Volume 19 No. 3 July-September 2013

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

भाकृअनुप
ICAR

ICAR NEWS
A SCIENCE AND TECHNOLOGY NEWSLETTER

RESEARCH UPDATE

PROMISING TECHNOLOGIES

Allele-specific PCR for diagnosis of benzimidazole resistance in nematode, *Mecistocirrus digitatus*

Resistance in nematodes to drugs of the benzimidazole (BZ) group has been found associated with polymorphism in *beta-tubulin* gene. Mutations at the 167th and 200th positions (Phe to Tyr) were found responsible for the development of resistance in nematodes against the drugs.

The present study was designed to utilize allele-specific PCR for the diagnosis of benzimidazole resistance in a trichostrongylid nematode, *Mecistocirrus digitatus;* blood sucker of ruminants. Initially, truncated *beta-tubulin* gene (1,204 size) was amplified from mRNA using self- designed degenerative primers. The truncated gene was cloned in the TA cloning vector, and was custom- sequenced and analysed. Further, gene-specific primers were synthesized from sequence of 3' and 5' RACE- PCR (Rapid amplification of cDNA ends- PCR) and amplification complete ORF (open reading frame) of *beta-tubulin* gene of the nematode. After RACE, the complete ORF was cloned and sequenced. The polymorphism or point mutation was predicted at 125th, 167th and 200th codon of the *beta-tubulin* gene by bioinformatic tools as on other known trichostrongylids; based on the analysis of the sequenced and deduced amino acids. From the complete ORF, allele- specific PCR primers were designed to amplify mutation sites, particularly at 200th position. Genomic DNA was isolated from the individual adult male and also from the female. And *beta-tubulin* gene was amplified by simple PCR, followed by AS-PCR for genotyping single worm for polymorphism. Genotyping using allele-specific PCR identified polymorphism at codon 200th in *beta-tubulin* gene, and this makes easy survey for BZ- resistant genotypes.

The allele-specific PCR could discriminate between heterozygotes and homozygotes. Thus, this method can find

Indian Council of Agricultural Research
Krishi Bhavan, New Delhi 110 001, India
www.icar.org.in

Nested PCR for *M. digitatus*
Lane M: 100 bp plus DNA ladder (Fermentas)
Lane 1-4: *beta-tubulin* gene from single larva

Allele-specific PCR for benzimidazole resistance diagnosis in *M. digitatus*
Lane M: 100 bp plus DNA ladder (Fermentas)
Lane1,3: Heterozygous single larva shows resistance (250bp) and susceptibility (550bp)
Lane 2,4: Homozygous single larva shows only susceptible (550bp)
Note: 750 bp is non-allele specific bands

utility in studying molecular epidemiology of BZ resistance. The technique will be standardized further using infective third-stage larvae for its practical utility in fields.

M. Sankar, A. Prasad[1], J. Misri[2], B.C.Saravanan[1], A.K. Zahid[3] and **P. Thirumurugan**
Division of Temperate Animal Husbandry
Indian Veterinary Research Institute
Mukteshwar (Uttarakhand) 263 138,
[1]Division of Parasitology, IVRI
Izatnagar (Uttar Pradesh) 243 122,
[2]Animal Health, ICAR Headquarters
[3]KVK, Kargil (SKAUST-K) 194 103

Grouper fish *Epinephelus tauvina* bred in India for the first time

The greasy grouper *Epinephelus tauvina* is the major fish species in India; but is not available in sufficient quantity in capture fisheries. Non-availability of its seeds in sufficient quantity at the right time from the natural environment is the major constraint in grouper farming. Otherwise, this is one of the fast-growing groupers and commands an excellent live-market. The species can tolerate wide range of salinities, and can grow up to a kg in 9 months after the initial nursery; and fetches a farm-gate price of ₹200 in the domestic market.

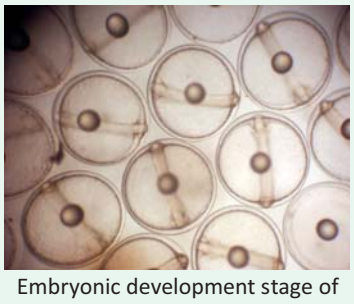
Technology has been developed for induced breeding and seed-production of the indigenous grouper broodstock. At present, arrangements are being made to grow seed of this fish in ponds in a participatory mode.

Female broodstock of greasy grouper (*Epinephelus tauvina*) in floating cage in Bay of Bengal off Visakhapatnam

Live-groupers of varying sizes (2.0–10.0 kg) were collected from wild and were stocked in cages maintained near to the shore. Groupers being protogynous, all stocked individuals were females. In the species, successful sex reversal (female to male) was achieved with hormonal and enzymatic manipulations. Fishes were implanted with different doses of enzymes. Female fish with intra-ovarian ova of diameter >450µ and sex reversed male were used for induced spawning.

Eggs hatched out with 78 % hatching rate after 19 – 20 hr of incubation at a temperature of 28-30°C. The newly hatched larvae measured from 1.0 to 1.4 mm. And the mouth opening was formed after 60 hr post hatch. Mixed feeding schedule was followed from 15th day post-hatch with *Artemia* nauplii, copepods and artificial diets. Metamorphosed fingerlings of 5–6 cm were obtained after 44 days.

This is the first successful larval rearing of greasy grouper in India, and would help promoting grouper aquaculture in cages as well as in grow-out ponds in the country.



Embryonic development stage of greasy grouper

12th day-old larva of the grouper (long spine stage)

Larva of the grouper on DPH 23(days post-hatch) (Free swimming stage)

Central Marine Fisheries Research Institute
P.B. No, 1603, Ernakulam North P.O., Kochi (Kerala) 682 018
e-mail: director@cmfri.org.in

Oyster-mushroom processing can be a boon to small-scale mushroom-growers

Oyster-mushroom (*Pleurotus* sp.) grows on a wide range of agricultural wastes in temperature ranging from 15 to 35°C with 100% biological efficiency; hence it is called as the 'Future Mushroom of India'. This mushroom has many advantages—simple cultivation practices, superior neutraceutical properties (57-65% carbohydrates, 20-30% proteins and 2-2.7% fat), and comparatively 1.5-2 times lesser cost of cultivation than commercially produced button mushroom. It has only marketing problems, owing to its high perishability, shorter shelf- life (1-2 days) and seasonal production that results in glut, and thus distress sale.

Various processing techniques have been standardized for fresh and dried oyster-mushrooms to develop value-added products. Crunchy quality oyster-mushroom biscuits, comparable with commercially available biscuits in terms of appearance, flavour and taste, have been prepared. From fresh mushrooms, pickle and mushroom-jam have been prepared. These value-added products have been found stable at the ambient temperature up to six-eight months. Oyster-mushroom powder was recommended at 5-10% of the total volume for preparation of biscuits and jam, based on the desired nutritional value, taste and flavour.

Oyster mushroom biscuits

Oyster mushroom jam

Oyster mushroom pickle

Trey sun drying

MAP of fresh mushroom

Fluidized bed drying

Oyster-mushroom can also be consumed in fresh form as mushroom curry, mushroom *pakoda*, mushroom patties and mushroom soup; all are low fat, protein-rich food for consumers. And preparation of these results not only in value-addition, but also extends shelf-life and gives additional returns to mushroom-growers.

And the problem of uncontrolled longer sun-drying (with 48-52% relative humidity at ambient temperature for 18-22 hr) responsible for deteriorating dried oyster texture and colour used for powder preparation has been resolved with the use of fluidized- bed drying (4-6 hr at 45-50°C hot-air temperature).

Modified atmospheric packaging (2.5-5% CO_2 and 5-10% O_2) of fresh oyster mushroom using plastic punnets of 200 g and 400 g over-wrapped with PVC film could extend its shelf-life by 6-8 days at 4-6°C storage temperature.

By adopting processing technologies and sound-marketing strategies, small-scale oyster mushroom-growers can increase their income by 18-35%.And application of post- harvest technologies would ensure supply of nutritionally- rich oyster mushroom products throughout the year.

G.C. Wakchaure and **Kamlesh K. Meena**
National Institute of Abiotic Stress Management
Baramati, Pune (Maharashtra) 413 115
e-mail: goraksha.wakchaure@gmail.com

New bottlenecks in papaya seed production in the North-Eastern Plains Zone

In papaya, seed production otherwise also is difficult because of its plants being dioecious and cross-pollinated. Quality-seed production and market value and export of papaya-fruits and seeds suffer from many limiting factors, including physiological disorders. Nutrient deficiencies of boron, zinc and sulphur and environmental stresses cause physiological disorders.

Bumpy fruits of papaya cv. Pune Selection 3

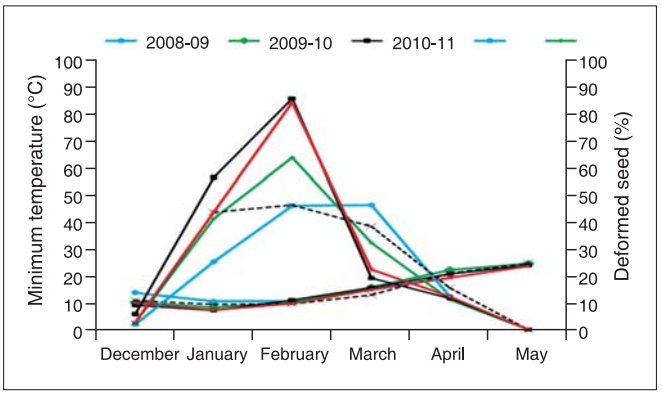
Bumpy fruits and deformed seeds have been identified as the new physiological disorders of papaya in the North Eastern Plains Zone. Deformity starts first in the young fruits, but symptoms become severe on the fruits close to physiological ripening. And infected tissues continue to increase in size, and end in forming a protuberance or a "bump", similar to a ball.

Deformed and normal seeds of the papaya cultivar

Visual differences were quite conspicuous in fruits and seeds of normal and bumpy fruits of papaya Pune Selection 3. Morphologically normal seeds are loose, black, smooth, shining and are easily removable from the fruit, but in the bumpy fruits, seeds were rough, tight, brownish, rough, disturbed and non-removable.

From December to May, a positive relationship was observed between the average monthly minimum temperature and deformed seeds. Increased incidence of deformed seeds was observed from December to February, and it decreased in the months thereafter.

The maximum incidence was observed during February due to lower temperature in January, which is the seed maturity period for February harvest.



Relationship between average monthly minimum temperature and deformed seeds

The stress associated with bumpy fruits may aggravate deformed seed incidence in Pune Selection 3. Fruit and seed disorders in papaya cause high economic losses in seed production during autumn-sown crop.

Pune Selection 3 was observed as the most susceptible germplasm line for bumpy fruits and deformed seed disorders.

