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ICAR NEWS

A SCIENCE AND TECHNOLOGY NEWSLETTER

RESEARCH UPDATE

PROMISING TECHNOLOGIES

Food-grade gelatin from fishery wastes

Gelatin is widely applied in the food and the pharmaceutical industries. Commercial gelatins are mostly derived from the mammalian sources, mainly pig-skin and cow-hide, but for many socio-cultural reasons and frequent occurrences of diseases, Bovine Spongiform Encephalopathy (BSE) and foot- and- mouth disease, alternative sources of gelatin are being searched for.

Gelatin from the skin of the freshwater carps has been extracted successfully. The physico-chemical and functional properties of this gelatin have proved its suitability in many applications, hitherto restricted only to mammalian gelatins.

Carp-skin gelatins are found to have a mild but easily perceivable odour, have snowy-white appearance and are light-textured. These are positive attributes, since it is easier to incorporate these gelatins into any food system without imparting any strong colour. So these gelatins find applications in the preparation of products like fruit-gums etc. They provide taste and colour neutrality; and give easy pouring ability due to low viscosity and excellent clarity. In addition, these gelatins give unique texture and excellent mouth-feeling chewability and attractive appearance.

Gelatin from carp skin

Gel dessert from carp-skin gelatin

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Carp-skin gelatin films have significantly low water vapour and oxygen permeability than mammalian skin-gelatin films, which indicate superior gas-barrier property of the carp-skin gelatins. This property has potential application in developing biodegradable packaging materials also.

Optimization of the process of gelatin production from freshwater fish skin will help in better realization of the price by the primary producers and processors, who can actually convert fishery waste into a significant source of income. This has an added advantage of a viable solution of environmental pollution in the fish-processing units by minimizing solid waste generated and by providing cleaner fish-processing environment. The maximum gelatin yield obtained from Rohu was 12.9%, followed by Common carp (12%) and Grass carp (10.5%).

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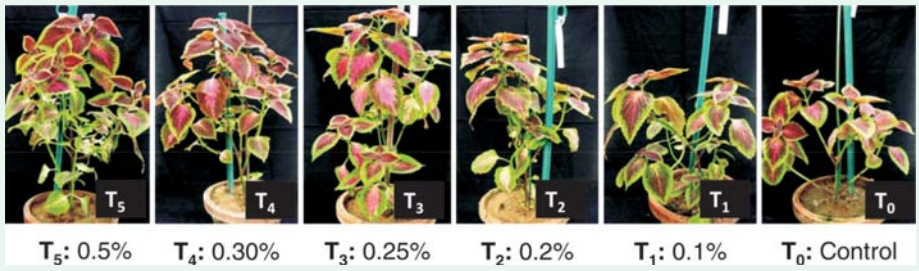
Pusa Hydrogel for growing healthy indoor plants

Superabsorbent polymers, specialty polymers called hydrogels, play an important role, in general, in conserving water, reducing irrigation frequency and in releasing sufficient moisture to growing roots of agricultural crops. These are largely cross-linked polyacrylates.



Coleus under different concentrations of *Pusa Hydrogel*

To grow fresh-and-healthier indoor plants for a longer time, adequate supply of water is a necessity for maintaining their normal physiological activities and membrane-transport processes.

Pusa Hydrogel, an indigenous superabsorbent hydrogel technology, has been developed for improving water-use efficiency of agricultural and horticultural crops. Its potential has recently been validated in an important indoor plant, *Coleus blumei*; commonly known as coleus or painted nettle. Well-rooted terminal cuttings of *Coleus* were used for evaluation of Pusa Hydrogel. The terminal cuttings were planted in plug-trays for root development. After 18 days, uniformly rooted cuttings were transplanted in 10 inches earthen- pots containing 5-kg of growing medium of sand, soil and FYM (1:1:1). To amend with the hydrogel, one kg of the medium was left untreated and placed at the bottom of the pot, and the remaining 4 kg was treated with Pusa Hydrogel at 0% (T_0), 0.1%, (T_1), 0.2% (T_2), 0.25% (T_3), 0.30% (T_4), 0.5% (T_5) on the dry-weight basis. Water-absorption capacity of the hydrogel amended growth medium was calculated. Need-based quantified irrigation water was applied to the cuttings. After completion of the experiment, it was observed that irrigation interval increased by 4.66 days in T_5, followed by 3.67 days in T_4. In control (T_0), irrigation was

Mean performance of Pusa Hydrogel w.r.t. water-use efficiency in *Coleus blumei* after 180 days of transplanting

Treatment	Total amount of water used (litres)	Water saving (litres)	Irrigation interval (days)
T_0	22.32	-	1.33
T_1	22.02	0.29	2.33
T_2	21.32	0.99	2.66
T_3	19.97	2.34	3.33
T_4	19.88	2.43	3.67
T_5	18.83	3.48	4.66

Mean performance of *Pusa Hydrogel* on growth related traits in *Coleus blumei* after 180 days of transplanting

Treatment	Plant height (cm)	Plant spread (cm)	Stem diameter (cm)	Number of primary branches	Leaf length (cm)	Leaf width (cm)	Number of leaves per plant
T_0	44.86	30.82	8.59	5.55	9.30	7.87	34.83
T_1	50.47	39.60	12.64	7.44	11.18	8.41	45.44
T_2	54.00	45.19	13.62	8.11	11.73	8.70	51.55
T_3	55.41	47.27	16.28	8.78	12.36	9.53	53.66
T_4	57.06	48.92	17.44	9.44	13.11	10.95	58.16
T_5	59.64	51.88	18.79	10.5	14.12	11.67	66.38

T_0: Control (0 g); T_1: 0.1% (4.0 g); T_2: 0.2% (8.0 g); T_3: 0.25% (10.0 g); T_4: 0.30% (12.0 g); T_5: 0.5% (20.0 g)

necessary after 1.31 days interval. The amount of water used in irrigating *Coleus* was 18.83 litres in $T_{5,}$ followed by 19.88 litres in T_4; significantly lesser as compared with 22.32 litres in the control. Growth-related traits were also influenced by the hydrogel application. Plant height, plant spread, stem diameter and number of leaves per plant increased with the rate of hydrogel applied, and maximum growth was observed in T_5 (0.5%). Leaf colouration measured in terms of anthocyanin content was more intense in plants grown in media amended with Pusa Hydrogel.

In view of the rising cost of the inputs and indoor-plant management, use of Pusa Hydrogel technology will surely help end-users in saving water and reducing irrigation frequency, in addition to obtaining plants of superior quality.

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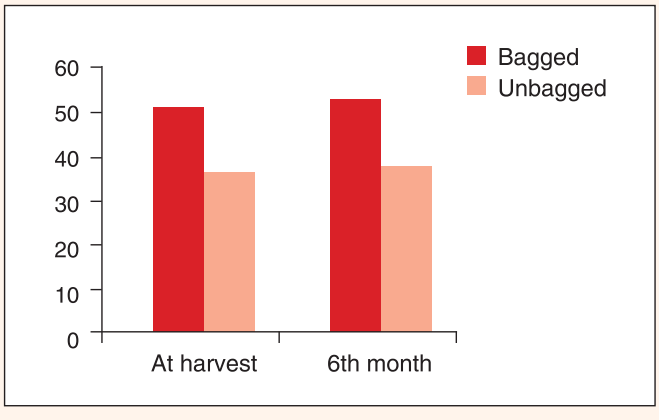
Fruit-bagging of apple-fruits for better colour and quality

In India, apples are primarily grown in hilly states of Himachal Pradesh, Jammu and Kashmir, Uttarakhand, and to some extent in the northern-eastern states. Colour of the apple-fruits is the single most important factor, which attracts consumers. At lower hills, colour development of fruits is not adequate, and hence majority of the farmers have started using ethrel (2-Chloroethyl Phosphonic Acid) as the pre-harvest spray for colour enhancement of fruits. Ethrel, although, helps in development of attractive red colour in apple-fruits but it causes several adverse effects – it enhances fruit drop, pre-mature leaf-fall; besides harvested fruits are of poor keeping-quality. And ethrel-treated apples need to be harvested at a stretch to get desirable price in the market.



