs of autosomes and a pair of sex chromosomes, typical of swamp-type buffaloes. Most distinctive karyotypic feature of swamp buffalo observed was size of fourth pair of metacentric chromosome. Chromosomal constitution and karyotypic characteristics of all Manipuri buffaloes confirmed swamp status of Manipuri buffaloes.

Comparison of mitochondrial D-loop sequence of these buffaloes with representative riverine and swamp type buffaloes further corroborated this conclusion. Phylogenetic tree positioned river and swamp haplotypes into specific and distinct groupings, which confirmed unequivocal classification of Manipuri buffaloes as a true swamp type. This study documented existence of pure swamp type Manipuri buffaloes in the north-east India.

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Mushroom biodiversity of Girnar forest of Gujarat

Explorations were undertaken in the dry deciduous forests of Amreli, Junagadh and Jamnagar and northern tropical thorn-forests spreading over Kutch, Bhuj, Junagadh, Rajkot, Amreli and Jamnagar where temperature varied from 33 to 39°C and humidity between 55 and 70%. Among edible mushroom species, Kutch and Bhuj regions were dominated by *Calvatia* sp., growing on sandy soils at high temperature and low humidity. This mushroom is locally very popular and relished. The forest areas in Sasan, Amreli and the Gir Sanctuary are found dominated by edible *Termitomyces* sp. An *Agrocybe* sp. was also collected from these forests. In Junagadh, wild *Calocybe* sp. and *Pleurotus* sp. were collected. Two soft *Polyporus* spp. have also been documented.

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PROFILE

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Integration of woody perennials in the farming system to improve land productivity through conservation of soils, nutrients and biodiversity to augment natural resource conservation, restoration of ecological balance, alleviation of poverty and to mitigate risks of weather vagaries

In India, our social, religious and cultural ethics have been closely linked with planting and protection of various trees. Tree biodiversity has been preserved in many areas because of its role in farming and other land-use systems. However, with increase in demographic pressure resulting in degradation of resource base and vast gap between demand and supply of woody produces, agroforestry has once again been identified as the most appropriate land-use option. Accordingly, the Indian Council of Agricultural Research (ICAR) had initiated a network project for organized research in agroforestry in 1983. To strengthen and co-ordinate agroforestry research, the National Research Centre for Agroforestry was established on 8 May 1988 at Jhansi (Uttar Pradesh).

Presently, it has one of the largest networks with 36 centres of the AICRP on Agroforestry at 25 SAUs and 11 ICAR institutes in various agro-climatic zones of India.

MANDATE

- To undertake basic and applied researches for developing and delivering technologies based on sustainable agroforestry practices on farms, marginal and wastelands for different agroclimatic zones in India.
- To co-ordinate network research with the state agricultural universities/ICAR Institutes/other related research institutes for identifying technologies which can be transferred from one region to another.
- To provide training in (a) research methodologies (b) use and application of technologies developed at various levels.
- To develop technological packages of different agroforestry practices for various agroclimatological zones for transfer to farm field and wastelands.
- To act as a repository of information on the subject.
- To collaborate with relevant national and international agencies for achieving the above objectives.
- To provide consultancy.

INFRASTRUCTURE

Laboratories. The Centre has 6 laboratories – Agronomy and Plant Physiology, Soil Analytical, Plant Protection, Tissue Culture and Biotechnology, Horticulture and Agroforestry.

ARIS Cell. Agriculture Research Information Service Cell has been established with the Local Area Network (LAN) at the Centre. Internet and CD-ROM database access have been provided through LAN. More than

Germplasm Collection

Under tree improvement programme, 220 germplasm of *neem*, 32 of *shisham*, 42 of *babul*, 13 of *kardhai*, 143 of *karanj* and 284 of jatropha are available in Active Field Gene bank.

50 clients are connected through Fast Ethernet Switches and enhanced CAT 5 cable. The Centre's Web Site has been developed and hosted on the Web server, the URL of web site is www.nrcaf.ernet.in.

GIS Lab. It is equipped with A0 size scanner and one desktop computer with 22" TFT monitor. Arc GIS 9.2, a GIS software, and IDRISI Andes, an image processing software, have been installed on the workstation.

Library. It subscribes to 31 periodicals (24 foreign and 7 Indian).

Photography Unit. A well-equipped photo lab meets day-to-day photographic and reprographic needs of the scientists.

Research Farm. The Centre has 86 hectares, out of which 67 hectares were degraded, which have been developed and are being utilized for experiments. For water harvesting, a farm pond of 25m × 18m × 2.5m capacity has been constructed at the Farm.

RESEARCH ACHIEVEMENTS

Agrisilviculture Programme

- In irrigated areas in *Dalbergia sissoo*-based agrisilvicultural system, grain yield of the intercrop was higher with deep ploughing as compared to normal ploughing.
- Irrespective of pruning and cropping, *Albizia procera* performed better in comparison to *Tectona grandis* and *Azadirachta indica* in agrisilvicultural system.
- In *Albizia procera*-based agrisilviculture, growth was not affected by crop rotation. Root training with GI sheet-barrier increased understorey crop yield by 6.0 % and 3.0 % in *kharif* and *rabi*.
- In rainfed areas, *Hardwickia binata* was better in terms of biomass and nutrient conservation compared to *Anogeissus pendula* and *A. latifolia*.
- *Eucalyptus tereticornis*-based agrisilviculture, block plantation and boundary plantation showed that above and below ground biomass was significantly better in agrisilviculture than in block plantation.