Parmeshwar Lal Saran, Ravish Choudhary, Ishwar Singh Solanki and **Kanhaiya Singh**
IARI Regional Station, Pusa
Samastipur (Bihar) 848 125
e-mail: plsdehradun@gmail.com

Nutri-cereal pearl millet with high iron and zinc

Pearl millet (*Pennisetum glaucum*) is a highly nutritious warm-season, cross-pollinated coarse cereal, grown annually on more than 29 million hectares in arid and semi-arid tropical regions of Asia, Africa and Latin America. In India, it is largely cultivated in the rainfed areas. Its major growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana, accounting for 90% of the total pearl millet area; remaining 10% is in Tamil Nadu, Andhra Pradesh and Karnataka.

Pearl millet is used as a feed as well as a fodder crop. Its grains have higher protein and fat contents than of wheat or rice, and its amino acids composition is more befitting for human nutrition compared to wheat or polished rice. It is rich in vitamin B-complex, potassium, phosphorus, magnesium, iron, zinc, copper and manganese. It is a rich source of energy (361 Kcal/ 100g) comparable to commonly consumed cereals such as wheat (346 Kcal/100g), rice (345 Kcal/100g) maize (125 Kcal/100g) and sorghum (349Kcal/100g) as per the nutritive value of Indian foods (NIN, 2003). Its grains are gluten-free, but have some inherent antinutritional factors, like phytic acid.

Development of crop cultivars with elevated levels of micronutrients is recognized globally as one of the approaches to provide sustainable solution to various health problems associated with micronutrients malnutrition, especially in the developing countries. Efforts have been initiated in the national pearl millet programmes and the ICRISAT to develop high iron and zinc parental lines, and thus to develop biofortified hybrids to achieve this goal.

Realizing variations and inconsistencies in estimates of Fe and Zn contents in the pearl millet seed-samples over years and locations, Fe and Zn estimations were done with X-ray Fluorescence analyzer (XRF) facility.

Large amount of variability has been observed in pearl millet for grain iron and zinc content. Iron (Fe) content of the seed varied from 24 to 140 mg/kg (ppm) and Zn from 15 to 95mg/kg (ppm). Iron and zinc contents in the released hybrids and composite varieties of pearl millet are as follows.

Hybrid/ Composite variety	Fe in ppm	Zn in ppm
Pusa 23	42	31
Pusa 322	42	38
Pusa 605	43	34
Pusa 415	48	41
Pusa composite 443	60	44

New breeding lines have been developed with high grain iron and zinc contents. The following are some of the lines with high quantity of grain iron and zinc.

Breeding line	Fe (ppm)	Zn (ppm)
PPMI 901	111.7	82.5
PPMI 902	119.8	82.7
PPMI 905	112.9	79.4
PPMI 912	108.6	85.7
PPMI 923	115.6	84.4
PPMI 936	140.1	92.9

Efforts are underway to understand genetics; underlying genes in accumulation of iron and zinc contents in pearl millet.

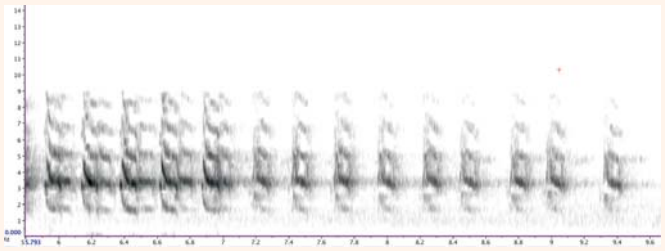
C. Tara Satyavathi, S.P. Singh, B.B. Singh
and **Mukesh Sankar**
Division of Genetics, IARI, New Delhi 110 012
e-mail: csatyavathi@gmail.com

Reduction in crop losses by birds using bio-acoustics

Damage by birds to agricultural and horticultural crops in some areas has assumed alarming proportions; in certain cultivated belts, farmers had to shift cropping patterns to avoid heavy losses (10-100% across the country). Close to around 200 species of birds are known to depredate. Rose-ringed Parakeets, Mynas, Crows, Sparrows, Munias and Weavers pose serious threat.

Traditionally, birds are dispersed from agricultural fields with visual deterrents like scare crows, Mylar ribbons and/ or acoustical deterrents like beating drums, shouting, wind chimes, gas cannons or by bursting crackers.

Bio-acoustics chiefly employs vocalization of birds; no artificial sounds or frequency modifications to bird calls are employed. Birds' vocalizations are classified into songs and calls. Though distinction is traditional and arbitrary; taxonomically birds are either song



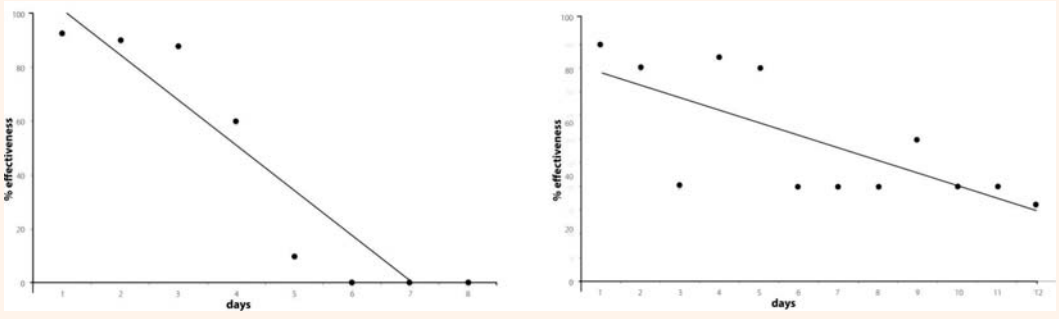
Sonogram analysis of Rose-ringed Parakeet alarm call

Call Sequence-1	Call Sequence-2
43 min (28 min bird calls + 15 min silence)	16 min (10 min bird calls + 6 min silence)
Used in ICRISAT	Used in DSR and Farmer's fields
IQR effectiveness: 42.6%	59%
Effective on six depredatory bird species	11 species

(oscines) or non-song (sub-oscines) birds; the latter ones are primitive. Song birds sing to communicate varied informations among and between species/genera. Typically, a bird would have a set of calls, each different from the other to convey a particular message, either seeking for a mate or announcing at an approaching danger etc. A House Crow employs 20 types of calls to communicate messages and a Warbler employs more than 1,600 types of songs (in some species, there are infinite types). Of these various communications, particular types like alarm, distress and predator calls elicit fleeing response from birds at the target area. Alarm calls are when birds' sight danger to their lives, distress calls are when caught by a predator; and when predator calls are played in the field, birds try to evacuate to safety.

Bird calls are usually recorded in the field with ambient sounds. The calls are spectrographically analyzed (called sonogram analysis) using Raven Pro and Final Cut Pro softwares. On the Y-axis frequency is plotted against time on the X-axis. Sonogram helps in understanding frequency range at which birds vocalize. Some birds do not respond to other species' calls, and on the extremity, Rock Pigeons do not respond even to their own species if the calls are not from the same region. In such cases, dialect of vocalization prevalent in a region can be recognized using above mentioned softwares. Additionally, the analysis helps in selecting appropriate sound drivers for use in the field. Bird vocalization happens in human audible frequency i.e., 20 Hz to 20,000 Hz; birds' hearing is sensitive in the range 2,000 to 8,000 Hz.

A set of alarm, distress and predator calls could be sequenced to disperse depredatory birds from the fields. Two such sequences were tested in sunflower and sorghum in and around Hyderabad, Directorate of Sorghum Research and in the ICRISAT fields.



Inter Quartile Range analysis of call sequences

The effectiveness of the call sequence was analyzed using Inter Quartile Range. The first sequence (above graph to the *left*) dispersed 43% of birds that visited fields and the second could do at 59% (above graph to *right*). Second sequence was an improvement over the first in increased number of calls and in reduced silence (no play) duration. Another improvement was that birds acclimatized very slowly to the second sequence, and by that time, the crop was already harvested.

In the ICRISAT, 94.3% of the control plot was devastated by birds (16kg/acre) in comparison to 1.3% in the experimental plot (416kg/acre) when first sequence was played. When second sequence was played, 50% of the control plot in farmers' fields was devastated by birds (242kg/acre) compared to 0.5% damage in the test fields (508kg/acre).

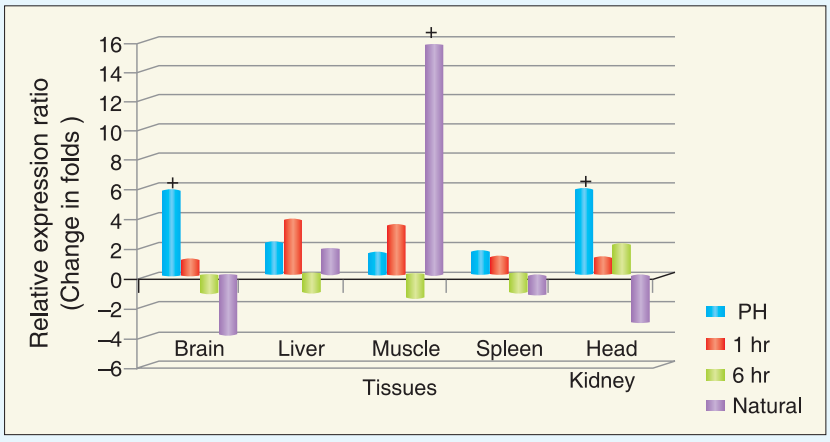
Number of farms used/being used	6
Number of farmers' fields experimented	2
Farmers' fields under experimentation	2
Research Institutes	2
Farmer's fields planned for the year	8-10

This research seems to be promising with future mandate of enhancing call library, using un-edited calls in the fields, and experiments on acclimatization of birds over seasons at the same place.

S. S Mahesh[1] and **V. Vasudeva Rao**[2]
[1]Via Life Sciences, Bengaluru (Karnataka) 560 010
[2]All-India Network Project on Agricultural Ornithology
Hyderabad (Andhra Pradesh) 500 030
e-mail: m@viaone.in

Biomarker candidate identified in fish for exposure to hypoxic environment

Three HIFs (Hypoxia inducible factors), which play central role in adaptive processes, were characterized from hypoxia- tolerant cat fish, *Clarias batrachus,* to elucidate their expression pattern under short- and long-term hypoxic conditions and for identification of biomarker candidate. Three isoforms reported of HIF-α subunit (HIF-1α, -2α and -3α) were studied widely in mammals; information regarding fish HIFs was limited.