Hunter 'a' value (redness) in bagged and unbagged apples

Unbagged apples Bagged apples

Advantages of the technology

- Bags are recyclable, can be used for 3-4 successive seasons
- It is a probable alternative to ethrel treatment in the lower hills
- Bagging improves appearance of apples
- Bagged fruits have higher level of calcium and that is retained during storage also
- Bagged apples have higher shelf-life
- Bagging improves eating quality of apples
- Bagging reduces significantly pesticide residues
- Incidences of storage disorders are reduced to minimum
- Bagging reduces incidences of insect-pests and diseases, thereby reduce expenses involved in purchasing insecticides, fungicides and other chemicals
- Fruit bagging can be an integral part of organic apple production
- Benefit: cost ratio of fruit bagging was found to be 1.37

A simple, eco-friendly technology of bagging Royal Delicious apple-fruits before harvesting has been developed for enhancing fruit colour and quality. The fruits are bagged on-the-trees with the single layered

Fruit-bagging effects on colour, firmness, calcium content, diseases and storage disorders in Royal Delicious apples

Parameter	Bagged fruits	Un-bagged fruits
Redness (Hunter 'a' value)	51.6	35.2
Fruit firmness (N)	32.5	22.8
Calcium content(mg/100g)	4.23	3.12
Bitter-pit (%)	1.8	14.6
Cork-pit (%)	1.1	4.8
Brown-core (%)	0.8	7.8
Fly-speck (%)	0.0	22.6

light-yellow spun-bounded bags about a month before the harvesting date. The bags should be removed at least 3-days before the harvesting, and can be reused in the next 2-3 seasons. Bagging resulted in the development of attractive red colour in apples along with significant reduction in diseases (sooty-blotch and fly-speck) at harvest. And the incidences of storage disorders such as bitter-pit, cork-pit and brown-core, were also reduced significantly in bagged apples. Further, it was found that at harvest and during storage, the bagged fruits were firmer and showed higher TSS, and ascorbic acid content compared to unbagged fruits. Similarly, bagged apples contained higher levels of calcium at harvest and that was maintained during storage also. Even at the end of 6th months of storage, bagged fruits showed significantly reduced incidence of bitter-pit (14.6%), cork-pit (4.8%), and brown-core (7.8%) over un-bagged apples.

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Wastewater reuse in crop production

Agriculture is the major user of water, and can accept marginal quality of water without apparent loss of productivity or degrading soil and water quality further. A large amount of effluent waters coming out from various industries can be utilized as per their suitability for agricultural perspectives, which otherwise are reported to defile natural resources and degrade health of the natural ecosystem.

Freshwater treatment | Freshwater + effluent 50:50

Comparative response on maize-crop to irrigation with effluent and freshwater

Effluent water reuse is a promising option, particularly during water shortage. Assessing irrigation potential and perfecting water reuse in a particular soil type/s has shown its effectiveness by ensuring crop returns without affecting quality of resources. Such as near neutral, saline, Ca and Mg salt-enriched paper-mill effluent has come up as a suitable and alternate irrigation source for acidic, non-saline Ca -deficient soils. Irrigation with the effluent at 5- cm per application has been found suitable to augment maize-grain yield by 3 to 6%. Nutrients' concentration also improved over freshwater irrigation in the order of Mg > P > Ca > K. No decline in important soil properties (*p*H, organic carbon, available N, P, K, exchangeable Ca, Mg) or increase of any unfavourable substances (Cd, Cr) was observed.

Likewise, for irrigation with cane-molasses-based distillery effluent (post methanated) alternate with freshwater or 50/50 as freshwater/effluent has been found favourable concentration to irrigate groundnut growing in non-saline, acidic red and laterite soils.

Irrigation consumes a major share of the available freshwater in India to provide food, feed, fodder, fuel, and for maintaining green space; 40% of the total cultivated area is under irrigation and rest is rainfed. Irrigation water meets timely water requirement of the crop and assures production even during water-stress situations. Therefore, with growing crisis of freshwater, there is a need to search for alternate sources, which support and sustain production.

Irrigation with the concentration of distillery effluent substantially improved groundnut pod / kernel yield even over freshwater irrigation, without compromising on crop nutrient uptake or soil properties. The study thus showed that following proper guidelines and management practices, effluent waters can be utilized safely in crop production.

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Genome characterization of sugarcane yellow leaf virus

Yellow leaf disease (YLD) is a newly reported disease of sugarcane in India. Its association has been established with the sugarcane yellow leaf virus (SCYLV), a phloem-limiting virus, belonging to family Luteoviridae and genus *Polerovirus*. Worldwide, seven SCYLV genotypes have been reported – five based on the complete genome [BRA (Brazil), PER (Peru), REU (Reunion Island), CHN1 (China) and HAW (Hawaii)] and two based on the partial genome characterization [CUB (Cuba) and IND (India)].

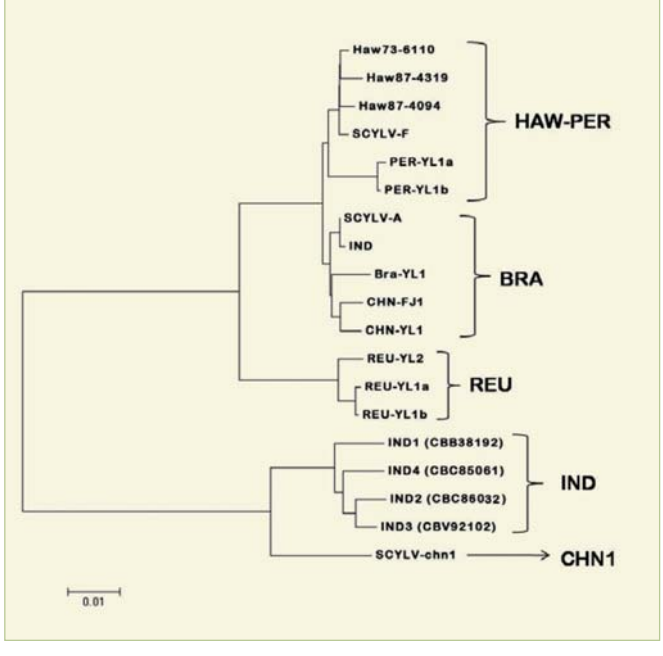
The disease has assumed epidemic proportions in the recent years in different states of India, especially in the tropical region. Overall, disease severity causes losses of crop growth of 2-3 months and threatens sustainability of many elite varieties in the field. The ratoon-crop suffers more severely than the plant-crop; thus there is serious setback to sustainable ratoon crops also.

To characterize full genome of the virus and to establish genomic variations existing in the Indian SCYLV populations, six different sets of forward and reverse primers were designed to target entire genome of the SCYLV containing overlapping ORFs (ORF 0 to ORF 5).