Vegetative Propagation

- Softwood-cleft grafting technique developed for *aonla*, jackfruit, mango, *bael* and guava.
- Bench-grafting technique developed for *aonla* and *ber*.
- Top-working technique developed for *Carisa spinarum* with *C. carandus*.
- Agro-technique for *aonla*-based agrihorticulture system developed for rainfed conditions.

Agrihorticulture and Silvipasture Programme

- In rainfed areas, average *aonla* fruit yield per plant was 109.67 kg for variety Kanchan, 88.25 kg for NA 7, 89.14 kg for Krishna and 61.40 kg for Chakaiya. Apart from fruit yield, 122 to 135 kg grain yield of blackgram was obtained from the system. Grain yield was 27.5% higher under wider spacing (10 m × 6 m)

Albizia-based agrisilviculture system

Poplar-based agroforestry system in Indo-Gangetic Region

Silvipastoral system for arid and semi-arid regions

as compared to closer spacing (5 m × 6 m).

- With *in-situ* moisture conservation in *aonla* by stone mulching, deep basin, deep tillage + deep basin, average fruit yield ranged between 20.80 and 23.37 kg/plant as against control (16.9 kg/tree).
- Under natural pasture, *aonla*, mulberry, *lasora*, *imli*, *bael* and *ber* were found quite adaptive and feasible on the basis of survival, growth and yield.
- Biomass production from degraded lands enhanced to 8-10 tonnes/ha/yr from 2-3 tonnes/ha/yr by introduction of leguminous trees, shrubs and herbs in the natural rangelands.

Tree Improvement and Silviculture Programme

- In neem, 220 accessions were evaluated for growth, seed yield, oil and azadirachtin content. Promising provenances have been identified and are being multiplied.
- Neem seeds maturing in November had 5.73 times more azadirachtin (0.86% azadirachtin A & B) than seeds collected in July (0.15%).
- Chickpea CSG 8962 under 9 years old neem plantation showed minimum grain reduction of 24%, followed by Radhey (26.5), Avrodhi (26.5) and DCP92-3 (27.1). They are recommended under agroforestry system with 50-55% tree shade.
- Sterilization method for explants of *Bambusa vulgaris* was standardized for its mass multiplication. Sprouting of shoots in basal MS media was recorded within a week of inoculation. The plantlets of *Pongamia pinnata* have been acclimatized following stepwise transfer from controlled conditions of culture room to mist chamber and then field conditions.

Biofuel Improvement Programme

- A total of 284 germplasm of *Jatropha curcas* (*rathan jyot*), an important bio-diesel species, have been collected from different parts of Uttar Pradesh, Uttarakhand, Madhya Pradesh and Maharashtra.
- In *Pongamia pinnata* (*karanj*), 143 germplasm have been collected from different parts of Uttar Pradesh, Madhya Pradesh, Rajasthan and Haryana. Its oil content ranges from 30.28 to 39.43%.

Quality planting material

- Promising plus trees of *neem* have been identified for straight bole, high drupe yield and oil content. Vegetative propagation technique by air-layering has been standardized for true-to-type plant multiplication.
- Two plus trees of *shisham* (PT-2 and PT-6) have been identified for straight bole. A seed orchard of *shisham* has been established.
- Four intraspecific hybrids of jatropha developed using promising plus trees as parent have showed yield potential up to 850 g/plant in the 2nd year after plantation with 35-38% oil content on the seed basis.

Social Sciences, Watershed and HRD

- Suitable trees have been identified for gum and resin in different agroclimatic regions.
- The home page of agroforestry databases (http://mirror.iasri.res.in/net) has now been reorganized with the addition of pages on tree growth modelling. These pages on tree growth modelling are in the initial stage of design and development and will be refined and fine tuned in future.

Agroforestry ensures water availability in drought-prone areas

Agroforestry interventions based integrated watershed management work in Garhkundar Watershed ensured availability of surface water in water-bodies throughout the year. Groundwater table increased by 2-6 m in more than 60% of open wells. The study revealed that even with 60% of normal rainfall in Bundelkhand region, water availability for drinking and successful crop cultivation could be ensured.

Watershed Management

A Watershed management programme has been initiated in Garhkundar-Dawar, Distt Tikamgarh (MP), a most disadvantaged district of Bundelkhand, on 850 hectares to demonstrate agroforestry technologies in the participatory mode. Eight checkdams were constructed to develop water resources. Marginal bunding of agricultural land (40 ha) and gabion structures in 1st order stream (150 Nos.) were developed to check erosion. In this watershed, approximately 895 people directly depend on its resources with 2,648 animals; of which 57.2 % are goat, 16.8% sheep, 11.3% buffaloes and 4.8 % cattle for their livelihood.

Agroforestry demonstrations. *Aonla*, guava and citrus were planted in about 4.0 hectares of cropped area. During the year, growth and productivity of top-worked *ber* plant vis-à-vis *desi ber* plant was monitored and it was found that in the 3rd year, top-worked *ber* plants attained about 50 per cent growth to that of *desi* plants.

Crop demonstration. Crop demonstrations on wheat crop with improved package of practices convinced farmer that by sowing in single direction against traditional practice of cross sowing, seed rate may be reduced to half.

Plantation. To increase permanent vegetal cover of the watershed, about 5,316 seedlings of various MPTs were planted along the *nallah* during July-August, 2007.

Livelihood. To ensure and improve livelihood status of the people, 4 SHGs (2 males and 2 females) were formed. All the SHG members were exposed to other successfully running SHGs to have an interaction and capacity-building. Activities like inter-personal loaning, moorthy making, goat-rearing, fish-farming and agarbatti-making were initiated in one of the SHGs. Out of 4 SHGs so constituted, 2 are regularly meeting and have generated cash and asset together worth Rs 35,000 and Rs 25,000.