Relative HIF-2α mRNA expression in *C. batrachus* following short-term (PH, 1 and 6 hr) and long-term (Natural) hypoxia exposure. (PH: progressive hypoxia up to 0.98 mg/litre dissolved oxygen, H1 and H6: hypoxic time period 1 and 6 hr at 0.98 mg/litre dissolved oxygen, after progressive hypoxia, NTR: long-term hypoxia exposure in natural habitat. Asterix (*) above/below bars represents significant difference ($p<0.05$) in expression levels in comparison to their respective normoxic control groups)

The complete cDNAs of HIF-1α, -2α and -3α were characterized. In *C. batrachus*, HIF-α subunit was found structurally similar in DNA binding, dimerization, degradation and transcriptional activation domains, but differed in oxygen-dependent degradation domains. Presence of c-Jun N-terminal kinase binding domain in HIF-α subunit was observed for the first time in fish. In adult *C. batrachus*, three HIF-α mRNAs were detected in different tissues under normoxic conditions; HIF-1α was highly expressed in comparison to HIF-2α and -3α in all the tissues studied. Short-term hypoxia exposure caused significant increase in three HIF-α transcripts in brain, liver and head-kidney, while after the long-term hypoxia exposure, significant up-regulation of HIF-1α in spleen and -2α in muscle was observed, and HIF-3α was significantly down-regulated in head-kidney. These observations suggest that differential expression of HIF-α subunit in *C. batrachus* was hypoxic-time-period dependent and may play specialized role in adaptive response to hypoxia. HIF-2α, with its highly elevated expression in muscle tissues, can be a robust biomarker candidate for exposure to hypoxic environment.

National Bureau of Fish Genetic Resources
Canal Ring Road, Telibagh, P.O.Dilkusha
Lucknow (Uttar Pradesh) 226 002
*e-mail:*director@nbfgr.res.in

Tomato-plant grafting for resistance to bacterial wilt

Tomato yields are seasonal due to high prevalent risks of pests and diseases. Farmers seldom plant tomatoes during rainy season; just to avoid incidence of bacterial wilt (*Ralstonia solanacearum* Yubuuchi). Rootstock replacement through tube- grafting has been considered effective in controlling this disease.

Swarna Baibhav, a promising F_1 hybrid of tomato, was grafted on the bacterial wilt resistant rootstocks of brinjal, Swarna Shyamali, Swarna Pratibha, HAB 900, HAB 901, and also of tomato Swarna Lalima. Complete compatibility was observed between the rootstock and the scion. The grafts grew vigorously and their cropping season also lengthened by a month as compared with the conventional methods. Swarna Baibhav on brinjal HAB 900 rootstock recorded the maximum yield (67.66 tonnes/ha) and higher number of fruits per plant (40) than other rootstocks. There was a huge loss in yield due to high mortality of non-grafted Swarna Baibhav (23.71 tonnes/ha). Percentage survival of rootstocks against bacterial wilt was 100% in Swarna Pratibha, followed by HAB 900 and HAB 901 (98.24%).

A.K. Singh[1], P. Bhavana[1], S. Kumar[1] and B.P. Bhatt[2]
[1]ICAR Research Complex for Eastern Region
Research Centre, Ranchi (Jharkhand) 834 010
[2]ICAR Research Complex for Eastern Region, Patna
(Bihar) 800 014

Cowpea landraces from Mizoram

In India, cowpea (*Vigna unguiculata*) is grown mostly for grain. Dual- purpose or vegetable cowpea is sparingly cultivated; that too mostly in the north-eastern states of India. The National Genebank at the National Bureau of Plant Genetic Resources, New Delhi, has 3,709 accessions of cowpea, of which very few are dual-purpose/vegetable types.

During November 2012, a collaborative exploration in parts of Mizoram was undertaken, involving Indian Institute of Horticultural Research, Bengalaru, and ICAR-NEH, Mizoram Centre. A total of 27 dual-purpose accessions of cowpea have been collected, comprising 9 popular landraces. Their seed characters and other traits have also been recorded.

The collected germplasm has been deposited in the National Gene Bank, NBPGR, for the long-term conservation.

Seed and other traits of cowpea landraces

Name	Seed size (mm)	100-seed wt (g)	Other traits
Behlawi	8.6x5.2	19.7	Leaves are used as a vegetable
Hlawite (*hlawi* means cowpea, *te* means small; small cowpea because leaf has small petiole)	8.1x4.3	11.6	Leaves and pods are used as a vegetable; pod size is 6 cm; leaf only is edible when grown in a season other than August
Behlawivarthau (means seeds are fat and big in size)	9.5x4.8	13.6	Leaves and pods are used as a vegetable; pod is green and 30-cm long; has spreading type growth habit; is sown in March
Behlawilaihawl (*laihawl* means middle; middle sized as compared to other cowpea genotypes)	10.0x5.2	11.3	Both leaves and pods are used as a vegetable; pod is red and is 30-cm long
Hlawivapual (means pod has red bordered)	9.0x4.3	12.7	Pod is green with red suture; has long shelf-life; is a long-duration crop
Behlawizungsenthau (*zung* means root, *sen* means red; means genotype is big in size with reddish roots)	9.3x4.3	8.9	Both leaves and pods are used as a vegetable; pod is green with pink suture and is 45-cm long
Beanbehlawi (seed resembles bean seed)	10.0x4.8	11.5	Both leaves and pods are used as a vegetable; pod size is 45 cm
Behlawilian	10.8x5.6	13.7	Pod is broad; both leaves and pods are used as a vegetable; is photosensitive
Furbehlawi (*fur* means rainy season; these genotypes are harvested during rainy season)	11.3x4.0	11.8	Both leaves and pods are used as a vegetable; pod is reddish- green; is photosensitive; is grown in summer

Seed diversity in cowpea landraces

Sunil, T.S. Aghora[1], Sudip Kumar Dutta[2], Lalremruati V.[2], S.K. Chakrabarty, F.B. Singh[2] and D.C. Bhandari[3]
National Bureau of Plant Genetic Resources
Regional Station, Hyderabad (AndhraPradesh) 500 030
[1]Indian Institute of Horticultural Research
Bengaluru (Karnataka) 560 089
[2]ICAR-NEH Mizoram Centre, Kolasib 796 081
[3]National Bureau of Plant Genetic Resources
New Delhi 110 012

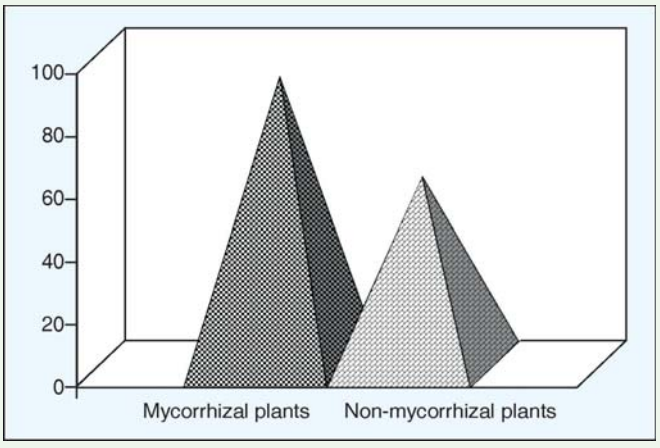
In-vitro clonal propagation of *lasora* (*Cordia myxa*)

Indian cherry (*Cordia myxa*) or *lasora* is an underutilized, drought-tolerant fruit-tree, spread over to arid and semi-arid regions of the North India. This is usually cultivated in a marginal ecosystem as it has many xerophytic characters. Unripe fruits are pickled alone or mixed with mango, and they are used as a vegetable also. Ripe-fruits are eaten raw. All fruits types have medicinal value and are considered antihelmintic, diuretic, demulcent and expectorant. Despite high value of this fruit-tree, it has remained underexploited, and hence needs attention.

Its propagation through seed generates variability, and the vegetative method of propagation, though successful, has been ineffective in rapid multiplication of the desired variety.

Micropropagation of *lasora*. **(a)** Shoot proliferation; **(b)** Rooting; **(c)** Acclimation under hardening chamber; **(d)** Transfer to polyhouse for bio-hardening and; **(e)** Plants ready for field transfer

Recently, a protocol has been standardized for *in-vitro* propagation of *lasora* using nodal segments. Single node cuttings from the new growth of the clonal selection of *lasora*, CIAH 1, were cultured on the MS medium supplemented with 2.0, 4.0 and 6.0 mg kinetin and BAP/L alone or in combination with 0.01 mg NAA/L. The best response of shoot regeneration was observed with 4.0 mg kinetin /L. Regenerated shoots from shoot buds were separated aseptically, and thereafter transferred to rooting medium containing NAA and IBA along with 750 mg charcoal /L. Of different combinations, medium supplemented with 2.0 mg IBA or NAA /L in combination with charcoal was found superior over other hormonal combinations for rooting. Rooted plantlets were transferred to *ex -vitro* conditions for acclimatization. Initial hardening for 10 days was done in the hardening chamber, a plastic chamber without a bottom of 37.5 cm × 27.0 cm ×22.6 cm and with two side-windows on opposite direction, which were used to regulate humidity to 85-90% by opening or closing. This was followed by bio-hardening with



Plant survival as affected by mycorrhizal inoculation during bio-hardening

arbuscular mycorrhizal fungi (AMF) in a polyhouse for a month with day-night temperature maintained at 27° ± 1°C, and with an extended photoperiod of 16 hr using white fluorescent light with relative humidity maintained at 80 - 85%, using humidifiers.

Hare Krishna, Dhurendra Singh and **S.K. Sharma**
Central Institute for Arid Horticulture, Beechwal
Bikaner (Rajasthan) 334 006
e-mail: kshun@rediffmail.com

Monoecious line of muskmelon developed

Muskmelon (*Cucumis melo*) is predominantly andromonoecious in sex expression, and in natural populations, its monoecious sex forms are also found. At present, main focus in muskmelon has been on the development of F_1 hybrids due to their high yield, uniform fruit shape and size, as well as consistently excellent quality.

Cost of hybrid-seed production is high because of the need of emasculation in the andromonoecious cultivars. Use of male-sterile line is also tedious owing to maintenance of a single recessive gene in heterozygous condition, also due to the problem of identification of male-sterile plants, and rogueing of 50% male-fertile plants from female row at the time flowering. Hence,

a

b

a. Monoecious sex form;
b. Fruit of monoecious line

development of monoecious muskmelon lines may help overcome these difficulties.

Two monoecious plants of muskmelon identified from a landrace AHMM/BR 8, collected from Sirohi District of Rajasthan, were self-pollinated and their seeds were collected separately. Individual plant progenies were grown and a single plant selection was exercised based on the sex form, earliness, fruit weight, fruit colour, seed cavity size, flesh thickness, flesh colour and TSS. Selfing and selection based on the desirable horticultural traits was continued up to five generations. This line produced round fruits with green sutures, salmon-orange flesh and developed 'full slip' stage at the ripening. Its Fruits contained total sugar: 336.9 mg/g, tannin content: 0.12 mg/g, phenol content: 34.7 mg/g and flavonoid content: 1.05 mg/g on the dry weight basis.