Foliar symptoms by YLD on sugarcane

Four SCYLV isolates were characterized from India infecting sugarcane Co 86032, CoC 85061, CoV 92102 and B 38192 after complete genome sequencing. Further, 25 other reported partial ORF 0, 27 partial ORF 1 and 23 partial ORF 5 sequences, belonging to seven different genotypes, were taken from the NCBI GenBank, and phylogenetic analysis was carried out. ORF 0 was compared between nt 200 and770 (571 nt), ORF 1 between nt 200and1,776 (1,557 nt) and ORF 5 between nt 3,579 and 4,189 (610 nt) and their deduced amino acid sequences were also aligned. The new full length SCYLV nucleotide sequences (~ 5,875 nt) were aligned along with those of five other available genotypes and all the sequences were trimmed to equal length of 5,616 nt on the basis of the multiple sequence alignment to reduce errors with unequal lengths of sequences in identity matrix. Phylograms were generated in BioEdit Version 7.0.4.1 software, and optimal tree has been generated for partial ORF (0, 1and 5) and complete genome sequences. Grouping patterns of the isolates were compared; similarity indices and percentage similarities were also generated using the same alignment.

Sequence analysis revealed that these isolates (SCYLV-IND) exhibited amino acid (aa) sequence differences of 29.2-31.8%, 28.1-34.4% and 30.7-33.4% with REU, HAW-PER and BRA in the partial ORF 0 sequences, respectively. Similarly IND isolates have 21.4-23.7%, 22.5-25.0% and 21.4-23.9% aa sequence differences with REU, HAW-PER and BRA, respectively, in the partial ORF 1. The differences were least in the ORF5; varied between 3.0 and 6.0% and 3.0 and 6.9% with REU and HAW-PER/BRA sequences. A phylogram with other genotypes based on the complete genomes showed that IND isolates shared 86.3-86.6% with REU, 86.1-86.7% with BRA and 84.9-86.2% with the recently combined genotype of HAW-PER. The genotype reported from China, CHN1 shared very close relationship with IND isolates with minimum difference



Phylogenetic tree of the SCYLV, based on the full length nucleotide sequences constructed by neighbour joining method with 1,000 bootstrap replications in BioEdit Version 7.0.4.1 software. Branch lengths are proportional to the number of substitutions. The IND isolates form a separate cluster with other genotypes, and are closely related to CHN1 isolate

of 4.3-5.3%, 4.8-5.8% and 2.5-3.0% in ORF 0, 1 and 5 in aa sequences, respectively, and 4.4-5.3% in the complete nucleotide sequences.

The complete genome sequence of the virus revealed more similarity among the SCYLV isolates from India, and also close relationship with the genotype reported from China. These findings indicate phylogenetic relation among the virus isolates from Asian countries. This is the first detailed information on the SCYLV genome from India.

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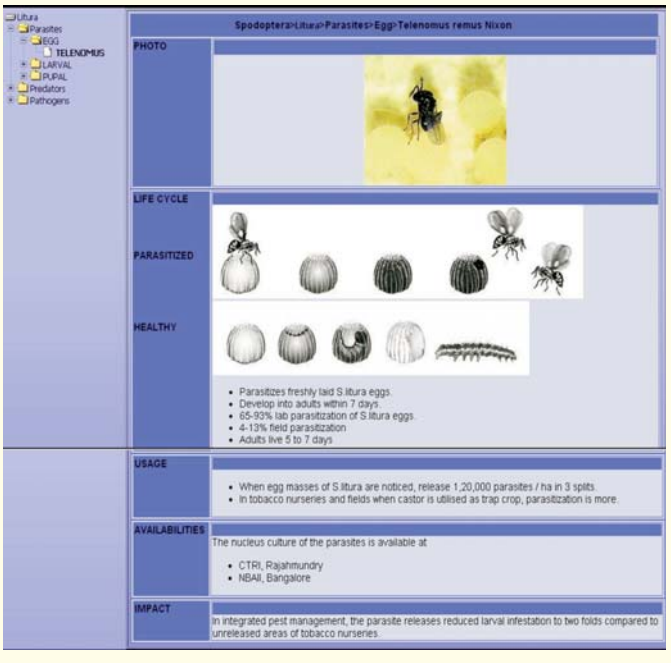
Expert system for identification of natural enemies of tobacco pests

Identification of biocontrol agents for tobacco pests involves recognition of biocontrol agents and the stage of the pests at which agents attack them.

Based on the information, an expert system has been developed for identification of natural enemies and disease symptoms caused by different pathogens of the tobacco pests, which will act as a decision tool for farmers and scientists.

Knowledge-base acquisition: The base for various biocontrol agents was created in the form of decision-trees, where pests — *Spodoptera litura, Helicoverpa armigera, Scrobipalpa heliopa*, *Bemisia tabaci, Myzus nicotianae* and *Lasioderma serricorne*— act as a root. '*Spodoptera*' consists of two sub-options namely '*Litura*' and '*Exigua*'. '*Helicoverpa*' consists of '*Armigera*' and '*Assulta*'. '*Scrobipalpa*' consists of '*Heliopa*'. '*Bemisia*' consists of '*Tabaci*'. '*Myzus*' consists of '*Nicotianae*'. '*Lasioderma*' consists of '*Serricorne*'.



Each sub-option is in-turn classified into 'Parasites', 'Predators' and Pathogens'. 'Parasites' consist of 'Egg', 'Larval' and 'Pupal'. 'Predators' consist of 'Insects', 'Spiders' and 'Vertebrates'. 'Pathogens' consist of 'Bacteria', 'Viruses', 'Fungi', 'Protozoa' and 'Nematodes'. A five- level tree was created for each pest for easy classification and accessing.

User-interface: To easily use the system, the user-friendly interface was developed with GUI using Java Script, which allows user to communicate with the system in a natural way by permitting use of simple selection menus or use of a restricted language, which is close to natural language.

Through user-interface, the user is allowed to add / update / delete /view information, view complete data for a particular agent like 'Telenomous' by selecting options like 'Spodoptera -> Litura -> Parasites -> Egg -> Telenomous'. The information for 'Telenomous' viz., 'Photo', 'Life cycle', 'Usage', 'Availabilities' and 'Impact' gets displayed and the hard copy of the same can be obtained. This expert system not only imparts identification skills but also directs non-expert clientele about ways to make effective use of bioagents.

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Grow-out evaluation of selectively bred 3rd generation *Macrobrachium rosenbergii*

Grow-out evaluation of the 3rd generation *M. rosenbergii* was carried out in three 400 m^2 (0.04 ha) earthen-ponds. A total of 3,628 juveniles (1.73±0.65 g) from 45 full-sib families were tagged individually with a visible implant Alphanumeric(VIA) tag and stocked in well prepared grow-out ponds. Tagged prawns were stocked at 3/ m^2 and reared for 120-130 days. They were fed twice daily with commercial-pellet-feed at 10% of the biomass per day in the first month. Feed rate was modified every month based on the body weight gained during the sampling. Water quality was maintained by frequent addition of freshwater. Dissolved oxygen, *p*H and ammonia levels were measured once a week. Ponds were continuously aerated with air-blower.

After completion of the grow-out period, ponds were dewatered and all surviving prawns were collected and sorted by sex and morphotype. All prawns were measured for carapace length, standard length, total length and individual weight; tag numbers with readable tags were also noted. These prawns were again released to another well prepared 0.04- ha pond until completion of the data analysis.

Final survival rate of tagged juveniles ranged from 77.8 to 89.6% with an average of 84%. Average retention of VIA tag was 60%; it ranged between 51.2 and 65%. Nearly 90% of the retained tags were readable. Average final size at harvest ranged from 20 to 21.2 g. Sex ratio was 1:1.11. The genetic evaluation of the 3rd generation prawns was also conducted. The data-set consisted of progeny of 2,203 offspring of 45 dams and 32 sires. A mating list was designed to be used in the production of 4th generation.

