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ICAR NEWS

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RESEARCH UPDATE

PROMISING TECHNOLOGIES

Aonla dietary fibre-enriched biscuits

CISH, Lucknow. Dietary fibre, vitamin C and antioxidant-enriched biscuits have been developed by incorporation of *aonla* pomace (a byproduct generated during *aonla* juice processing). The dietary fibre content of the finished product was about 5-fold higher than the control and the vitamin C and antioxidant concentration were 15.6 mg/100g and 0.25 g % respectively. Biscuits have a shelf-life of more than 3 months when wrapped in 100 gauge polypropylene pouches under ambient conditions. The biscuits prepared in accordance with the invented process can be supplemented as fibre, vitamin C and antioxidant fortified diet for children and adult alike. The fibre-enriched biscuits may be helpful in curing the constipation and other ailments related to fast food habits.

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New technologies for spices

IISR, Calicut. The Institute has developed technologies for black pepper (*Piper nigrum*), cardamom (*Elettaria cardamomum*), ginger (*Zingiber officinale*), tumeric (*Curcuma longa*) and cinnamon (*Cinnamomum verum*).

BLACK PEPPER

For better production of black pepper following technologies, viz. Rapid multiplications technique, Serpentine method, and Drip irrigation, were developed.

Rapid multiplication technique

This technique utilizing bamboo splits is recommended for large-scale production of planting materials.

After planting in the bamboo, the first harvest of cuttings can be done after 90-105 days and the subsequent harvest at 60–75 days. Each rooted vine can give about 10 cuttings in one harvest and about 40 cutings will be obtained in an year. A shed of 6 m × 24 m would accommodate 600 bamboo splits. On an average 20,000 cuttings can be produced annually by this method. This method is thus advantageous for producing a large number of rooted cuttings within a short period, throughout the year. The cuttings are also robust owing to the abundance of roots leading to more than 90% establishment in the field.

Serpentine method

Each node of black pepper plant should be pressed into the mixture *Trichoderma* (1g/kg potting mixture), with polythene bags with 'V'-shaped midribs of coconut leaves. As new shoots arise these are to be trailed horizontally in polythene bags containing potting mixture. Once 20 nodes get rooted, the first 10 polythene bags with the rooted nodes should be separated by cutting at the internodes. The internodal stub should be pushed back into the potting mixture. These stubs also produce a secondary root system. Daily irrigation is to be given using a rose-can. Application of vermiwash or *Pseudomonas* @ 25 ml/plant encourages the growth of the cuttings. After 3 months these cuttings are ready for planting in the field. On an average 60 cuttings can be obtained in an year by this method from each mother cutting. Cuttings raised in media consists of coir-pith a compost and, granite powder in 2:1 proportion with *Azospirillum* spp. and *Phosphobacteria* as nutrient source yields higher biomass production.

Drip irrigation

Irrigating black pepper @ 7 litres / day / vine through drip irrigation from October to March is recommended for increasing yield from black pepper monocrop on *Erythrina* live support at an altitude of 50-60 m MSL. This technology is useful for similar black pepper growing area like Kerala, Karnataka and Tamil Nadu where moisture stress is experienced during summer.

CARDAMOM

The significant results were obtained from developed technologies, viz. Rapid clonal propogation technique, drip irrigation and pollination management in cardarmom (*Elettaria cardamomum*).

Rapid clonal propagation technique

An efficient clonal propagation technique (trench method) for large-scale multiplication of cardamom from suckers has been developed. The minimum planting unit consists of one grown up sucker (rhizome) and a growing young shoot. On an average 32-42 suckers were produced after 12 months of planting per one planting unit. Taking the barely minimum of 50% of this suckers/clump one can get 16-21 planting units (1 grown up sucker along with a growing young shoot that is sucker) from one mother-planting unit after 12 months. From an area of 1 ha clonal nursery 1,148,144 to 1,94,439 planting units can be produced after 12 months. Clones thus produced would be free from virus, rhizome rot and root knot nematodes.

Drip irrigation

Drip irrigation of cardamom was recommended with 8 litres/plant daily from 15 January for increasing yield.