Characteristic features of AHMM/BR 8

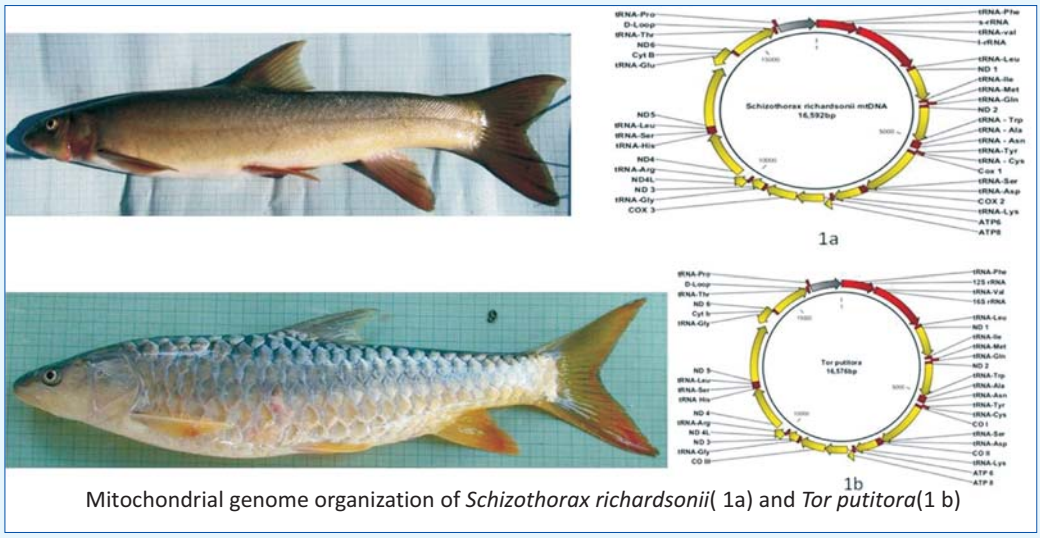
Parameter	Range
Days to 50 % female flower	43.80-46.13
Days to first fruit harvest	70.20-73.87
Fruit diameter (cm)	11.32-12.76
Flesh thickness (cm)	3.43-4.00
Width of seed cavity (cm)	4.37-5.12
Total soluble solids (%)	10.8-11.3
Flesh hardness (g/cm^2)	478-570
*p*H of flesh	5.64-5.87
Fruit weight (kg)	0.8-1.10
Number of fruits/plant	3.47-4.27

Developed stable monoecious line of muskmelon can be utilized in F_1 hybrid-seed production, which may reduce 50% time required in emasculation and also enhance fruit-set, and ultimately reduce cost of hybrid production.

B.R. Choudhary, S.M. Haldhar, R. Bhargava, S.K. Maheshwari and **S.K. Sharma**
Central Institute for Arid Horticulture
Bikaner (Rajasthan) 334 006

Complete mitochondrial organization of coldwater fish species

Complete mitochondrial genomes of Snow trout (*Schizothorax richardsonii*) and Golden mahseer (*Tor putitora*) have been sequenced for the first time. Mitochondrial genome of *S. richardsonii* is 16,592 bp (NCBI GENBANK accession No. KC790369) in length and of *T. putitora* is 16,576 bp (NCBI GENBANK accession No. KC914620) in length. Both the genomes consist of 13 protein coding genes, 22 tRNAs, 2 rRNA genes and one putative *control region*. Gene organization and its order is similar to other vertebrates. The present findings of mitochondrial genome sequencing would serve as a reference data and would also contribute significantly to study phylogeny of both the species for genetic improvement programme.



Mitochondrial genome organization of *Schizothorax richardsonii*(1a) and *Tor putitora*(1 b)

Directorate of Coldwater Fisheries Research
Anusandhan Bhavan, Industrial Area
Bhimtal (Uttarakhand) 263 136
*e-mail:*director@dcfr.res.in

National Academy of Agricultural Research Management, Hyderabad

It is a premier Institute in the agricultural research management, enabling National Agricultural Research System to adapt to changes through continuous innovation

Director's Office *Auditorium*

The NAARM was established by the ICAR at Hyderabad in September 1976 as the Central Staff College of Agriculture. The Campus is spread over 50 hectares in Rajendranagar (17°18'49"N latitude and 78°24'42" East longitude) in Hyderabad, about 20 km from Hyderabad Rajiv Gandhi International Airport, Shamshabad, 25 km from Secunderabad Railway Station, 16 km from Hyderabad Railway Station, 16 km from Kacheguda Railway Station and 12 km from Imlibun/Mahatma Gandhi Bus Stand.

Earlier its role was only to impart Foundation Training to the new entrants of the Agricultural Research Service (ARS) of the ICAR. In 1979, it acquired its present name and its Mandate also expanded to enhance performance and effectiveness of the NARS through capacity-building, research and policy support in agricultural research and education management. Based on the recommendations of the Fourth Quinquennial Review Team (QRT) of the NAARM, the Academy has started a two-year postgraduate education in Agricultural Management and of one-year postgraduate education in Technology Management. At present, NAARM activities cover four broad areas – Capacity-building of

The NAARM Logo

The NAARM logo was unveiled during the institute's Foundation Day celebrations on 1 September 2012.

The logo comprises four elements: **The Globe; The Human; Agriculture; NAARM in English and Hindi**

The National Academy of Agricultural Research Management (NAARM) in Hyderabad in India is the only institution of its kind in the world primarily established for building capacity of individuals and of institutions of the National Agricultural Research System (NARS).

MANDATE

- To be an integrated institution of agricultural management, focusing on creation, dissemination and application of knowledge through its education, training, research, consultancy and policy-support programmes.
- To serve as an apex resource centre for collection, compilation, documentation and dissemination of innovative learning resources and practices in agricultural management followed in India and other countries.
- To work as a catalyst for building and enhancing competence of individual scientists and also the capability of institutions of the NARS for addressing contemporary issues in agricultural management.
- To facilitate organizational renewal of the NARS and management of change.
- To serve as a think-tank for the NARS and to provide research-based inputs and advice to agricultural policy-makers, planners, administrators and others.
- To establish and foster functional partnerships and effective networking with leading management institutes of the world in order to emerge as a global thought and knowledge leader.

The Academic Teaching Block (*Top*); The Administrative Block (*Bottom*)

the NARS; Research; Postgraduate education; and Policy support.

The Academy has contributed significantly in the development of a new generation of scientists and research leaders not only in the ICAR but also in the NARS. It has also facilitated several new policies, institutional mechanisms, and initiatives leading to enhanced capacities in the NARS for research, education and extension management. The strength of the Academy lies in its unique blend of training, research and education activities that interactively reinforce one another. No other institution, public or private, addresses such a wide need of capacity- building of the NARS at the scale and at the range offered by the Academy.

INFRASTRUCTURE

Academic: The institute has a State-of-the-art Academic Block with Teaching Halls, Conference Halls, Committee Rooms and Seminar Halls with video- conference facilities.

Library*:* It has books and journals on agricultural research management, science policy, system studies, project management, futurology, forecasting, educational technology, teaching, transfer systems and policies, women studies, information management, research communication, ICT, HRD, IPR, and administration. It has around 25,000 books and more than 200 journals. The library also has online access to premier journals.

Laboratories: It has following laboratories: ARIS, GIS, CCTV, Multimedia, Server, Organizational Behaviour, Audio-visual and Communication, and Video.

PROGRAMMES AND ACTIVITIES

Capacity-Building

The NAARM organizes capacity-building programmes (CBP) for research managers, scientists, and teachers, and technical, administrative and finance personnel of the NARS. The CPB are classified as follows.

Foundation Course: The Foundation Course for the Agricultural Research Service is induction training for the newly recruited scientists in the ICAR. Its objectives are to train participants in various aspects of agricultural research and project management, including developing skills for managing interdisciplinary research.

Leadership Development Programmes: These programmes are designed for leadership development for transition of the National Agricultural Research System into National Agricultural Innovation System. There are following three programmes.

- **Executive Development Programmes** on the Leadership Development for newly-recruited Directors, Zonal Project Directors, Assistant Directors General, and Joint Directors of the ICAR and other Institutions in the NARS, who are in the Research Management Position cadre.
- **Management Development Programmes** on the Leadership Development (Pre-RMP Cadre) for Heads of Divisions and other Senior functionaries in the ICAR and other Institutions in the NARS, who are in the pre-Research Management Position cadre.
- **Management Development Programmes** in the Agricultural Research for Heads of Divisions of the ICAR Institutes, Project Coordinators of the ICAR, and Head of Departments, Associate Directors of Research, and Associate Deans of the State Agricultural Universities.

Refresher Courses: These courses are organized to update knowledge and skills of the intended participants in the topical areas. Their duration ranges from 10 to 21 days. Participants include recruited Senior/Principal Scientists through lateral entry from the University and other than the Agricultural Research Service of the ICAR.

Management Development Programmes/Faculty Development Programmes: These programmes are targeted for mid-career managerial, scientific, technical and administrative personnel of the NARS. They are

designed towards imparting advanced knowledge and skills in the agricultural research management, human resource management, information and communication management and administrative and financial management.

Workshops: These provide a forum for interactions on the policies in agriculture, agricultural education and related sectors on a national and an international level. The recommendations of these workshops and seminars are a useful resource material for the NAARM programmes. Participants are Scientists of the ICAR Institutes/State Agricultural Universities, who are involved in the National Research Management activities, Faculty in Universities/Colleges, Leaders of NGOs taking-up NRM- related projects, Faculty of Krishi Vigyan Kendras and State/District level Officers of Agriculture and Allied departments.

International Training Programmes: These programmes provide an opportunity for participants to upgrade their knowledge in the specialized areas of agricultural research management and educational technology. These programmes are formulated on specific demand from the International Institutions, particularly from the developing countries for their Scientists and Managers. Participants require prior approval from the Indian Council of Agricultural Research and the Government of India and have to complete Visa requirements.

Sponsored Programmes: These are customized for research and educational institutions of the ARS. They are conducted off-campus for Scientists and Managers from the sponsored Institutions. The course contents are Research Project and Agricultural Research; System and its Management; Human Resource Management and Development; Information Technology for Content Development and Management; E-Learning and Distance Education in Agriculture; Educational Planning, Management and Development; Decision Support Systems for Sustainable Agriculture; Implications of WTO, and IPR in Agricultural R & D; Training Management; Developing Winning Research Proposals; Performance Assessment of Agricultural Research Organizations; Advances in Administration and Financial Management.

RESEARCH

The Academy addresses research needs in the following major areas, which also indicate functional divisions of the Academy.

Research Systems Management: Agricultural scenario and policy analysis; research project management; research prioritization, monitoring, evaluation and impact assessment; identifying new policy initiatives for productivity enhancement of the NARS; policy studies on the agricultural production-consumption systems and sustaining rural livelihoods; technology forecasting and assessment in agriculture; intellectual property management; agribusiness management; agrobiodiversity and biosecurity management.