On-farm testing of *M. rosenbergii*

Four farmers from Odisha were selected for on-farm testing of 3rd generation (G3) prawns. Samples of 400-500 post-larvae from each of the 45 full- sib families were stocked in a 400 m^2 earthen-pond to raise juveniles for on-farm testing. These post-larvae were fed daily with commercial starter feed and reared for 70 days. After 70 days, juveniles were collected and supplied to selected farmers for on-farm testing. A total of 9,200 juveniles (2.8 g) were supplied in the last week of December 2011 for on-farm evaluation of G3. Growth of prawns was monitored at monthly intervals. Final data were collected after 120 days of grow-out culture. Overall, final average harvest body weight of selection line was 44.5±22.8 g and that of control line was 22.3±14.2 g. One farmer reported good survival (70%), comparable to on-station results and excellent growth (51.5±26.8 g for selection line and 22.5±14.4 g for control line). Another farmer also recorded good growth (39.3±17.6 g for selection line and 22.3±13.6 g for control line), but survival was 30% only. Due to water scarcity during grow-out period (January to April), two farmers were not able to maintain water level at the recommended level and nearly lost all stocked animals.

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Clay-based interventions for removal of triazine herbicides from water

The normal water-treatment process of chlorination, followed by coagulation/flocculation using alum and PAC (poly aluminium chloride) was observed to be inefficient in removal of triazine herbicides, viz. atrazine and metribuzin (32-41 % removal).

When clay minerals were used along with the standardized optimum dose of alum or alum+PAC, there was considerable improvement in removal of pesticides. Intervention of normal bentonite increased removal efficiency by 80-100%, while nano- and surface modified clays increased efficiency by 94-100%. The optimized treatment process of chlorination, followed by modified nano-montmorillonite clay and then coagulation/ flocculation with alum and PAC gave 100% and 94.1% removal of atrazine and metribuzin, respectively.

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Peach-based agri-horticulture land-use system for degraded Shivaliks

In a study at Chandigarh under the peach- based agri-horticulture land-use system established in 2008 in the degraded Shivaliks, first fruiting was obtained after

3rd year of plantation that generated revenue of ₹25,000 and during 4th year (2012), the revenue increased to ₹130,000. The maximum yield was obtained under the moisture-conservation treatment of circular trench and clusterbean(*guar)* intercropping. Runoff and sediment loss was found minimum in peach + clusterbean + circular trench and maximum was in control (pure peach plantation). The results indicated that peach + clusterbean + circular trench was the most compatible land-use system for rehabilitation of degraded Shivaliks in terms of resource conservation and revenue generation.

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Rohu database developed

Considering easy accessibility of electronic format, a database on rohu entitled "Rohu (*Labeo rohita*) database" has been developed of the last two decades by collecting information from different books, journals, webs, newsletters and communications from researchers.

The database contains almost all available information like morphological characters, food and feeding habit, growth and maturity, nutritional requirement, physiological variations with change of water quality and climate, natural and induced culture practices, genetics and genetic improvement studies, diseases and immunity, microecology, flesh quality and value addition, and some of the available technologies for rohu culture.

Genomic and proteomic analyses using bioinformatics tools would help researchers in finding structural and functional relationship. The information related to DNA barcoding and microsatellite data of rohu would also aid in unambiguous identification of species and for genetic analysis.

The database would be a source of advanced information and ready-reference material for students, researchers and persons dealing with research and culture on rohu. The database has been linked to the ICAR website.

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Productivity enhancement in two-tier horticulture system

In fruit-flower- based two-tier horticulture system in Doon Valley (Dehradun), where mango was already growing since July 2004, vermi-compost with chemical fertilizers (50% each) along with sunnhemp and weed mulching recorded maximum mango canopy spread (3.70 , 3.31 m) and fruit yield (31.18 , 30.29 kg/ tree), respectively, over pure chemical fertilizers. The fruit yield with vermi-compost and chemical fertilizers was 10%, 19% and 25% higher as compared to FYM + NPK (50%), poultry manure + NPK (50%) and pure NPK treatments, respectively, due to higher moisture conservation (6.85 cm) in the soil profile at 1 m^3 and high organic carbon (0.72%) in 0-30- cm soil. Maximum total soluble solids (18.2 °Brix) in fruits were noticed in poultry manure with chemical fertilizers (50% each) under sunnhemp mulch, where moisture conservation was least among the treatments.

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Asiatic hybrid lily with pollenless trait

The Asiatic hybrid lily is one of the most important ornamental plants world-wide, which has been derived from the interspecific crosses of section Sinomartagon. *Lilium* flowers usually have dark-red or brown pollen-grains, which stick to clothes. Consumers have shown general preference for lily cultivars that do not release pollen-grains; a few Asiatic hybrid lily cultivars without pollen-grains have been bred abroad.

Floral organs in PL clone

Normal *Lilium* flower

Two plants of Asiatic lily, showing pollenless phenotype (PL clones), have been developed by selfing lily Pollyanna with cross of Pollyanna × Shiraj. In PL clones, filaments were short (3.38 cm, 2.4 cm) and did not reach stigmas.

Asiatic hybrid lily cultivars usually have long filaments and their anthers reach stigmas. In PL clones, filament tops are somewhat enlarged resulting in formation of immature anthers that usually contain no pollen-grains.

In some cases, immature anthers were seen containing orange-coloured immature pollen-grains, but they did not dehisce. Thus, these phenotypes have been designated as pollenless. The longitudinal length of the inner tepals of these clones was an average of 6.96 cm and 7.03 cm, which was shorter than parental cultivars of Asiatic hybrid lily (usually 10.1cm in cv Pollyanna and 8.0 cm in cv Shiraj). The genetic background of this trait (pollenlessness), however, is unknown.

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Central Institute of Fisheries Education, Mumbai

To achieve academic and research excellence by creating state-of-the-art infrastructure and globally competitive faculty

GENESIS AND GROWTH

The Central Institute of Fisheries Education (CIFE) has accomplished the present status of a premier Institute/ University offering higher education in the fisheries sector in the country over the period of fifty years of impressive service to the Nation. The institute was established on 6 June 1961 as a training institute by the Government of India under the FAO/UNDP assistance to impart professional training to in-service personnel of the Departments of Fisheries of different states. It came under the administrative control of the Indian Council of Agricultural Research on 1 April 1979, and institute's scope and mandate were widened to include research and extension activities. The CIFE was conferred the status of Deemed to be University on 29 March 1989. Thus the area of operation of the CIFE included higher education as well. Despite metamorphosis of the Indian fisheries sector into a thriving industry, there are still vast resources that are underutilized, throwing open many uncommon opportunities and challenges for the educational and research institutions. This institute responds to these changes by becoming an innovative- and -proactive institution to lead to knowledge-based revolution.

Vision

- To be the world-class organization providing leadership in fisheries education and research.

MANDATE

- To conduct post-graduate academic programmes in core and emerging disciplines of fisheries science
- To conduct basic and strategic research in frontier areas of fisheries
- To conduct demand-driven training and educational programmes for different stakeholders in fisheries sector
- To provide technical support, inputs for policy development and consultancy services

Faculty: The faculty strength of the CIFE has grown over the years to 70 in position of the sanctioned strength of 106. The CIFE has highly qualified and trained faculty that are drawn from the best universities in India.

INFRASTRUCTURE

Initially, the CIFE was housed in the Institute of Science building, Bombay, and in 1964, it was shifted to a rented building at Masjid Bunder, Bombay. In March 1967, the Institute moved to an independent campus at Seven Bungalows, Versova, in the western suburb of Bombay. And at present, CIFE is housed in a newly developed sprawling building at Yari Road Campus, Versova. The institute has six research divisions, equipped with state-of-the-art laboratory facilities, including wet laboratories to carry-out quality research and training.