Runoff and soil loss. Runoff and soil loss reduced by 34 and 43% in treated area as compared to untreated area (control). More than 2 m increase in water level in 53.3% wells was recorded inside the watershed.

- The database on *Garcinia*-based systems in India has been recently added in the series of bibliographic databases on the biodiesel species.

Agronomic practices such as planting methods, irrigation, filling mixture composition, fertilization, spacing and pruning schedules for raising some of the promising MPTs in association with annual crops have been developed and standardized.

THRUST AREAS FOR XI PLAN

- Eco-region specific agroforestry technology generation and extension.
- Agroforestry intervention to meet growing needs of households and industries.
- Agroforestry for mitigating climate change effects and for environmental amelioration through carbon sequestration, bioremediation and resource conservation.
- Agroforestry for biofuel from trees-borne oilseed and bio-energy production.
- Human resource development and dissemination of agroforestry technologies.

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Varietal Releases

High-yielding satputia

Thirty-five advance lines of satputia (*Luffa hermaphrodita*) were evaluated in a randomized block design with three replications each in *kharif* 2008 and 2009. Among these, VRS 1 has been identified with horticultural traits. It produced early fruiting (44.0-46.2 days for first picking) coupled with higher fruit yield.

This line produces hermaphrodite flowers, appearing at 5.0-7.6 nodes. Its fruits are tender and are produced in clusters (4.8-5.6 fruits/cluster), weighing 30.5-36.7g, and they are 13.5-15.0 cm long. The fruit is characterized by 10 dark green, superficial and continuous longitudinal ridges.

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Chinese pea cv. Swarna Tripti

Snow/Chinese peas (*Pisum sativum* L.) are edible-podded peas. These nutritious and fibreless fresh green pods are consumed as sweet salad or as cooked vegetable. Thin-walled and fibreless (lack of parchment) green pods are harvested when they are sufficiently flat, but prior to seed development. The crop can be grown from October to March in the eastern region of the country.

Swarna Tripti at pod-bearing stage

A breeding programme for this crop was initiated in 1999, and a powdery-mildew-resistant snow-pea line HASP 1 was developed through hybridization between a green podded and powdery-mildew-resistant shell (garden) pea line JP 585 and a light-green podded and powdery-mildew-susceptible snow-pea variety Oregon Sugar Podded, followed by selection in the segregating generations. Over the years, HASP 1 has performed very well at farmers' fields in Jharkhand, Bihar and West Bengal for green pod yield, quality and resistance to powdery mildew (average disease score on 1-5 scale is 1.5). On the basis of its performance, HASP 1 has been released in 2008 by the Central Variety Release Committee as Swarna Tripti (IC 548862) for commercial cultivation in the eastern region. The variety is found suitable for winter cultivation in fields in plains and also during winter-early spring (Jan-April) in Netarhat hills (elevation >1,000m above mean sea level) as an off-season crop. This variety becomes ready for first

harvest in 80-85 days after sowing, and has high export potential. Its pods are sweet and sufficiently flat (7.3-7.5 cm x 1.85-1.88 cm), and are green at harvest stage.

Cowpea cv. Swarna Harita

An improvement programme on vegetable cowpea resulted in the development of Swarna Harita; IC 285143, an elite germplasm line, collected through survey in Jamalpur area of Burdwan district of West Bengal. This pole-type variety proved its superiority over check varieties Pusa Komal and Arka Garima at Ranchi, Faizabad, Sabour, Parbhani, Lam, Raipur, Jabalpur and Vellanikkara centres of the AICRP (Vegetable Crops). It exhibited excellent performance regarding fresh pod yield and quality at farmers' fields also. The variety has very long (51.92-55.60 cm), dark green, heavy (12.95-13.58 g) and pulpy pods which become ready for first harvest in 50-55 days after sowing. It was released in 2008 by the CVRC for commercial cultivation in West Bengal and Asom, in Jharkhand, Bihar, Uttar Pradesh and Punjab, in Chhattisgarh, Andhra Pradesh and Orissa and in Tamil Nadu, Karnataka and Kerala.

Soybean cv. Swarna Vasundhara

An improved variety Swarna Vasundhara released in 2008 by the CVRC is an elite germplasm line EC 384907, introduced from the AVRDC, Taiwan. It has green pods that become ready for harvest in 75-80 days after sowing, and are mainly 2- and 3-seeded with 50-55 % recovery of shelled bright green beans. The farmers

have accepted this new vegetable soybean variety for growing as a rainfed *kharif* crop in the uplands of eastern India. These shelled fresh green seeds are found good in taste as a cooked vegetable alone or in combination with other vegetables like potato.

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Onion Arka Swadista

Onion varieties suitable for fermented preservation were being imported from the other countries at a very high cost and were grown through contract farming, and were processed and exported.

Some processors collected undersized white onion bulbs, rejected for fresh consumption from onion markets, and used them for processing but the product quality was poor.

Breeding work undertaken to develop suitable onion varieties for fermented preservation processing

resulted in the development of Arka Swadista. This onion line was developed from advanced progenies of the cross between the high TSS lines with the white onion lines through pedigree selection, followed by backcross breeding. Arka Swadista has TSS 20%, dry matter content 19%, and it is uniformly white, oval globe in shape, and its edible bulb is 98.32%. The variety was identified by the Institute Variety and Technology Identification Committee (IVTIC) in October 2009.