Information and Communication Management: Information technology policy for the NARS; information technology- based decision support systems; digital multimedia resources for agricultural development; geographical information systems; knowledge management; participatory technology development and transfer; distance training; and collaborative tools for promoting research.

Human Resource Management: HRD strategies for the NARS; leadership and organizational climate; evolving systems for HRD; performance appraisal and accountability in agricultural research and education; impact assessment of training; and educational technologies for enhancing learning.

Agribusiness Management: Agricultural market research; supply-chain management; commodity trading and future markets; finance and insurance; international trade in agriculture; agri-food retail management; rural marketing; agribusiness strategy; risk management in agribusiness.

Education Systems' Management: Curriculae design and development; instructional strategies and techniques; technology in education including multimedia enriched e-learning content development and delivery; teaching-learning processes; academic evaluation; educational planning, administration and management.

Extension Systems Management: Extension policy, planning and management; extension information systems; ICTs in participatory technology development; ICT applications for village knowledge centres; institutional innovations in extension; e-extension and m-extension, gender mainstreaming in extension.

EDUCATION

Two postgraduate Diploma programmes are being offered.

Postgraduate Diploma in Management (Agriculture) PGDM (A): It is a two-year programme for agriculture and allied disciplines, approved by the AICTE.

Postgraduate Diploma in Technology Management in Agriculture (PGD-TMA): It is a one-year programme for the experienced agricultural professionals, offered in distance mode, in association with the University of Hyderabad, Hyderabad.

POLICY SUPPORT

The Academy improves efficiency and effectiveness of the NARS by suggesting policy options. In addition, the Academy provides a platform for dialogue on the important national issues through brainstorming sessions/high-powered committee meetings. Some important issues addressed in the past include: bio-security, technology forecasting, food and nutritional security, precision agriculture, good governance, public-private partnership, climate change and agricultural development, and others.

ACHIEVEMENTS

- Capacity-building programmes 1,055 in number were conducted from 1976 to 2013; comprising an innovative curriculum, which is continuously revised. Some of the CBPs were conducted in off-campus mode in the ICAR institutes and State Agricultural Universities.
- From 2007 onwards, the institute facilitated participation of more than 400 scientists of the NARS in the international training programmes in the frontier areas of agricultural research.
- Policy support on the important national and organizational management issues in agriculture and agricultural research included sustainable rural livelihood security, biodiversity conservation, intellectual property protection and commercialization of technologies, regulatory issues for GMOs, technology forecasting, food and nutritional security, good governance, public-private partnerships, climate change and agricultural development.
- Consultancy was given to many agricultural research and development institutions in India and abroad for customized teaching, training and research support.
- Established ICT-enabled village-knowledge centres, and co-ordinated policy development by organizing workshops, dialogues and brainstorming sessions on

Group photograph of the scientists of the **First Batch of the Foundation Course on Agricultural Research Project Management (FOCARS)** (1 Sep to 11 Dec 1976)

Trainees of the FOCARS 97 batch (1 Jan to April 2013)

NAARM partnerships with National and International Institutions

- The ICAR institutions and Krishi Vigyan Kendras
- The Government of India institutions such as the Department of Science and Technology (DST)
- State Agricultural Universities and Central Universities such as the University of Hyderabad and others
- Management Institutions – the Administrative Staff College of India, Indian School of Business, Indian Institutes of Management, National Institute of Agricultural Extension Management (MANAGE), National Institute of Rural Development and Institute of Public Enterprises
- Consultative Group for International Agricultural Research institutions—the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India; the International Maize and Wheat Improvement Centre(CIMMYT); and the International Food Policy Research Institute (IFPRI)
- Private Sector and NGOs
- The World Bank and the Food and Agriculture Organization of the United Nations (FAO)
- South Asian Association for Regional Cooperation (SAARC)
- Department for International Development (DFID, United Kingdom).
- NARS of developing countries such as Sri Lanka, Nigeria, Yemen and Tanzania
- Universities and institutions in both developed and developing countries

the contemporary national issues.

- Advised farmers and innovators to protect innovations and community resources as Geographic Indications.
- Acted as Help Desk for the National Agricultural Innovation Projects under component 2, component 3 and component 4, and facilitated development and management of consortia research projects.
- Handholding of several State Agricultural Universities (SAUs) and Deemed-to-be Universities of the ICAR in developing e-content in Dairy Technology, Home Science, Fisheries, Horticulture, Veterinary Science and Agricultural Engineering.
- Agribusiness Knowledge Centre in a public-private partnership facilitated knowledge flow and networking among stakeholders in the agri-value chain.
- Handholding of Women Self Help Groups (SHGs) in the selected villages of Nalgonda district in Andhra Pradesh through a portal hosted on the NAARM website.
- Developed an Agriculture Gateway to India website to enable literate progressive farmers to explore information on commodities and marketing.
- Students of the Postgraduate Diploma in Agriculture (Management) were successfully placed in the national and multinational companies.

THRUST AREAS DURING XII PLAN

Enhance Individual and Institutional Capacities of the NARS for Innovation

Enhance Capacities for Leadership and Governance: Institutionalize a framework for leadership development of research professionals at all levels of the NARS—early, mid-career, senior professional and research manager levels; Enhance leadership, human resources management and governance capacities for managing change in the NARS to meet challenges of market orientation of research and sustainable agricultural development.

Mobilizing Science and Technology for Innovation and Sustainable Development: Enhance capacities for research policy, priority- setting, planning, management, monitoring and evaluation in the emerging contexts of food security, globalization and sustainable development; Enhance capacities for technology foresight and strategic management of intellectual property and commercialization of technologies.

Information and Communication Management: Enhance capacities for managing data, information and knowledge in agricultural research, education, technology transfer and institutional governance; Enhance capacities and skills by incorporating emerging information technologies (cloud computing, GIS and mobile technologies) in the agricultural research, education, extension and agribusiness.

Extension Systems Management in a Market-driven Environment: Enhance operational, adaptive and generative capacity of frontline agricultural extension systems to address emerging challenges; Enhance capacities in use of ICTs to provide customized knowledge, skills and solutions to farmers, farmer groups and rural communities.

Education Systems Management for Faculty Excellence and Enhanced Teaching-learning Experience: Enhance capacities for agricultural education policy, planning and evaluation in the institutions of the NARS; Enhance capacities for faculty excellence and technology-enhanced learning to increase learning opportunities and to create vibrant learning organizations.

Agribusiness Management: Enhance capacities for food and agribusiness management education and research in the NARS; Enhance capacities for improving efficiencies and managing risk in agricultural production and market systems; Enhance capacities for entrepreneurship and strategic management of agribusinesses.

Postgraduate Education in Agricultural Management

Postgraduate programmes and Doctoral programmes to cut-across thrust areas to provide learning opportunities to a new generation of young leaders to address emerging challenges in the Indian and global agriculture. These programmes will adopt a multidimensional technology and knowledge-driven approach in agricultural management education.

Globalizing reach

Organize customized, demand-driven on- and off-campus international training programmes; Provide high-quality learning in a distance mode through open-learning initiatives; Carry-out demand-driven collaborative research studies that can enhance food security, rural livelihood, policies and agribusiness; Institute scientist/student exchange programmes with different nations.

S.L. Goswami
National Academy of Agricultural Research Management
Hyderabad (Andhra Pradesh) 500 030
e-mail: director@naarm.ernet.in
Web: http://www.naarm.ernet.in

Pusa Mustard 28 (NPJ 124)

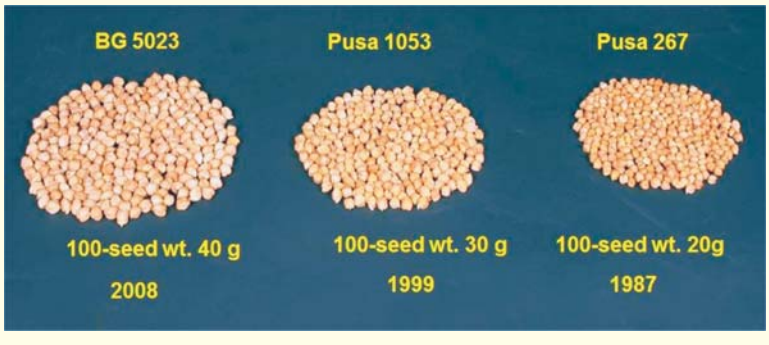
This mustard variety has been released from the IARI for Haryana, Rajasthan, Punjab, plains of Jammu and Kashmir, Delhi and western Uttar Pradesh for early sown (September), irrigated areas. It matures in 107 days, and yielded on an average 1.99 tonnes of seeds/ha and 41.5% oil content. Its per day productivity was found higher (18.63 kg/day/ha) than all the earlier released varieties. It showed high temperature tolerance at seedling stage and grain-filling stage, and fits well in the multiple cropping systems. With this, an additional (catch) crop can be taken between *kharif* and *rabi* in the North-Western Plains Zone, when the fields generally remain fallow after the harvest of *kharif* crops (during September) and before the sowing of *rabi* crops, particularly wheat, sugarcane and vegetables (Mid-December). It is a good substitute for *toria*.

D.K. Yadava
Division of Genetics
IARI, New Delhi 110 012
e-mail: dkygenet@gmail.com

Improved chickpea productivity by breaking alliance between seed size and yield

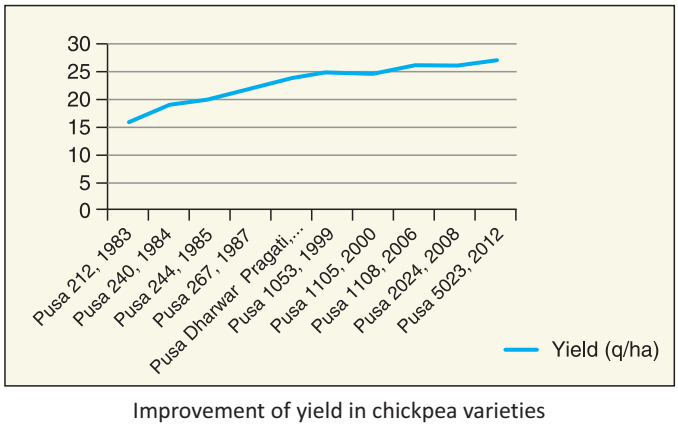
Multiple hybridizations and *desi* × Kabuli introgressions and distant hybridizations resulted in breaking of alliance between seed size and yield in chickpea.

Improved seed size in *desi* varieties



Improved seed size in Kabuli varieties

Beginning with *desi* chickpea, Pusa 212, which had 100- seed weight of 14g and yielding capability of 1.6 tonnes/ha, the first extra-large seeded *desi* chickpea variety Pusa 5028 has been developed with 100-seed weight of 40g and yield of 2.7 tonnes/ha.