GOLDEN JUBILEE CELEBRATION

The Golden Jubilee function of the institute was celebrated on 6 June 2011. Dr S. Ayyappan, Secretary, Department of Agricultural Research and Education, and Director General, ICAR, was the Chief Guest. He emphasized upon the great advances made by the institute in the area of education, and also in the fisheries research and extension, particularly in bringing about aquaculture revolution in Andhra Pradesh, shrimp farming in inland saline waters and in reclamation of degraded land in Maharashtra through aquaculture.

Apart from the headquarters in Mumbai, the Institute has four centres located in different aqua-climatic regions (Kolkata in West Bengal, Kakinada in Andhra Pradesh, Powerkheda near Bhopal in Madhya Pradesh and Rohtak in Haryana) of the country with farms and infrastructural facilities for imparting hands-on training to students, farmers and development personnel as well as to conduct need-based research.

Facility for ornamental fish breeding: The CIFE has excellent ornamental fish hatchery-cum-culture facilities in both the campuses and its Kolkata Centre.

Aqua-farms

- Brackishwater fish farm (3.2 ha) in the CIFE Kakinada Centre, Andhra Pradesh
- Freshwater fish farm (8 ha) in Balabhadrapuram, CIFE Kakinada Centre, Andhra Pradesh
- Freshwater fish farm (44 ha) in the CIFE Powerkheda Centre, Madhya Pradesh
- Freshwater fish farm (4 ha) in the CIFE Rohtak Centre, Haryana
- Ground saline water farm (10 ha) in the CIFE Rohtak Centre, Haryana

Library: It is designated as the "*National Library for Fisheries and Allied Sciences",* and has a rich collection of books, journals, on-line databases like ASFA, CeRA, etc. The information of all publications in the library is available over the On-line Public Access Catalogue (OPAC).

Library

The library has a collection of about 35,000 books, and subscribes to 30 foreign and 61 Indian Journals; and has 135 e-books.

The digital section of the library is equipped with 28 computer terminals connected to LAN and internet to access e-resources. The NAIP project "e-GRANTH" is in operation to digitize in-house publications and to connect different libraries of the ICAR and the State Agricultural Universities.

Learning resources: The class-rooms are equipped with computer-and-LCD-projection systems, and the laboratories have sophisticated equipments that provide ideal and effective learning environment. A state-of-the-art computer centre provides round-the-clock Internet service with broadband connectivity.

In addition, the Institute has a modern auditorium, community hall, conference hall, and three committee rooms, equipped with the latest audio-visual equipment for hosting seminars, conferences and cultural functions. Ornamental aquarium facility housing variety of ornamental fishes provides hands-on training to students, and attracts a large number of visitors, particularly students from schools and colleges.

Vessels: The CIFE has two fishing vessels — *MFV Saraswati* (OAL-36.57 m) and *MFV Narmada* (OAL-11.6 m)—to support its on-board research and training programmes on fishing, navigation, oceanography and other such studies.

International guesthouse

The *Saraswati* is equipped with the Global Positioning System (GPS), Very High Frequency Radio (VHFR), and Radiotelephone (RP), Echo sounder, Sonar and Trawl-eye.

MFV Saraswati

Museum: The CIFE museum houses fascinating collection of a large variety of finfishes and shellfishes and other aquatic animals; mostly collected during cruise programmes, organized for on-board training of students.

Centre of Advanced Faculty Training

The CIFE was recognized as the Centre of Advanced Studies (CAS) in Fisheries Science by the ICAR in 1994 to improve competency of faculty working in the ICAR and the State Agricultural Universities.

In the XI Five Year Plan, the CAS has been renamed as the Centre of Advanced Faculty Training in Fisheries Science.

So far, 24 training programmes covering various disciplines of fisheries have been conducted, and more than 200 faculty-members have been trained.

SIGNIFICANT ACHIEVEMENTS

Academics

The CIFE is currently offering Doctoral and Master Degrees in 11 disciplines of Fisheries Science. The institute has trained foreign students also, mainly from Afro-Asian countries. The institute has awarded 165 Ph.D and 884 M.F.Sc degrees.

Research and technology

The research thrusts of the CIFE involve high-quality basic research of applied value focusing on the development of site-specific and user-friendly technological packages. The institute has developed different types of carp hatchery models, has evolved hatchery-management techniques for prawns and shrimps; made successful use of ground saline-water for aquaculture; has assessed impact of shrimp farming on coastal environment; and has developed a cost-effective hormonal preparation for induced breeding of fish.

Technologies Developed

- Giant freshwater prawn seed production using artificial sea-water
- Scampi seed production using inland ground saline water
- Tiger shrimp farming in salt-affected areas
- First culture of *Litopenaeus vannamei* in salt-affected areas
- Controlled breeding and seed production of Pengba, *Osteobrama belangeri* – an endangered fish
- Catfish hatchery technology and rearing of seed under three- tier system
- Culture and fattening technology of mud- crabs
- Non-inbred seed production technology of carp·
- Optimization of spermatozoa requirement for artificial insemination in carp
- Short-term preservation of catfish milt
- Raising fish seed in cages
- Organic aquaculture through biofertilizers
- Colour enhancement of ornamental fish through carotenoid-rich feed
- Immunodiagnostic kit for white-tail disease of giant freshwater prawn
- Long-hairpin RNA expressing plasmid vaccine to control white spot syndrome virus in *Penaeus monodon*
- Ready-to-eat fish meat fortified snack (Fish- munch)
- Ready-to-eat fish sandwich-spread in retort pouches
- Anti-stress formulation for fish-seed transport: CIFELOSTRESS
- Anti-stress herbal formulation for live-fish/ shellfish: CIFECALM
- Nutrient-dense micro-particulate diet of fish

In addition, research programmes on molecular markers, transgenic fish, disease diagnostics, nutraceuticals, radio-ecology, nanotechnology, bioremediation and environmental monitoring have been strengthened to create centres of excellence as cutting-edge research areas.

Extension

The CIFE conducts need-based short-term training programmes on various aspects of fisheries for fisher-folk, aqua-farmers, entrepreneurs and others. The CIFE has a system of farmer-advisory service, in which entrepreneurs and aqua-farmers are given expert guidance on problems relating to fisheries and aquaculture.

Policy support

The CIFE has taken a lead role in facilitating the process of evolving an overarching Fisheries and Aquaculture Policy Framework through field- oriented research- cum-advocacy project. Five Zonal Workshops covering all the states and union territories were organized wherein more than 600 people representing all stakeholders participated. State-wise policy review and consultations helped identify sub-sector-wise specific policy issues as well as for evolving Draft Policy Framework with policy options and required interventions. Haryana, Bihar, Asom, Rajasthan, Madhya Pradesh and Tamil Nadu have already come forward to review and reorient their policies and prepare development plans; where the CIFE has been providing research-based technical, development planning and policy support to the states.

Consultancy Services

The CIFE offers consultancy services on – seed production and grow-out operation of carps; hatchery management and farming of giant freshwater prawn; hatchery and grow-out operation of penaeid shrimps; culture of live-food organisms; aquaculture in ground saline-water ponds; diseases diagnosis and their control in aquaculture; bioactive and biomedical compounds from marine biota; engineering aspects of aquaculture; environmental monitoring, etc.

Linkages and collaborations

The CIFE has collaborations with the World Fish Centre, Network of Aquaculture Centres in Asia-Pacific, Food and Agriculture Organization, Bay of Bengal Programme, NORAD, NACA, Australian International Centre for Agricultural Research, French National Institute for Agriculture Research and Universities such as Aburn, Stirling, Curtin, Wageningen, Guelph, etc. apart from linkages and collaborations with national organizations and universities.