Onion Arka Ujjwal

Improvement in the multiplier onions resulted in the development of the line MLT 436. This was developed through pedigree breeding by crosses between the selections of Natu and Mutlore local types, and then selection was made in the advanced generation.

Arka Ujjwal has TSS 18%, dry matter content 19%, and its bulb colour is dark red. The variety was identified by the IVTIC in October 2009.

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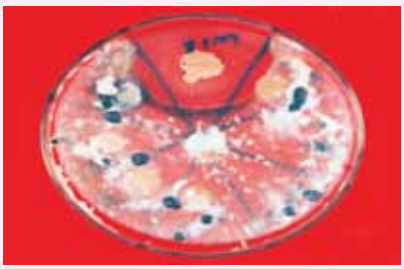
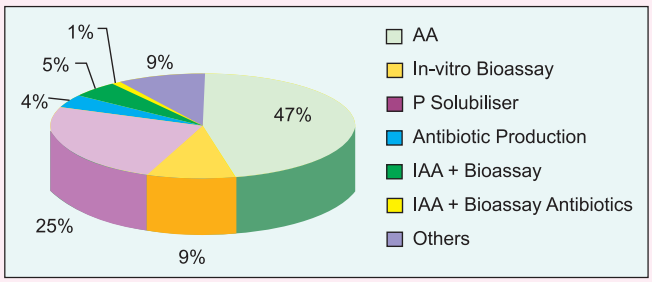
Fluorescent pseudomonads in rapeseed-mustard

Fluorescent pseudomonads have been found potential candidates for use as bio-agents in agriculture. A total of 138 fluorescent pseudomonads from endosphere and rhizospheric soils of eight varieties of mustard grown in the IARI fields were characterized for their plant-growth promoting traits, auxin production, P-solubilization, *in-vitro* bioassay against *Sclerotinia sclerotiorum* (a fungal pathogen of mustard), and for antibiotic production (phenazine, pyoluteorin, 2,-4 diacetylphloroglucinol or DAPG).



In vitro bioassay against *Sclerotinia sclerotiorum*

Understanding relationship between rhizosphere and functional diversity of microbial population may help in evaluating effects of microbial inoculation on the pre-existing indigenous population.



Per cent functional diversity of fluorescent pseudomonads

A total of 64 Isolates were found positive for IAA production, and about one-third of the total isolates were able to solubilize insoluble form of phosphorus. And only 13 were able to inhibit fungal pathogen *S. sclerotiorum*. This study also indicates that mustard rhizosphere supports low frequency of antibiotic-producing fluorescent pseudomonads.

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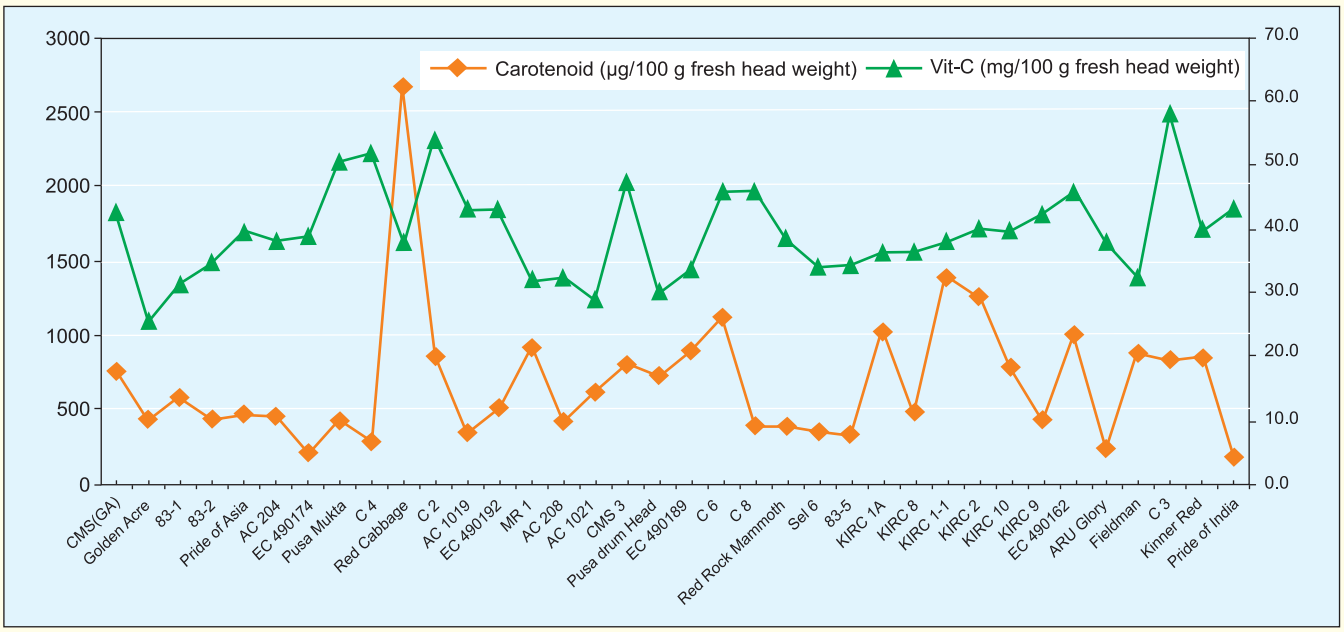
Cabbage genotypes with higher carotenoids and ascorbic acid

There were reports of heritable variants of cabbage for carotenoids (vit. A precursor) and ascorbic acid (vit. C) contents. Bio-fortifying cabbage with high contents of carotenoids and ascorbic acid in good agronomic background can help in alleviating vitamins related deficiencies like cataract and scurvy, widespread among 57% of the children below six years of age.