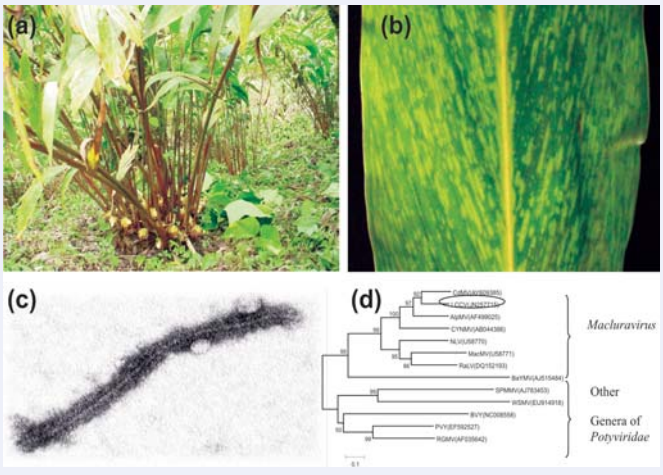
Improvement of yield in chickpea varieties

In Kabuli types, Pusa 1003 was first developed in 1996, with 100-seed weight of 25g and yield of 1.5 tonnes/ha. And the first *kabuli* chickpea extra-bold-seeded variety, Pusa 1053 (Pusa (100-seed weight of 40-42g) and with a very high yield (2.6-2.7tonnes/ha) was also developed. Large-seeded *kabuli* types are preferred by consumers and they fetch premium price to farmers.

C. Bharadwaj, J. Kumar, Shailesh Tripathi and **K.V. Prabhu**
Division of Genetics, IARI,
New Delhi 110 012
e-mail: chbharadwaj@yahoo.co.in;
jk_meher@rediffmail.com

Resolved etiology of large cardamom chirke disease

Large cardamom (*Amomum subulatum*), an important aromatic spice crop, cultivated extensively in Sikkim state and Darjeeling district of West Bengal, is affected by a chronic viral disease, known as 'chirke disease', which results in over 80% yield losses. Though this disease is known for over 50 years, for the first time virus associated with it has been identified.



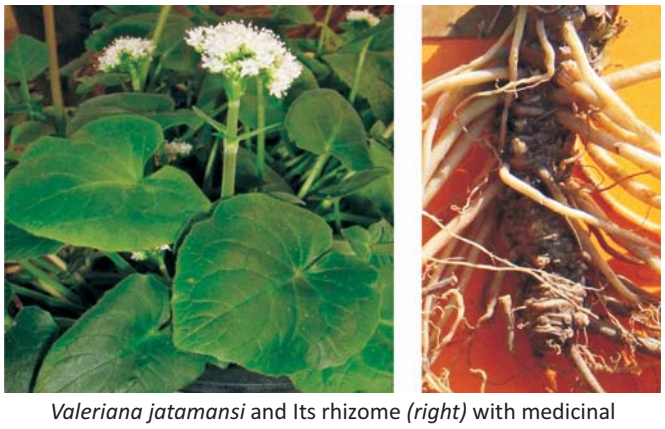
Chirke on large cardamom cultivar, Varlangey. **(a)** Healthy plant bearing flowers; **(b)** Affected leaf showing streak mosaic symptoms; **(c)** Virus particle decorated with antibodies; **(d)** Coat protein gene sequence revealing a new virus species under the genus *Macluravirus*

The filamentous virus particles measuring 625-650 nm × 12.5 nm were observed from the chirke-affected plants. Further, the 3' terminal genome sequence containing partial NIb, complete capsid protein gene and 3' untranslated region of the virus revealed identity of a new virus species, named as the large cardamom chirke virus (LCCV), under the genus *Macluravirus*, family Potyviridae. This virus is most closely related to cardamom mosaic virus, causing katte disease of small cardamom, cultivated in the southern India.

Bikash Mandal and **R.K. Jain**
Division of Plant Pathology, IARI, New Delhi 110 012
e-mail: leafcurl@rediffmail.com, rakeshjain56@yahoo.co.in

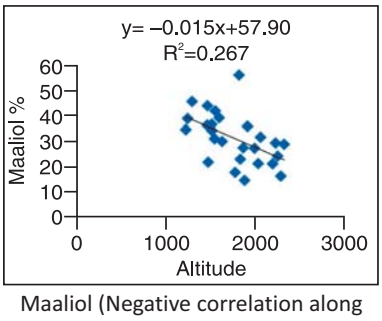
Indian Valerian from Central Himalayan Region

Indian Valerian (*Valeriana jatamansii*; syn: *Valeriana wallichii*) is well known to traders of flavour and fragrance for its medicinal and aromatic properties. It is a perennial herb, belonging to family Valerianaceae, and is called *Jatamasi, Samyo, Mushkabala, Heeverum, Tagar, Sugandhbala* and *Sumaya* in local parlance. It is distributed in Afghanistan, the Himalayan region (Kashmir to Bhutan), Asom, Tibet, Myanmar and Western, Central China at elevation range of 1,500 to 3,000 m above mean sea level, and is confined to shady-moist habitat. It usually flowers and fructifies from March to June, and can reproduce through vegetative propagation (by suckers and rhizomes) and seeds.

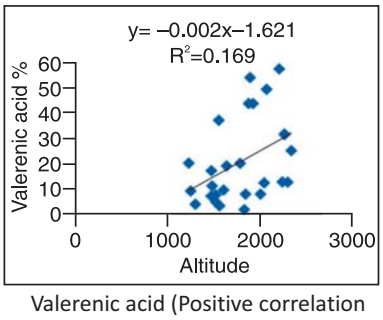


Valeriana jatamansi and Its rhizome *(right)* with medicinal and aromatic properties

Its rhizome paste is useful in headache, sore throat, indigestion and people suffering from shock. In the traditional system of Himalayan region, its dried whole plant is esteemed for incense fire; powdered rhizome is used for perfuming tobacco; and rhizome paste is used for wound-healing and rheumatism. Dried rhizomes are used as an insect safeguard for woollen cloths. Its shoot juice can be applied for eye ailments. Because of the increasing demand of the plant for herbal remedy and its constant habitat reduction, it may be over-exploited.



Maaliol (Negative correlation along altitudinal gradient)



Valerenic acid (Positive correlation along altitudinal gradient)

To reduce over-exploitation and stress on the natural habitats, extensive field works were

conducted to identify superior chemo-types in the Central Himalayan Region; and a total of 26 accessions have been collected from different eco-geographic locations along with the passport information.

Volatile oil was extracted from the rhizomes through Clevenger Hydro distillation; oil yield varied from 0.36 to 3.29%. When oil samples were subjected to Gas Chromatography (GC), major chemical constituents found were : Maaliol (14.69 to 55.77%) and Valerenic acid (0.19 to 5.7%) with negative and positive correlation along the altitudinal gradient of 1,230 to 2,260 m amsl. High percentage of Maaliol content was observed from 1,300 to 1,900 m amsl; and 1,800 to 2,200 m amsl was observed ideal elevation for high percentage of Valerenic acid. Superior chemo-types *i.e.,* IC 573206: 55.77% and IC 566865: 45.41% for Maaliol and IC 574510: 5.7% and IC 574522: 5.36% for Valerenic acid have been identified.

***K.S. Negi, *S.S. Koranga, *S.N. Ojha, *A. Rayal, **M.M. Pandey, ** A.K.S. Rawat** and ***P.S. Mehta**
*National Bureau of Plant Genetic Resources
Regional Station, Bhowali (Uttarakhand) 263 132
**National Botanical Research Institute (NBRI-CSIR)
Lucknow (Uttar Pradesh) 226 001
e- mail: ksnegi1960@gmail.com

'Pusa Breakfast Cereal' from quality maize protein

A ready-to-eat "**Pusa Breakfast Cereal**" with quality protein maize (QPM) has been prepared. QPM with better yield and protein quality than the normal maize as well as lower glycemic response is being advocated for introduction in the regular diet. The product was prepared through extrusion processing; which offers advantages of least nutrient losses during processing, high throughput capacity and no environmental pollution over the traditional processes. The product has also been incorporated with functional ingredients containing phytonutrients, which impart natural, attractive colour.

Nutritional quality of Pusa Breakfast Cereal

Energy	382 kcal energy per 100 g
Moisture	3% (wb)
Protein	9.6%
Fat	1.5%
Ash	2.4%
Fibre	3.4%
Carbohydrate	82.5%
Calcium	122 mg/100g
Iron	3 mg/100g
Total carotene	2.9 mg/100g
b-carotene	2 mg/100 g

This product is round in shape and has soft texture, and can be consumed with/without milk. It has been rated highly acceptable on organoleptic evaluation by the people of different age-groups. The product is free of synthetic colour and flavour. As it is with low glycemic value, it can prove to be suitable even for diabetic people. The product can be a malnutrition fighter. It can augment income of growers/ farmers as they

Pusa Breakfast Cereal

Pusa Breakfast Cereal with functional ingredients

themselves can process grain into the product or the demands from the processing industries may result in more demand of grains.

Advantages

- The product is crispy and light.
- It contains phytonutrients that may help in fighting illnesses.
- It has micronutrients — calcium and iron.
- It has lower glycemic value, thus may be suitable for diabetic.
- It has good quality protein, thus has potential to fight malnutrition.

S. K. Jha and **Om Prakash**
Division of Post-Harvest Technology
Indian Agricultural Research Institute, Pusa
New Delhi 110 012
e-mail: skj_ageg@iari.res.in

Vegetable varieties from the ICAR Research Complex for Eastern Region

Swarna Deepti Tomato

It is a promising hybrid of tomato showing resistance to bacterial wilt and early blight. Its plants are vigorous and determinate in growth habit (70-75 cm). Fruits are ready for first harvest 60-65 days after transplanting. They are round and are borne in clusters of 4-5, and are of medium large size (120-130 g).

This hybrid possesses many quality attributes — TSS 4.5-5.0° brix and acidity 0.3-0.4%; average yield potential of 100-105 tonnes/ha. It was released in 2011 by the Institute Variety Release Committee for cultivation in Jharkhand, Bihar, Chhattisgarh, Odisha and West Bengal.

Swarna Suruchi Pointed Gourd

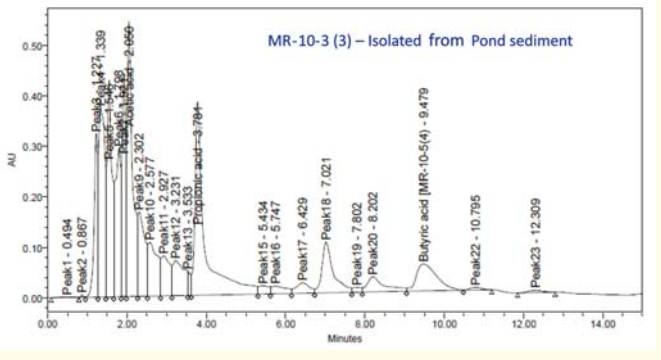
It has been developed through clonal selection. Its fruits are oval and are light greenish with both sides being blunt. It possesses good number of premium attributes—fruit weight (35-40 g), fruit length (8.5-9.0 cm), fruit breadth (3.0-3.5 cm), pulp weight (25-30g), and vine length (2.5-3.0 m).Its average yield potential is 25-30 tonnes/ha. It was released in 2011 by the Institute Variety Release Committee for Jharkhand, Bihar, Chhattisgarh, Odisha and West Bengal.