Honours and Awards

Some faculty-members have been conferred with Rafi Ahmed Kidwai Award, Dr Rajendra Prasad Award and Best Teacher Award by the ICAR. Faculty members have been also recognized for their contribution as fellows of the National Academy of Agricultural Sciences (NAAS) and National Academy of Science-India (NASI).

The institute has received several awards for promotion of *Rajbhasha* in the scientific endeavours and communications.

THRUST AREAS FOR XII PLAN

Academic

- Developing world-class curriculae and innovative pedagogy
- Initiation of academic sandwich programmes with renowned foreign universities
- Establishment of global outreach centres
- Initiation of Post-Doctoral programmes in various disciplines

Research

Flagship programmes

- Inland saline aquaculture
- Utilization and conservation of ornamental fish resources

Research priorities

- Diversification of aquaculture
- Biodiversity assessment and conservation
- Application of nanotechnology and biotechnology
- Climate change
- Improved management of aquatic animal health and environment
- Seafood quality assessment and enhancement
- Livelihood and food security of marginal farmers and coastal fishers

Network programmes

- Aquatic animal disease surveillance and forecasting
- Radio-ecological studies with fisheries perspective
- DNA barcoding of fish and marine life

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IARI VARIETIES

IARI wheat varieties HD 3059, HI 8713and HW 5216 have been identified for release during the 51st AICW&BIP Scientists' Meet held at Durgapura, Jaipur (Rajasthan) from 24 to 27 August 2012.

WHEAT HD 3059

Wheat HD 3059 has been identified for the late-sown irrigated conditions of the North-Western Plains Zone [Punjab, Haryana, Delhi, Rajasthan (except Kota and Udaipur Divisions), western Uttar Pradesh (except Jhansi Division), parts of Jammu and Kashmir (Kathua district), parts of Himachal Pradesh (Una district and Paonta Valley) and Uttarakhand (*tarai* region)]. It is an early-maturing (121 days), semi-dwarf (93 cm) wheat with an average yield of 4.25 tonnes/ha and a genetic potential of 5.94 tonnes/ha under the late-sown irrigated conditions. This variety possesses high degree of resistance to all the three rusts, including stem-rust race Ug99 and its variants. It has shown superior quality parameters with high protein content (13.6%), high sedimentation value (52 ml), best Glu-1 score (10/10), and meets all the criteria for superior bread- and *chapati* -making qualities.

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WHEAT HI 8713

HI 8713 is a high-yielding durum wheat with a wide adaptability; it gave 5.6 to 5.7 % higher yield over durum checks HI 8498 and MPO 1215. It also showed 1.5 % to 19.3 % yield superiority over bread wheat checks, Lok 1, GW 322 and PBW 343. It can serve as a "dual purpose" variety suitable for both *chapati*- making and for pasta preparation, due to its moderate SDS-sedimentation value (~ 30 ml) and high semolina recovery. It can contribute to "nutritional security" in the central India because of its high protein content (~ 12.0 %), high yellow pigment (~ 7.16 ppm) and good level of essential micronutrients like iron, zinc, copper and manganese. It showed good level of field resistance to stem and leaf rusts; ACI values remaining <15.0 for stem rust and <10.0 for leaf rust. It exhibited high degree of adult-plant resistance to highly virulent pathotypes including 40A of stem rust, and 77-5 and 104-2 of leaf rust. It showed seedling resistance to most pathotypes of leaf rust race 77-complex, and stem rust races 40-complex and 117-complex. With rust- resistance spectrum different from that of HI 8498 and MPO 1215, it can help diversifying resistance base, ensuring protection to timely sown wheat cultivation in the central India.

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WHEAT HW 5216 (PUSA THENMALAI)

It is a bread-wheat variety with diverse gene sources to combat disease at foci of rust (Southern hill zone). The areas suitable for its cultivation include Southern hills in Tamil Nadu and Karnataka.

The variety yielded significantly superior to checks, HW 2044 and CoW(W)1. The mean yield of 4.87 and 3.64 tonnes/ha in various locations of Tamil Nadu (hills and lower hills) and Karnataka (areas adjoining),

respectively, over three years of testing was significantly higher than checks. It exhibited high degree of seedling resistance to most stem, leaf and yellow rust pathotypes under artificial epiphytotic conditions and to all the existing races in the proposed zones under natural epiphytotic conditions. It produces grains with higher test weight (81.47kg/hl) and better grain quality (>12% protein and 44.75 sedimentation value).

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PUSA VIRAT KNOL KHOL

This has been released by the Himachal Pradesh State Seed Sub-Committee for cultivation in Himachal Pradesh. It has dwarf plant type and semi-spreading habit. Its individual knob weighs around 800 g, and its average yield is 23.2 tonnes/ha, which is 44% higher than the standard variety, White Vienna. Harvesting can be done from 50 to 60 days after transplanting. Both knobs and leaves are edible, and there is little or no fibre development in this variety at maturity. It can withstand high frost and cold. Seeds may be sown during April to October in hilly regions and October to December in the north Indian plains.

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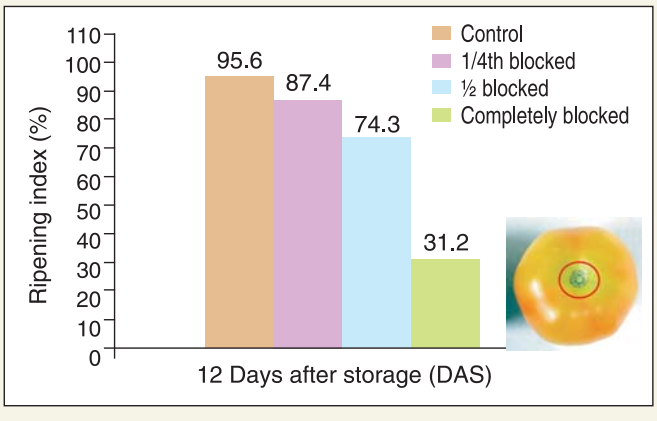
Role of stem-scar region in ripening of tomato-fruits

Delayed fruit ripening in tomatoes is a desirable trait to enhance their transportability. Hence identification of a suitable marker for delayed ripening can greatly assist in breeding suitable lines. Stem-scar region, a visible morphological character, can be used in selecting or breeding tomato varieties for delayed ripening.



Effect of different degrees of blocking stem-scar region of tomato-fruits at harvest time (green mature stage) on the ripening index (%) at 12 days' storage

A positive association was observed between the ripening and the size of the stem-scar region of the tomato-fruits. Blocking this region of tomato-fruits completely or partly reduced respiration and thus delayed ripening. Reduction in respiration and delay in ripening were due to alteration in the internal gaseous composition of the fruit in favour of lower O_2 to CO_2 ratio.

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Zinc sulphate heptahydrate conditioning for Zn biofortification in basmati rice

Commercial grade zinc sulphate heptahydrate, $ZnSO_4.7H_2O$ (ZnSHH), is the most widely used source of Zn for amelioration of Zn deficiency in crops. However, it releases water of hydration at temperatures above 30°C and forms lumps on storage. This makes it difficult to handle this compound and apply it in the fields. Conditioning of ZnSHH with ZnO and *neem* oil reduces release of its water of hydration and prevents lump formation.

Field experiments with various combinations of ZnSHH, ZnO and *neem* oil were conducted to study effects of conditioning of ZnSHH with ZnO and *neem* oil on the growth, productivity, uptake and Zn fortification in grains of Basmati rice Pusa 1121. The results showed that ZnSHH conditioned with 2% ZnO and 4% *neem* oil improved yield attributes, grain and straw yields, Zn uptake and partial factor productivity (PFP), agronomic efficiency (AE), recovery efficiency (RE) and physiological efficiency (PE) of Zn in basmati rice.