Cabbage genotypes, 26 indigenous and 10 exotic lines, maintained at Katrain were evaluated. Samples were taken at a fresh marketable stage and those frozen immediately in liquid nitrogen, and the ones stored at –80°C, and were analysed for carotenoids and ascorbic acid contents. Genotypes found with high carotenoids (>900 µg/100g fresh head weight) were Red Cabbage, KIRC 1-1, KIRC 2, C 6 KIRC 1A, EC 490162 and MR 1. And most promising genotypes for high ascorbic acid content (>45 mg/100g fresh head weight) were C 3, C 2, C 4, Pusa Mukta, C 8, C 6 (all savoy types), CMS 3 and EC 490162. Its also indicated that inclusion of savoy-type genotypes in the breeding programmes would be beneficial to improve ascorbic acid content of cabbage heads.



Carotenoids and vit C among various cabbage genotypes

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Papaya mealy bug, an invasive species, spreading fast to crop-plants

Papaya mealy bug, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae), is polyphagous, and has been recorded on more than 55 host-plants in more than 25 genera. Economically important host-plants of the papaya mealy bug include papaya, hibiscus, avocado, citrus, cotton, tomato, brinjal, chillies, beans and peas, sweet-potato, potato, mango, cherry, and pomegranate. Its infestations are typically observed as clusters of cotton-like masses on shoots and fruits.

Adult female is yellow, is covered with a white waxy coating, approximately 2.2-mm long (1/16 inch) and 1.4-mm wide. A series of short waxy caudal filaments less than 1/4 length of the body exist around the margin. Its eggs are greenish yellow and are laid in an egg-sac that is three-to-four times body length and is covered with white wax. Ovisac is developed ventrally on the adult female. Adult males are coloured pink, especially during pre-pupal and pupal stages, but appear yellow in the first and second instars. This bug can be easily distinguished from *Maconellicoccus hirsutus* as it has eight antennal segments, in contrast to nine in the latter species, and they leave a bluish tinge in alcohol.

Papaya mealy bug feeds on plant sap by inserting its stylet into the epidermis of the leaf, as well as into the fruit and stem. While doing so, it injects toxic substance into them.

The pest was observed during early 2006 in and around Coimbatore where papaya cultivation and papain production is on increase. It has spread to other crops such as *bhendi* (Okra), cotton, teak, mulberry and sunflower. Enemies of the mealy bug in natural environment include *Cryptolaemus montrouzieri*, *Spalgis epius* and lacewings, which are generalist predators that have a potential impact on the reduction of mealy bug population.

Implementation of the classical biological control programme was successful in the Republic of Palau using encyrtid parasitoids *Anagyrus loecki, Pseudleptomastix mexicana* and *Aerophagus papayae*. The Bureau is in the process of introducting these parasitoids into India.

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Value-added chilli products

India produces 1,851,500 tonnes of green chillies from 737,500 hectares and exports 81,500 tonnes. Green chillies have vitamins C and A and also have antioxidant properties.

Processing of these chillies can have a vast potential as it would lead to avoidance of lengthy drying operation, and can also provide chilli-powder with higher nutrition and controlled pungency. Characteristic colour of the dried chillies is one of the essential quality indicators; non-enzymatic browning and chlorophyll loss during drying contribute substantially to colour losses in green chillies.

A process has been standardized for making green chilli-powder and puree. About 130 g of green chilli-powder and 300 ml of puree could be prepared from one kilogram of fresh green chillies. Financial evaluation for processing 200 kg of green chillies per day was carried out. Estimated cost of plant and machinery was Rs 713,000. Considering raw material cost at Rs 15/kg of green chillies, cost of green powder (100g dry weight) at Rs 120/kg, and of puree (600g) and chillies sauce at Rs 100/kg, breakeven point was calculated at 49.15% with a payback period of 1.91 year.

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Pomegranate arils: Quality maintenance and shelf-life

Minimal processing of arils includes minimal peeling of fruits carefully at room temperature with a little mechanical damage. Arils are then washed in a sodium hypochlorite solution (100 ppm) for 5 min and allowed

to dry. Separated and chlorine-treated arils are dipped in antioxidant solution (5% w/v citric acid or ascorbic acid) for 30 seconds, dried and packed in 19µ semi-permeable film (150 g of arils/bag).

Pomegranate fruit has a coriaceous rind and its seeds are surrounded by a sweet-and-juicy pulp (aril), corresponding to eatable portion, separated by a white and astringent membrane.

Mridula variety fruits are big, red with brilliant appearance, and their peel thickness is moderate, and arils are of good size, red, and are with good juice yield and high soluble solids content, low acidity and a dark-red colour due to high anthocyanins.

Its processed arils packed in 19 µ or 25 µ semi-permeable film and stored at 5 ± 1° C maintained quality, colour and shelf-life up to 16 days.

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Natural-synthetic composite geotextiles for protecting river-bank

Bank erosion causes inconceivable damage to human habitation and property. To evade this, a set of novel geotextile fabrics using jute /jute-coir blended yarn and polyolefin-tape yarn have been developed. Geotextile samples contain more than 60% (w/w) natural fibres. Production viability of the developed geotextiles was tested through continuous production of geotextile fabrics using commercial-scale machines. Fabric samples performance was also evaluated following ASTM standard test methods. The blended fabrics, having much balanced property parameters, are found durable, more effective than both 100% natural and 100% synthetic fabrics and also much cheaper than 100% imported synthetic geotextile fabrics.