Pollination management

In cardamom pollination is effected by the activity of bees (*Apis cerena indica* F. and *Apis dorsata* F.) A minimum of 4 honeybee colonies (about 500 forages per colony) per ha (3,000 plants) is required for effective pollination of cardamom.

CINNAMON

The outcome of the developed technologies, viz. Cutting and Air layering pertaining to cinnamon (*Cinnamomum verum*) showed good yield.

Cutting

For raising cinnamon from cuttings; semi-hardwood cutting of about 10 cm length with 4 leaves are taken and dipped in IBA 200 ppm or in a rooting hormone (deradix) and planted either in polythene bags filled with sand or a mixture of sand and coridust in the ratio 1:1 or in sand beds raised in a shaded place. The cuttings in polythene bags must also

Table 1. Technologies developed by IISR to control major pests and diseases of important spices.

Major diseases/contraints	Technology
Phytophthora foot-rot in black pepper	Phytosanitation, minimum tillage, two pre-monsoon sprays with Bordeaux mixture (1%), one drenching with copper oxychloride (1%) combined with potassium phosphonate spray and drench, in place of Bordeaux mixture.
'Katte' and 'koke kandu' of cardamom and stunted diseases of black pepper	Rouging out diseased plants and phased replanting with healthy plants.
Nursery management in pepper and cardamom nurseries to suppress disease	Soil solarization with polythene sheets for 30-40 days as a pre-sowing treatment. Incorporation of VAM and *Trichoderma* in the nursery.
Rhizome rot of ginger	Healthy seed selection, seed dressing with *Trichoderma,* and its soil application coupled with organics. Soil solarization.
Nematodes and root grubs in cardamom	Spot application of phorate @2.5 g/clump twice/year between April-May and October-November.
'Pollu beetle' in black pepper	Shade regulation and spraying quinalphos (0.05%) during July (21-30 days after the setting of berries) followed by 3 sprays of Neemgold (0.6%) between August and October.
Shoot borer in ginger and turmeric	Prune freshly infested shoots at fortnightly intervals during July-August, and spray malathion 0.1% at monthly intervals during September-October.

be kept in a shaded place or in a nursery. The cuttings are to be watered regularly 2 to 3 times a day for maintaining adequate moisture and prevent wilting. Rooting takes place in 45-60 days. The well rooted cuttings can be transplanted to polythene bags filled with potting mixture and maintained in a shaded place and watered regularly.

Air layering

It is done on semi-hardwood shoots of cinnamon. A ring of bark is removed from the semi-hardwood portion of the shoot and a rooting hormone (IBA 2,000 ppm or IAA 2,000 ppm) is applied on the portion where the bark has been removed. Most coir dust or coir husk is placed around the region where the hormone has been applied and is secured in position by wrapping with a polythene sheet of 20 cm length. This would also avoid moisture loss. Rooting takes places between 40 and 60 days. The well-rooted air layers are separated from the mother plant and bagged in polythene bags filled with potting mixture and kept in a shaded place or nursery by watering the plants twice daily. The rooted cuttings and layers can be planted in the main field with the onset of rains.

TURMERIC

The developed production and protection technologies on turmeric, *Curcuma longa*, gave better yield.

Production and protection technologies

The study was conducted on the followings:

(A) Nutrients for turmeric

Farmyard manure or compost @ 30 tonnes/ha has to be applied by broadcasting and ploughing at the preparation of land or as basal dressing by spreading over the beds to cover the seed after planting.

(B) Rhizome rot disease in turmeric

- Rhizome treatment with a combination of mancozeb (0.25%) and quinalphos 0.075% for 15 minutes is the recommended practice.
- Soil drenching with metalaxyl mancozeb (0.2%) or mancozeb (0.25%) at 15 to 20 days interval twice with the first appearance of the symptom
- Crop rotation is also recommended to reduce the incidence of rhizome rot.

GINGER

The research work conducted on ginger, *Zinigiber officinale,* through developed production and protection technologies gave significant results.

Production and protection technologies

The study was conducted on the followings:

(A) Management of soft rot and bacterial wilt in ginger

- Well-drained soil with gentle slope is good.
- To be planted in raised beds.