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Varieties/hybrids of Indian mustard

Four varieties and one hybrid of Indian mustard have been identified for release in the 19th Annual Group Meeting of the AICRP on Rapeseed-Mustard during 3-5 August 2012 at the Birsa Agricultural University, Kanke, Ranchi (Jharkhand).

Variety/hybrid	Maturity (days)	Oil content(%)	Average yield (kg/ha)	Recommended for	Special characteristics
RH 0749	139-163	38.7-39.7	2,419-2,826	Haryana, Jammu, northern Rajasthan and Punjab	Suitable for timely sown irrigated areas; is tolerant to high temperature at seedling stage
Divya 33	136-161	36.0-40.7	2,346-2,673	Haryana, Jammu, northern Rajasthan and Punjab	Suitable for timely sown irrigated areas
PBR 378	134-156	37.7-41.9	2,254-2,692	Haryana, Jammu, northern Rajasthan and Punjab	Suitable for rainfed areas
JMWR 08-3	120-141	37.1-41.2	1,515-1,874	Haryana, Jammu, northern Rajasthan and Punjab	Suitable for late-sown areas
44S01(Hybrid)	87-123	36.9-42.7	1,109-1,429	Asom, Bihar, Chhattisgarh, Jharkhand, Odisha and Manipur	Early maturing, medium tall

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Two novel genetic stocks of Indian mustard registered

Two genetic stocks have been registered with the NBPGR, New Delhi. DRMR WFM 1 of the Indian mustard (*Brassica juncea*) from the Directorate has been registered for its white petal colour;a unique trait in *B. juncea*, which normally possesses flowers with yellow petals only. It has been given registration number INGR12007. White colour of the petal can be a useful morphological marker for many studies in the breeding programme.

Another genetic stock RH 0116 (IC0584669; INGR11033) of the Indian mustard has also been registered from the CCSHAU, Hisar, for its tolerance to salinity (10 ds/m) at the seedling stage.

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High oil soybean – NRC108

Indian soybean genotypes have been reported to possess oil content in the range of 13.0-21.8%; with major popular varieties containing approx. 18 % oil, with maximum recovery of 17% in the industry. Globally, genetic potential reported for oil content in soybean is 25%. An increase of even 1% in oil content of popular soybean varieties can yield additional 1 lakh tonnes of oil (assuming approx. 10.0 million tonnes of total soybean produce is fed into oil-extraction plants), thereby saving ₹600 crore in edible oil import. This underscores the dire need to develop high-oil content soybean varieties, besides expansion of area under soybean cultivation.

NRC 108
Freshly harvested seeds (inset)

NRC 108 has been developed by crossing Hardee with NRC 7, and it has advanced to F_7 generation. The harvested seeds have been found to contain average of 24% oil content. The plant of this genotype has purple flowers (blooming in 35 days), attains height of 59 cm, and reaches harvest maturity in 94 days. The seeds are of light-yellow colour with brown hilum and weight of 100 mature seeds (10 % moisture) is 14.4 g. The plant gives a yield of 2.6 tonnes per ha. Development of NRC 108 is a step towards bridging down the gap between edible oil demand and its supply in the country.

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Pollination syndrome limits fruit-set in custard-apple

Custard-apple (*Annona squamosa*), also known as sugar-apple, is a minor tropical fruit of India but its demand in ice-cream and sweet-meat sector has enhanced its scope. But production of custard-apple is reeling under poor fruit-set, productivity and fruit quality, which causes severe monetary losses to farming community, mainly of the central India.

Floral traits of custard-apple, drooping habit of flowers, lack of nectar secretion, poor pollen production and odour, are barriers for effective pollinators like bees. These traits act as a niche for less effective pollinators like beetles. Nitidulid beetles, *Carpophilos domidiatus* and *Carpophilos hemipterous,* were identified as the only visitors and pollinators. Pollination is poor in the custard-apple, in spite of high pollen germinability (78%) and longer stigma receptivity (30 hr), as beetles do not deposit sufficient pollen on to stigma, and thus in turn affect fruit-set. This can be attributed to foraging habit and small body size of beetles. And the protogynous dichogamy nature of the flower further aggravates the problem. Increase in fruit-set was observed with population density of beetles (4-5/flower), which increased with rainfall and humidity.

Investigation on the pollination biology of *Annona squamosa* clearly indicates functionally specialized pollination system, which restricts potential pollinators and allows inefficient pollinators; this is called "pollination syndrome".

Pollination syndrome is a new concept which is defined as a suite of floral traits, including rewards associated with attraction and utilization of specific 'functional groups' of pollinators. The syndrome provides a mechanistic explanation for floral diversity, i.e. convergent adaptation for specific types of pollinating agents.

Floral traits and specific reward system of custard- apple exhibit obligate specialization by filtering only *C. hemipterous* and *C. domidiatus* as pollinators, and thereby explicitly indicate cantharophilous pollination syndrome. Hence the fruit-set and quality of custard-apple is directly associated with the inefficient pollen delivery due to natural barriers, which can be overcome by increasing population density of beetles or by hand pollination.

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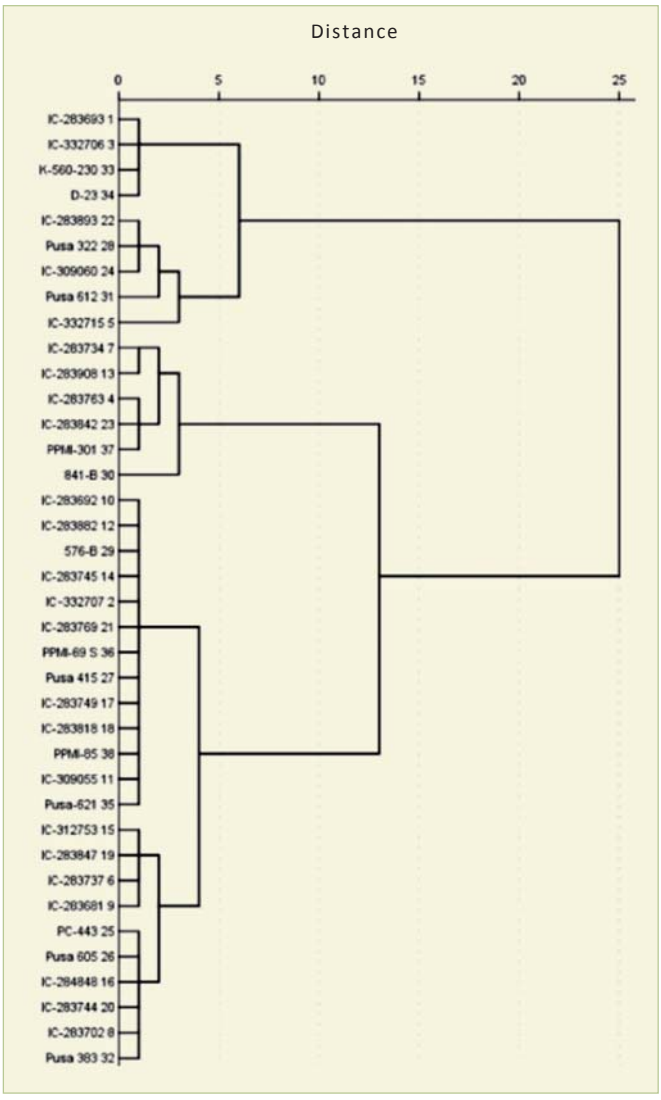
Bajra germplasm for ready-to-eat popped-up snacks

Pearl millet (*bajra*) is rich in vitamin B-complex, potassium, phosphorus, magnesium, iron, zinc, copper and manganese; its grains are gluten-free, but have some inherent anti-nutritional factors, like phytic acid, etc.