A field trial was conducted for protection of a part of the bank of the Mayurakshi river (rainfed river) at West Bengal using these geotextiles as reinforcing material for stable grass-turfing.

River bank covered with geotextiles

A total shower (till laying of geotextiles) during monsoon was recorded nearly 140 cm, and then at the end of the full monsoon period, even after the release of the stored water from Tilpara barrage at 125,000 cusec (plus additional 40,000 cusec from local catchments due to a spell of spear-headed shower for continuously three days during the same period), no change (deformation) and zero erosion of the part of the river-bank under trial was observed. While, on the rest of the parts (where geotextiles were not been used), major soil erosion including rain-cuts (number of rain-cut–64/100 m length of river-bank) were visible. It was also noticed that Durba grass grew extensively in more or less to the same extent on the geotextiles of all combinations.

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Paneer from peanut milk

Peanuts contain about 40.1% of fat and 25.3% of protein, and are a rich source of calcium, iron and vitamin B complex like thiamine, riboflavin, niacin, and vitamin A. They also contain high levels of oleic acid and sistosteral, which lower blood cholesterol level; vitamin E, which has antioxidant and anti-ageing properties; and resveratrol, which is a polyphenol, possessing strong antioxidant activity.

Peanut paneer developed by the institute is a tasty and nutritious product made by coagulating warm-peanut milk with food-grade coagulants. It can be converted into a variety of value-added products such as paneer pakoda, paneer tikki, kadhai paneer etc. Paneer prepared from whole kernel has: moisture

62.1±.8%, proteins 13.6±.5%, fats 19.2±1.5%, ash 1.9±.2% and carbohydrates 3.2±0.1%. Low fat paneer from peanut-milk can also be made with high nutritional and acceptability score. The technology for making full fat and low fat peanut paneers is ready for commercialization.

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Alcohol production from agro-residues

A laboratory-scale plant of 0.5 litre/batch capacity was designed for alcohol production from agri-residues of paddy straw and maize stalks. The unit was evaluated with ground paddy straw and maize stalks. The average alcohol yield (in absolute terms) from the paddy straw was 100-110 ml/kg of the ground straw and from maize stalks, it was 170-180 ml/kg of the ground stalks.

The study revealed following suitable process parameters for alcohol production:

a) grind agro-residues below 0.5-mm mesh size
b) thermo-chemical pre-treatment of the ground biomass straw with 2% NaOH and autoclaving at 121°C
c) hydrolysis of washed thermo-chemically pre-treated washed straw with cellulase enzyme (Palcosoft Super 720) at 50°C for 4 hours, and further keeping of the mixture is at room temperature up to 24 hours
d) fermentation of hydrolysed biomass mixture with yeast culture and supplement at room temperature (about 35°C) up to 80-100 hours.

Fermentation and primary distillation unit

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New dimension for camel-rearing

Traditionally, camels in India have been considered only as the means of transportation and source of draught power. Although dromedary camels were first domesticated for milk. Till recently also, the only users of camel milk were nomadic camel handlers (Rabari of Rajasthan). It is lately being realized that production and quality of camel milk can play an important role in human nutrition. Organized marketing of camel milk can be a source of income for camel-rearing sector of the rural population as well as for contributing to country's total milk pool.

Camel is capable of lactating even during severe droughts due to various homeostatic adaptive mechanisms which conserve body water, making it available for milk. Camel can live over 3 weeks without water intake. And it needs only 1.9 kg of dry matter to produce one litre of milk, compared with 9.1 kg of the matter by cows. Dromedary has the ability to maintain lactation for much longer periods than cattle; up to 2 years and at consistently high levels. And unlike four stomached ruminants, the camel does not produce high levels of methane, a greenhouse gas, which is one of the major contributors to global warming.

Properties of camel milk. Camel milk is opaque white with normal milky odour, slightly salty or sweet in taste. Its milk fat is lower in percentage as compared to cow and buffalo milks, but is spread throughout the milk in small micelles, which makes it easier to digest. The shelf life of raw camel milk is 8 – 9 hours and is much higher than cattle and buffalo milks. Camel milk contains higher vitamin C, calcium, salt and urea as

well as micro-minerals, making it a complete food. And the milk is amenable to preparing products like flavoured drink, *kulfi*, ice cream and sweets to prolong its shelf- life as well as to have value-added products.

Camel milk also possesses antimicrobial properties which are expected to have beneficial effect in treatment of certain infectious diseases.

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Improved purse-seine net

Purse-seining is aimed mainly at catching dense, mobile schools of pelagic fishes, and includes all elements of searching, hunting and capturing.

Purse-seine net was usually developed with mesh sizes ranging from 18 to 20 mm in the main body of the netting and was mainly for targeting anchovies, sardines and mackerels. The net has been redesigned and the mesh sizes of the conventional purse-seine have been replaced with larger mesh size (45 mm), and modified gear was operated by the fishermen using 18 m OAL purse-seine boat '*Mosha*', having 102-hp engine capable of doing-multi day fishing.

Catch details. A total of 89 trips were carried out with improved large mesh purse-seine net during 2004-06. The catch mainly comprised large sized mackerels, tunas, carangids and black pomfrets.