A.K. Singh[1], R.S. Pan[1], S. Kumar[1], J.P. Sharma[1] and **B.P. Bhatt[2]**
[1]ICAR Research Complex for Eastern Region, Research Centre, Ranchi (Jharkhand) 834 010
[2]ICAR Research Complex for Eastern Region, Patna (Bihar) 800 014

Clostridium strains isolation for butanol production

Agricultural wastes are mainly composed of lignocellulosic materials (LC), which have a great potential as a fermentation substrate, provided their cellulosic and hemicellulosic fractions can be depolymerized and utilized efficiently. Common substrates for butanol fermentation on an industrial scale were starch-containing crops like corn, maize and potatoes, but later on interest was focused on the sugarbeet and sugarcane molasses as cheap sugar sources. In addition, other alternative carbon sources, whey, apple-pomace or sago, were also tested in the laboratory.

Acetone, butanol and ethanol (ABE) production by solventogenic Clostridia is a well known process. This fermentation is biphasic, including an acidogenic and a solventogenic Clostridia, during which re-assimilation of acids occurs, forming ABE solvents. The main limitation of ABE fermentation relates to butanol toxicity on the test microorganism, leading to low solvent synthesis, and therefore butanol-tolerant strains of *Clostridium acetobutylicum* were exploited.



A total of 310 samples from various sources were collected and butanol- producing *Clostridium* strains were isolated. The total number of solvent- producing Clostridia was 63.91 % in the soil with *p*H range of 7.6-8.0 and organic carbon content of 0.8- 5.1.

Among the 57 cellulolytic isolates from mangrove samples, 25 showed cellulose degradation and were quantified by testing in 1% CMC broth in terms of reducing sugars by the DNSA method. The cellulase was extracted from the promising isolates.

Organic carbon and *p*H of the samples and *Clostridium* strains isolated

Sample	*p*H range	Organic carbon (%)	No. of *Clostridium* strains isolated	Occurrence of *Clostridium* strains (%)
Distillery dump soils, distillery effluent treated sugarcane field, paddy field, pond soil sediment, field crops	6.0-6.5	0.3-0.4	112	23.09
Compost, sediment, distillery effluent treated sugarcane field, mangrove samples, paddy soil	6.6-7.5	0.5-0.7	63	13.00
Soil sediment, sugarcane effluent treated field, field crops, pond soil sediment, forest soil	7.6-8.0	0.8- 5.1	310	**63.91**
Total			**485**	**100**

Influence of various sugars on the growth of *C.acetobutylicum*

Sugars tested (@ 20g/ L)	Growth measured in terms of absorbance at 12 hr interval		
	24 hr	48 hr	72 hr
Monosaccharide			
Glucose	1.63	1.96	1.33
Mannose	1.93	1.32	1.42
Galactose	**1.67**	**1.68**	**1.72**
Fructose	1.43	1.14	1.31
Pentose sugar			
Arabinose	1.29	1.69	1.59
Ribose	1.51	1.45	1.31
Xylose	**1.66**	**1.67**	1.84
Disaccharides			
Maltose	1.72	1.84	1.71
Lactose	1.86	1.86	1.80
Sucrose	1.61	1.69	1.68
Control (Uninoculated)	0.71	1.32	1.34

Note: +ve ———— OD_{600} of the culture > 1.0 @ 24 hr
Weak ———— OD_{600} of the culture >0.4 @ 24hr but never reached 1.0 @ 72hr.
-ve ———— OD_{600} never exceeded of 0.15 @72 hr

Utilization of the carbohydrate sources by the standard *Clostridium acetobutylicum* (ATCC 824) strain was studied using pentose sugars, monosaccharides and disaccharides. It showed growth in all sugars tested at 24hr of incubation except Mannitol. However, in xylose, there was adaption to the sugar, as it showed increase in growth till 72hr. This indicates that in two-phase digestion process, the strain can utilize xylose sugars and produce butanol.

Analysis of the organic acids produced by the standard strain as well as isolates was done. The three common intermediate acids produced in the metabolic pathway (acetic acid, propionic acid and butyric acid) were analyzed. *C acetobutylicum* ATCC 824 showed 33.79 mg acetic acid/ml , 29.62 mg butyric acid/ml and 271.62 mg propionic acid/ml. The isolates exhibited acetic acid ranging from 22.10 to 117.76 mg/ml, butyric acid from 0 to 121.88 mg/ml and propionic acid from 12.13 to 121.19mg/ml. Maximum butanol was produced by MR-10-3(3) isolate.

So far, *Clostridium* isolates from various habitats have been characterized for biochemical properties to ascertain butanol-producing strains.

Geeta Shirnalli[1], N.O. Gopal and **S. Karthikeyan[2]**
UAS[1], Dharwad (Karnataka) 580 005
TNAU[2], Coimbatore (Tamil Nadu) 641 003
e-mail: geetashirnalli@yahoo.com

Wheat Leaf Area Index retrieval from satellite remote sensing

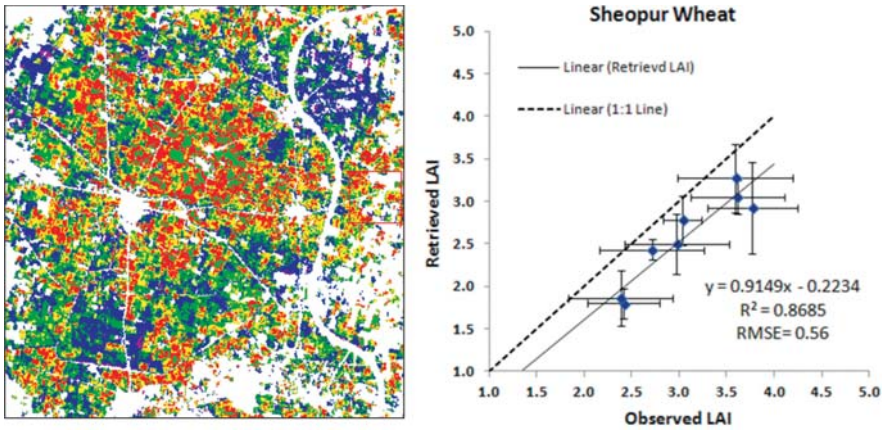
Traditionally, remote sensing images have been used for mapping ground features and for change detection studies. Lately, research is being carried out to use remote- sensing images at the regional scales to quantify crop biophysical parameters— leaf area index, leaf chlorophyll content and leaf moisture.

Among the parameters, leaf area index (LAI) is an important one, quantifying crop growth, and can be used to infer ecological processes such as photosynthesis, transpiration, and evapo-transpiration, and thus estimation of crop yield.

This study outlines the work on the retrieval of wheat LAI from broadband reflectance data corresponding to the Indian Remote Sensing (IRS) LISS-3 (Linear Imaging Self Scanner) sensor by means of canopy radiative transfer model PROSAIL5B.

The PROSAIL5B model was calibrated and validated for two years with ground measurements in the experimental fields and the farmers' fields. Three inversion techniques to invert PROSAIL5B model tried were: a look- up table with best solution (LUT-I), a look-up table with best 10% solutions (LUT-II) and an artificial

neural network (ANN). All the three could estimate biophysical variables by capturing variability in observed values, though accuracy of estimation varied. Accuracy assessment by the target diagram showed superiority of LUT-II over the other two approaches, and ANN was the worst performer, showing highest bias.



Wheat LAI map of a part of Sheopur district (Madhya Pradesh) and its comparison with ground measurements

The LUT-II inversion approach of PROSAIL5B model was implemented for the IRS LISS-3 image of 5 February 2012 for district Sheopur, Madhya Pradesh, and retrieved LAI of wheat-crop. The satellite image was pre-processed for geometric and radiometric corrections. Software codes in IDL were written for the generation of LUT and for performing inversion of the model. Wheat LAI varied between 1.5 and 3.5. The comparison with the ground observations showed that the model inversion underestimated LAI with a RMSE of 0.56 though estimated LAI showed a very high R^2 of 0.86 ($p<0.01$). The results of study imply that we can generate operational crop biophysical product of LAI from IRS LISS-3 for various applications.

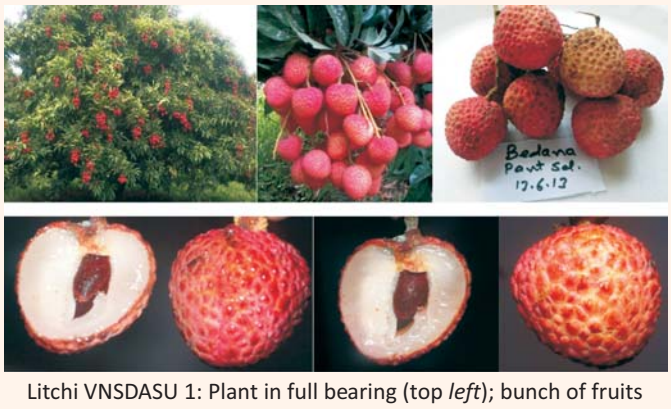
V.K. Sehgal, R.N. Sahoo, S. Pradhan and **Ravender Singh**
Division of Agricultural Physics
Indian Agricultural Research Institute, New Delhi 110 012
e-mail: vksehgal@gmail.com

VNSDASU 1: A promising litchi clone

Litchi is an important subtropical fruit with a refreshing, juicy, fragrant aril. Packed with nutrition, the luscious fruit in the commercially-grown litchi cultivars has 60-70 % edible portion with a large seed. The main selection pressure for a promising litchi clone has been to have high pulp ratio with smaller seed and with a high yield potential.

A promising clone VNSDASU 1 has been identified. Its fruit has more than 83 % pulp with approximate fruit weight of 30 g. The yield potential of the clone (about 60-year-old tree) is 2.0-2.5q/plant per year.

This is regular in bearing and produces crimson-red fruits. The plant is comparatively free from any pest/ disease. In view of all these characters, this clone has been regenerated for detailed characterization and multilocation testing.