Bajra -grains can also be popped like corn and rice; but its popping yields are usually low (<40%). In var. PC 443, through simple-and- easily adoptable processing technique, popping yield could be increased from 30 to 64%. Optimum processing conditions required for popping are: 16% moisture content, 4hr tempering time and 270-280°C popping temperature. The final popped product obtained is crunchy and ready-to-eat. Product's proximate composition estimated is: 11.2% protein, 7.36% fat, 2.96% crude fibres, 3.83% ash, 72.81% carbohydrate and 1.84% moisture. And total antioxidant content has been estimated at 15.47 µ mole Trolox/ 100g. While popping, there is significant reduction in phytic acid also, from 516.37 in raw grains to 373.82 mg/100g in popped product. The popped product is rich in micronutrients, especially iron (5.02 mg/100 g) and zinc (3.01 mg/100 g).



Dendrogram for distances in popping characters among pearl millet germplasm/varieties

In *bajra*, 38 varieties have been evaluated for popping potential. They showed significant difference in popping yield, puffing index and popped size, and have been grouped into three clusters on the basis of the popping characters. Their popping yield varied from 48.23 to 83.82%, puffing index from 5.37 to 10.55, and popped size from 4.36 to 8.84 mm.

IC 283734, IC 283745, IC 283763, IC 283842, IC 283908, 841 B and PPMI 301 with highest mean popping yield of 75.56 % and puffing index of 8.90 can be exploited for making popped snack.

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Low-cost nutritive guava-lemon-ginger squash

Guava is the 6th most important fruit-crop of India, which is cultivated in subtropical and tropical climates. In spite of its high nutritive value in terms of vitamin C and antioxidants, market value of the fruit experiences seasonal variations; the rainy-season crop is sold at a very low price and the winter crop at comparatively higher price.

Considering substantial post-harvest losses of the rainy-season guava, lemon and ginger blended guava squash was prepared to enhance economic value of the crop. Moreover, guava is an important crop of the small farmers; and hence the processed product will generate income for them.

Guava-lemon-ginger squash was prepared with 22.5% guava juice, 5.0% lemon juice and 1.5% ginger juice. With the addition of 200 ppm potassium metabisulphite, the product can be kept for 80-90 days in refrigeration (4 °C). The TSS, acidity, *p*H and total sugar of the product were 43.5 °Brix, 1.32%, 3.4 and 41.5%. Squash is rich in vitamin C content (212-235 mg/100g) and antioxidants. The product has very pronounced sensorial attributes in terms of appearance, flavour, sweetness and overall quality. It is cost-effective (B: C ratio 2.2:1) also, as preparation cost of one litre of squash was ₹62 and selling price was ₹135. Farmwomen were imparted hands-on training on squash-making to improve their entrepreneurial capability as well as to address nutritional security issue.

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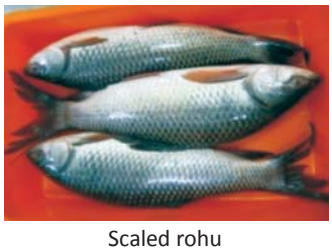
Fish descaling machine

A fish-descaling machine has been designed and developed. This can be used for removal of scales from all types of marine as well as freshwater fishes. It is equipped with a perforated rotating drum and an induction motor of variable frequency drives. The drum has a capacity to load 10-kg fish at a time. The time of operation and rpm of the drum has been standardized for each species under different size categories for efficient removal of scales. The rpm of the drum can be adjusted at a minimum of 2 rotations to a maximum of 80 rotations per minute. Trials conducted have shown that 98% of the scales could be removed using descaling machine. For sardine, the process requires 5 minutes at 20 rpm, for rohu, it is 10 minutes at 30 rpm and for tilapia, it is 8 minutes at 25 rpm.

The material can be loaded and unloaded and operated easily by a single person; thereby it is a useful tool to overcome the shortage of skilled manpower in the fish-processing industry. Mechanization of descaling activity can significantly reduce handling time, thus shortening pre-processing period also. This in turn will reduce overhead cost and also enhance quality of the final product.



Scaled rohu

Descaled rohu

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WAY FORWARD

SCIENCE-LED developments in agriculture in the country have made significant contributions in the last five decades to enable India in achieving self-sufficiency in food production, and also in ending an era of foodgrains' imports.

In order to sustain food security and to feed burgeoning population of the country, which is likely to be 1.3 billion by 2050, continued research efforts for development of technologies are imperative. With the 50% of the World's farming population living in India, the country is striving to raise foodgrains' production by almost 40%, when yields of major food crops are plateauing, natural resource base is degrading, new biotypes of pests and pathogens are emerging and climate is changing. To mitigate these challenges and to accelerate agricultural production and productivity, processing, value addition, health foods, diagnostics and vaccines for livestock and plant protection, nanotechnology offers many opportunities.

The nanotechnology *per se* has varied applications in agriculture including development of simple gadgets for early detection of pests, diseases and nutrient deficiencies; for sustained release of pheromones and insecticide molecules for effective insect- pest management; fabrication and development of smart delivery systems to enhance input- use efficiencies of nano-agricultural inputs and development of smart food packaging to extend shelf-life of fruits, vegetables, flowers, dairy and poultry products, besides quality control and value addition of agricultural products. In India, application of nanotechnology in agricultural research and development is rather new, and includes development of dipstick assay based on the nanogold particles for detection of potato viruses at the field level; nanogold- based lateral flow immuno-dipstick assay using teliospore antibodies for detection of Karnal bunt in wheat; and formulation of nano-fertilizers and slow release of nutrients from nanofertilizers. In contrast to products and technologies generated for medicine industry, processes for generation of products in agriculture and veterinary sectors need to overcome certain serious limitations relating to biological and ecological safety and also of paying capacity of farmers.

It is in this context that the Indian Council of Agricultural Research is launching a new initiative 'National Platform on Nanotechnology in Agriculture' in the XII Plan to facilitate researchers in all branches of agriculture, including basic sciences, to bring in novel ideas and experiments to prove their hypotheses, leading to practical applications. The nanotechnology platform would accelerate research activities by providing appropriate state-of-art facilities at the selected research institutes, which will be accessible to all concerned for necessary capacity- building activity also. While ICAR has the expertise in developing standard operating practices on biotech products for conducting laboratory and field trials, efforts are, however, nascent in testing nano-particles of agricultural importance to build a consensus in the society on their commercial use and viability. Here is an invitation for experts from different fields to join hands in enhancing nanotechnology applications in agriculture.

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

We expect tangible outcomes from the 'Nanotechnology Platform' proposed in the XII Plan in the form of (i) nano-based diagnostic kits/ sensors for detection of diseases and nutrient deficiencies at the field level, (ii) nano-biosensors for detection of food contaminants, (iii) nano-pheromones/ nanosensors and nano-bioformulations for control of pest and diseases, (iv) nano-agri-inputs and smart delivery systems with enhanced input-use efficiency, (v) growth monitoring sensors, (vi) nano-chips in identity preservation and tracking, (vii) nano-composite films for improving shelf-life of agri-products (vegetables, fruits, processed foods), (viii) encapsulated functional ingredients for targeted delivery and, above all (ix) biosafety protocols.

We are confident that with the enhanced application of the new technology, qualitative and quantitative yield improvements can be manifested with significant reduction in post-harvest losses, and a win-win situation can be established for both producers and consumers.

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