Catch of skipjack tunas

45-mm mesh size purse-seine net

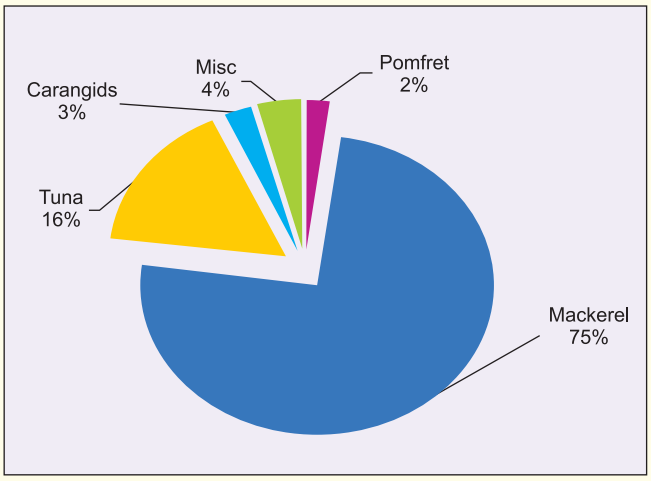
Purse-seine net is made by joining 65 rectangular pieces. The length of the net is 1,000 m and the depth is 72 m. Polypropylene ropes of 12 mm and 10 mm diameter are used for head rope and foot rope respectively. The ring rope is made up of polypropylene 24-mm diameter which passes through brass rings and facilitates closing of the bottom of the net. The bridles are made up of 12 mm diameter polypropylene double rope. The main webbing is made up of polyamide multifilament 210d × 4mm × 3mm of 45-mm mesh. Selvedge of 7 meshes depth of 40-mm mesh size of 1.5 mm diameter HDPE is attached to head rope. Lower selvedge of 11 meshes depth of 80-mm mesh size of 1.5 mm diameter HDPE is attached to foot rope. After lacing selvedge pieces to main webbing, side meshes are loosely hung on hanging lines at a fixed ratio. The bunt is made up of three pieces of polyamide multi 210d × 6 × 3 of 30mm mesh size. The hanging coefficients given on float and lead lines are 0.7 and 0.76 respectively. A total of 6,000 nos of spindle shaped plastic floats of 15 mm in length and lead sinkers of 200 g each, total weighing 1,000 kg are evenly distributed on the head and foot ropes respectively. A total 65 circular brass rings each weighing 1.3 kg are used for purse rings.

The landing of quality fishes gave purse-seine fishermen better value for their catch.

With increased and good quality catch, purse-seine fishery revived, and presently about 24 purse-seiners are in operation in Cochin Fisheries Harbour and all purse-seiners have changed over to 45-mm mesh size and operate in deeper waters, targeting skipjack tuna, little tuna, travelley, black pomfret, horse mackerel, barracuda, seerfish and mackerel.

On an average, a purse-seine boat should fetch revenue of Rs 40 lakh per year by sale of fish to break even. During 2008, the average revenue of purse seiner exceeded Rs 75 lakh.

The CIFT has also designed a new tuna purse-seine net having mesh size up to 120 mm for



Catch composition by the large mesh purse-seine net

targeting yellowfin and other large pelagics in deeper ocean.

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Live-fish storage system

Sherpur in Ludhiana is the biggest and important live- fish market of Indian major carps, Silver carp, Bighead, Grass carp, Common carp and Catfishes in the northern India, and here farmers bring live-fish (20–30 tonnes daily) from different parts of Punjab and Haryana. Mostly farmers bring fishes in the noon hours and sell all by evening. But the problem arose when not all fishes were sold and there was no storage arrangement.

An storage system for live-fishes with aeration has been designed and developed at the institute and tested for a year in Ludhiana. This live-fish storage system consists of a blower with a pressure regulator and an air filter, FRP tanks, diffuser stones, and a regulator and a distribution pipe assembly. To keep live-fish for market purpose, 20 litres of water is required per 5–8 kg fish. The installed capacity of the fish storage is 350 kg. By running aeration system, mortality of fish was found nil for all varieties in 24 hours of storage. Water temperature remained almost static for 24 hours of storage against the change in ambient temperature, water *p*H increased with 24-48 hours from 6.7 to 8.6. The total dissolved solids (TDS) also increased with storage duration from 0.44 to 0.800 mg/litre depending upon the fish variety stored.

The cost of the system worked out at Rs 30,000 approx for 200-kg capacity storage. And storage cost worked out at Rs 1.50/kg for 24 hours; the price difference in the cost of live and dead fish is almost 50%.

The efforts are being made to motivate fish-traders to install such a facility to minimize losses.

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Genetic improvement of giant freshwater prawn

Juvenile prawns from Gujarat, Kerala and Orissa representing different agro-ecological regions reared to sexual maturity were involved in a complete diallel cross (3 × 3) in different mating batches to establish a base population to start selective breeding programme. Performances of pure strains and crosses resulting from diallel design were evaluated after communal testing. Offsprings of each of the families were hatched and grown in separate tanks until large enough to be individually tagged. In total, larvae from 84 full-sib families were reared for 4-6 weeks in brackishwater (10 ppt), and post-larvae from these full-sib families were reared in nylon hapas in freshwater (earthen ponds) till they attained taggable size. Prawn juveniles from 60 full-sib families representing all 9 possible crosses were then tagged individually with visible implant alpha numeric tag VIA (standard size format 1.0 mm × 2.5 mm) as well as with visible implant elastomer (VIE) tag as a batch tag (nine codes for nine crosses). A total of 2,233 prawn juveniles from 30 full-sib families (80 juveniles from each family) representing all nine crosses of three stocks of *Macrobrachium*

rosenbergii were tagged in the first phase and stocked for communal rearing. In the second batch, 2,537 juveniles from 30 full-sib families were tagged and stocked for communal rearing. Stocking density employed was 3 nos/m^2. Prawns were harvested for final data collection after 120-135 days of rearing and all prawns that survived were collected, sexed and measured individually (total length, carapace length, standard length, wet weight).