Litchi VNSDASU 1: Plant in full bearing (top *left*); bunch of fruits (top *centre*); fruits after detachment (top *right*); cut view of fruit showing small seed and high pulp (bottom *left* and *right*)

Comparative advantage of new selection (VNSDASU 1) over existing commercial litchi cultivars

Cultivar/ Clone	Fruit colour	Fruit wt (g)	Fruit length (cm)	Fruit width (cm)	Fruit shape	TSS (^{0}Brix) (g)	Acidity (%)	Seed wt (g)	Peel wt	Pulp wt (g)	Pulp (%)
Shahi	Red	20.15	3.23	3.19	Oval	16.36	0.20	2.58	2.62	14.96	74.04
China	Light red	19.20	3.73	3.23	Conical	17.15	0.34	3.35	3.75	12.12	63.12
Bedana	Light green	18.01	2.87	3.06	Round	18.47	0.18	1.70	3.41	13.21	73.20
VNSDASU 1	Dark red	29.65	4.01	3.79	Cordate	18.53	0.26	1.39	3.55	24.70	83.17

Vishal Nath, S.D. Pandey, Awtar Singh and **D.S. Mishra***
NRC on Litchi, Mushahari, Muzaffarpur (Bihar) 842 002
*GBPUAT, Pantnagar
Udhamsingh Nagar (Uttarakhand) 263 145

Dynamics changing of mango pollinators

Mango-flowers are visited by many insects — *Lasius niger, Chrysoma megacephala, Lucilia Caesar, Musca domestica, Apis cerena, Episyrphus* sp., *Idioscopus* sp., *Braunsapis,* etc. Some of them play the role of an effective pollinator; characterized by visitation frequency, foraging time and abundance.

There has been a temporal variation in dynamics of mango pollinators. Mango exhibits andromonoecy (panicle bears both hermaphrodite and staminate flowers). Proportion of flowers varies primarily with climate and varieties. Under the coastal plain of Odisha, flowering in Dashehari and Gulab Khas starts in the second fortnight of November and continues up to the first fortnight of January. And Langra, Amrapali and Mallika start bearing flowers in the second fortnight of January and continue up to February.

During November-December when temperature ranges between 15.2 and 29.0 °C, *Lasius niger* (black garden-ant), a nectar forager, was most important visitor/ pollinator with visitation frequency of 4.3/panicle/ minute and foraging time of 6.3 sec/floret. With the change in temperature (14.8 - 26.5 °C) between January and first fortnight of February, *Chrysoma megacephala* (oriental latrine fly) became most important in terms of visitation frequency (6.5/panicle/minute) and foraging time (4.2 sec/floret). The peak activity of pollinators was observed between 9 am to 11 am, irrespective of the species.

Effectiveness of pollinator was assessed in terms of fruit-set, and it was observed that fruit-set (pea-bud stage) was relatively better (2.4%) when *Chrysoma megacephala* visited panicle than visits by *Lasius niger* (1.6%). Visitation frequency of *Musca domestica* and honeybees was not significant during flowering period; earlier they used to play an important role in mango pollination. Studies clearly indicate change in dynamics of pollinators as well as influence of temperature on visitors (*C. megacephala* prefers relatively low temperature). Moreover, visitation frequency as well as fruit-set was significantly reduced as temperature increased above 32 °C. Hence for yield sustainability in mango, conservation, restoration and sustainable use of pollinator diversity in an ecosystem is imperative.

Kundan Kishore, A. K. Shukla, Naresh Babu, Samiksha and **D. N. Sarangi**
Directorate of Research on Women in Agriculture, Bhubaneswar, (Odisha) 751 003
e-mail: kkhort2003@yahoo.com

Bioactive-compound-rich squash from mulberry

A bioactive- compound- rich beverage 'squash' has been prepared from a mulberry (an underutilized fruit) variety CIAH Sel. 1. It contains 25% mulberry juice with 45% total soluble solids and 1% acidity.

One serve of this fruit beverage (100 ml) contained 29.8 mg phenol, 12.6 mg flavonoids, and total antioxidant activities (CUPRAC) were 98 mMTE.

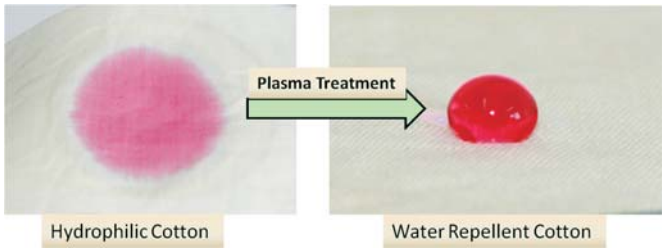
Mulberry squash

The fruit-squash has been found acceptable in taste, flavour and appearance among the testers.

Hare Krishna, R.S. Singh and **S.K. Sharma**
Central Institute for Arid Horticulture
Beechwal, Bikaner (Rajasthan) 334 006
e-mail: kshun@rediffmail.com

Value-addition to cotton textiles using water-free *Plasma Technology*

After agriculture, textile is the second largest contributor to employment generation and GDP of the country. Chemical processing of textile is water- and energy- intensive. Approximately, 100 litres of water is used to process a kg of cotton textile, which is finally discharged as an effluent contaminated with unused process chemicals. Discharge of effluents into the water streams affect water quality, resulting in serious impact on flora and fauna and fertility of agricultural lands. Declining availability of good quality water is also posing a serious threat to sustainability of textile industries. Shortage of water in the near future would lead to serious challenges in agricultural and industrial sectors, including textile. Therefore, textile industries are now slowly moving towards development of water-less or low water- based processing technologies such as digital printing, spray and foam finishing and plasma processing.



Plasma can be used to develop value- added products with different functionalities such as water, stain and oil repellent, hydrophilic, antimicrobial, flame retardant, UV protective, dirt-repellent and antistatic. Being a water-free process, it will save not only water, but also save energy required in various drying steps.

A proto-type atmospheric pressure plasma reactor has been designed, and has been developed indigenously. This reactor is suitable for processing and finishing fibres, yarns and fabrics such as cotton, jute, wool, silk etc. It was used to develop water- repellent cotton textile without affecting its comfort properties. Water-repellent textile would help protect both the textile and its user from unwanted wetting, staining or chemical contamination.

The plasma reactor was used to treat cotton fabric with plasma in between two rectangular aluminium electrodes of size 8×6 cm^2. Plasma was generated in the presence of helium (He) and fluorocarbon gases. After plasma reaction of 3-8 min, hydrophilic cotton turned into hydrophobic type. As a result, a water droplet was not absorbed by the fabric even after 1800s, whereas, it was absorbed within 4s in the untreated sample. Water contact angle in the plasma treated sample was 140° as compared to ~0° in the untreated sample. FTIR analysis showed presence of different fluorocarbon groups and EDX analysis showed the presence of ~4% fluorine atoms on the surface, which are responsible for water repellency in the otherwise hydrophilic cotton.

The whole treatment process was carried out in the dry state without use of water. Traditional process for similar textile finishing uses ~10 litres of water, takes 20-30 min time, requires high energy for multiple drying steps and may compromise even fabric comfort quality. Adoption of emerging plasma technology would thus place cotton-processing industry at a technological advantage vis a vis its competitors in view of the better quality at lower costs.

Kartick K. Samanta, S. Saxena, A. Arputharaj, M. Bhowmick, S. Basak, Gayatri T.N. and **A.H. Shaikh**
Central Institute for Research on Cotton Technology
Adenwala Road, Matunga, Mumbai 400 019
e-mail: karticksamanta@gmail.com

Published by Dr Rameshwar Singh, Project Director, Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi 110 012. *Phone:* 011-25842787; *Fax:* 011-25843285; *e-mail:* pddkma@icar.org.in. Lasertypeset by M/s Print-O-World, Shadipur, New Delhi 110 008, and printed in India at M/s Royal Offset Printers, A-89/1, Naraina Industrial Area, Phase I, New Delhi 110 028.

Conceptualization and Editing : **Shashi A. Verma** ***Design & Production :*** **Dr V.K. Bharti and Punit Bhasin**

WAY FORWARD

INDIAN Agriculture to a large extent depends on weather and climatic conditions. In early 1988, a National Centre for Medium Range Weather Forecasting (NCMRWF) was established by the Government of India to develop suitable numerical weather-prediction models to issue weather forecasts, and to inform and guide farmers in advance to undertake farming activities.

The NCMRWF together with the Indian Meteorological Department (IMD), the Indian Council of Agricultural Research and the State Agricultural Universities provides Agro-meteorological Advisory Service. From 1 June 2008 onwards, under the Integrated Agro-meteorological Advisory Service (IAAS), the IMD has started issuing quantitative district-level weather forecast up to 5 days. The products comprise quantitative forecasts for rainfall, maximum and minimum temperature, wind speed and direction, relative humidity and cloudiness. In addition, weekly cumulative rainfall is also being forecasted.

The All-India Coordinated Research Project on Agrometeorology (ICAR) under its flagship Project "National Initiative for Climate Resilience in Agriculture (NICRA)" has also initiated efforts to improve existing Agromet Advisory Services to extend them to block level, which presently were only at the district level. As current weather conditions along with weather forecasts and crop conditions are a pre-requisite for preparing agro-advisory services, 100 network stations, where Automatic Weather Stations (AWS) are installed, monitor daily weather. The data from each AWS flows to the Central Server Facility at the Central Research Institute for Dryland Agriculture, Hyderabad, for comprehensive analysis vis-à-vis agro-advisory. A website has also been developed (http://aicrpam-nicra-aws.in) that is accessible to farmers.

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

District-level weather forecast is being used along with current crop and weather condition for preparing block-level advisories by respective KVKs under NICRA; for which methodology has been devised by the KVK, Belgaum. In this model, Field Information Facilitators (FIFs) have been appointed in 10 Talukas of the district to collect information on weather, crops etc. for precision in advisories. FIFs supply information telephonically or by e-mail to develop a qualitative Agromet Advisory specific to village/farmers in consultation with Agrometeorologists and Scientists of the NARS/IMD. Overall, KVKs are envisaged as hubs for formulation and dissemination of agromet advisories at the district/ block level through ICTs.

Information dissemination through mobile short-messaging service (sms) is also being popularized among farmers. To this effect, several organizations including IMD, NABARD and ICAR are issuing alerts/warnings and agro-met advisories through an effective multi-lingual tool. Quite a few pilot projects have been launched by the Government of India on the use of mobile technologies for farmers in the country. At private level, `fasal' a free sms service to boost farmers' income is placed, and is effective in Karnataka, Andhra Pradesh, Tamil Nadu and Gujarat.

With the introduction of the food security act in the country, it is all the more important that we do not lose our agricultural produce but for precision agro-advisory. The President of our country, Shri Pranab Mukherjee, on the 16th July 2013, at the 85th ICAR Foundation Day, also launched a sms portal for farmers.

As a way forward, all the service providers are striving for converging available datasets to have a unified agro-advisory for better socio-economic and agricultural impact and for helping farmers for better crop planning.

(S. Ayyappan)
e-mail: dg.icar@nic.in