Data from the communal rearing were analyzed using SAS and ASREML softwares. The results indicated that sex, cross and their two-way interaction effects were statistically significant for harvest weight. Kerala stock was significantly different from Orissa and Gujarat stocks. There was negative or non-significant total heterosis effect for recorded traits. Based on the results of the data analysis, mate allocation for raising the first generation was completed and breeding was started from June 2009 and in the first batch post-larvae from 45 full-sib families were produced and were reared in separate nylon hapas till reaching taggable size; 3,844 juveniles from these were tagged with VIA tag and stocked for communal rearing in three 0.04 ha ponds to raise the first generation.

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Broodstock development of cobia for the first time

Sexes of cobia were determined by cannulation, and males and females were segregated and stocked in separate cages. One of the females with intra-ovarian eggs around 700 µ was selected for induced breeding. The size of the female was 120 cm and weight was 23 kg.

Two males were also selected. Their sizes were 100 cm and 103 cm, and they weighed 11 kg and 13.5 kg. The selected brooders were introduced in a roofed cement tank with sea-water. At around 1300 hours, brooders were induced for spawning with HCG at doses of 500 IU per kg body weight for the female and 250 IU per kg body weight for males.

Total eggs spawned were estimated at 2.1 million. The eggs were collected by a 500 µ mesh and stocked in the incubation tanks with varying densities. Eggs hatched after 22 hours of incubation at a temperature range of 28-30° C. The percentage of hatching was 80, and the total number of newly hatched larvae was estimated at 1.5 million.

The mouth opening was formed on the 3rd day post hatch. The larvae were stocked in 15 FRP tanks of 5-tonne capacity each at an average density of 50,000 larvae per tank for intensive larviculture.The remaining larvae were stocked in three 100-tonne cement tanks for extensive larviculture trials. The intensive larviculture tanks were provided with green water at a density of about 1x 105 cells per ml and rotifers were enriched with DHA SELCO at a density of 6-8 nos. per ml. In the extensive larviculture tanks, green water along with rotifers are being maintained. Good survival of larvae is being observed, and the larviculture is progressing well.

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THE LAST PAGE

Maize (*Zea mays* L.) holds a unique position in the world agriculture as a food, feed and a source for diverse industrially important products. And it accounts for 15 to 56% of the total daily calories of the people in several developing countries.

In India, organized research on maize improvement in the country had started in 1957 with the launch of the All-India Co-ordinated Maize Improvement Project (AICMIP); the first of its kind. The impact of this project is evident from the fact that while the area under the maize has gone up from 3.16 m ha in 1950-51 to 8.3 m ha in 2008, its yield reached from a mere 0.5 tonne/ha to 2.4 tonnes/ha; with a considerable scope for further growth.

Since 1990s, greater emphasis has been laid on the development of high-yielding single-cross maize hybrids that have higher resource-use efficiency under diverse soils and climates. Both public and private institutions are also shifting seed production from double-cross hybrids to single-cross hybrids.

Although developed countries, particularly the USA, contribute predominantly to maize production, its demand in the developing countries is expected to surpass to that for wheat and rice by 2020; largely driven by rapid growth in poultry and livestock sectors. The expected demand for maize in India alone will be 35 mt by 2020.

Nearly 80% of the maize area in India is rainfed, and is prone to several abiotic and biotic stresses. Given the rapidly growing demand for maize, which will require intensified cropping systems in the context of increasing scarcity and value of agricultural water and likely unfavourable climate change scenarios, the drought tolerance trait in maize is certain to become important and valuable in the near future.

As more than 85% of the maize is used directly for food and feed, its quality has a greater role for food and nutritional security of the nation. Indian scientists have developed a series of QPM hybrids, including Shaktiman series, HQPM1 and Vivek QPM 9, and several other QPM hybrids are in the pipeline. Besides these hybrids, sweet-corn, baby-corn, pop-corn and high-oil corn have a great demand in the domestic and international markets.

Maize farmers worldwide have played a pivotal role in generating and conserving novel varieties and preserving traits that may prove of importance in the unforeseen circumstances. Although maize was introduced into India several centuries ago, its vast genetic resource, especially landraces, is still available, particularly in the North-Eastern Himalayan region. Generation of knowledge also of their genetic and adaptive histories and breeding value is of importance, as farmers around the world are coping with changes in temperature and water availability to maintain food supply for ever-increasing population.

Dr S. Ayyappan, Secretary (DARE) and Director-General (ICAR)

Opportunities for implementing molecular marker-assisted breeding technologies in maize have increased tremendously in the recent years. Significant strides have been made in the National Agricultural Research System particularly with regard to the understanding of the phenotypic and molecular diversities in maize germplasm and identification of genes influencing diverse traits and in implementing marker-assisted selections (MAS) for improving nutritional quality and disease resistance. Yet, there is a vast potential and need to expand scope and impact of such operations.

The levels of collaborations and partnerships with the international research institutions and the private sector institutions have to be enhanced significantly in the coming years for developing high-yielding, stress tolerant and nutritionally rich maize hybrids for strengthening conservation agriculture in maize-based cropping systems, and for better dissemination of improved cultivars to diverse maize-growing regions of the country.

The All-India Maize Research Workshop is being organized at Srinagar in April 2010, wherein we expect that some promising varieties/hybrids of maize, especially new single-cross hybrids developed to suit different agroclimates will be released, and research programmes will be chalked out to overcome production constraints including availability of adequate quantity of quality seed to enhance cultivation of improved maize, its productivity and profitability – for maize is the future crop for food as well as feed.

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