- Select rhizomes that are bold, shining and attractive having at least 2 to 3 golden colour sprouts and no undersirable odour, mold growth or insect damage.
- Treat the seed rhizomes for 30 min. with Mancozeb (0.3%) or carbendazium (0.3%) and shade dry the rhizomes.
- Drench fungicidal [Copper based (1%) or Mancozeb (0.3%) or Metalaxyl (0.125%)] solution at the planting.
- Repeat this drenching 30, 60 and 90 days after planting.

(B) Management of rhizome scale in ginger

- Discard severely infested rhizomes before storage of rhizomes.
- In severe infestations, dip seed rhizomes in quinalphos 0.075% and store along with dried leaves of *Strychmos nux-vomica* + sawdust in 1:1 proportion.

(C) Management of shoot borer in ginger

- Prune freshly infested shoots (as indicated by the extrusion of frass) at fortnightly intervals during July-August.
- Spray Malathion 0.1% at monthly intervals during September-October. Consereve natural enemies.

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Sprout suppressant in reducing potato loses

CPRI, Shimla, The use of safer chemical, Isopropyl N-(3 Chlorophenyl) Carbonate (CIPC), a sprout suppressant in potatoes, stored at higher temperatures (8°C and above) meant for processing, was found very effective in controlling potato tuber-moth in stores besides checking the sprout growth. The CIPC spray 'Grow Stop Basis 30 EC' containing 30% a.i. @ 40 ml/tonne of potatoes (dissolved in 160 ml of water and applied with a rotary disc sprayer) showed significant results.

The incidence of potato tuber moth in treated tubers in country stores was observed to be negligible (0.3–2.8%) compared to 3.6–27.6% in untreated tubers up to 50 days. Further, the tubers treated with CIPC were not only healthy but also showed no shrivelling. In contrast untreated tubers showed potato tuber moth damage, having typical potato tuber moth galleries inside, and tubers also shrivelled during storage. The treated tuber were analyzed in laboratory for CIPC residues, which were found to be under permissible limit. Thus tubers were found safe for human consumption.

CIPC can be safely used by farmers for controlling the potato tuber moth damage in stores, and maintaining the desirable quality of potato both for table and processing purposes at least for 2 months after storage.

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Spiritless shellac-based varnish resistant to heat and water

IINRG, Namkum. Two shellac-based varnishes, MSV 001 and MSV 005, have been developed, using a non-spirit solvent system, for polishing wooden furniture, musical instruments etc. Since spirit is not available freely in the market, the present ready to use formulations solve the problem. The drying time of the varnishes is 10 to 15 minutes in comparison to commercial samples (2-5 hr). The short drying time protects the surface from sticking the dust particles and reduces the time for consecutive coatings. The commercial varnishes lack this quality because of their longer drying period. The varnishes retain the texture of costly wood and provide a beautiful sheen. The films of these varnishes are resistant to both water and heat.

The technology has been transferred to private Industries/ Chemical Industries at Kerala and Karnataka.

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Camel milk-based skin cream

NRC on Camel, Bikaner. The collaboration research on skin care properties of camel milk has yielded encouraging result. The joint research efforts of scientists of NRC on Camel and the dermatologists of S.P. Medical College, Bikaner, showed that the camel milk can make a good formulation or base for a skin cream. Among the skin care products in the markets the cream with moisturising, glowing and anti-oxidant properties are in high demand. The camel milk is reported to have such ingredients like moisture, vitamin C, zinc, free form of calcium and peptidoglycan recognition proteins (an antibiotic like molecule). The inital tests have resulted into an encouraging response from the test users regarding its moisturising and glowing effects. It is anticipated that after its complete formulation

Conserving Agrobiodiversity in the Himalayas

NBPGR, New Delhi.The National Bureau of Plant Genetic Resources has recently initiated studies on on-farm conservation of agrobiodiversity at selected sites in Uttarakhand, Himalayas. Existing crop genetic diversity at species and genetic level in traditional production systems was assessed and factors for changes in crop compositions and farming systems during the recent past were scrutinized. The documentation of traditional agricultural biodiversity was helpful in understanding the following information on the target species viz naked barley (*Hordeum vulgare* ssp. *vulgare*), buckwheat (*Fagopyrum esculentum* and *F. tataricum*), *Perilla* (*P. frutescens*) and rice (*Oryza sativa*):

- The amount and distribution of genetic diversity being maintained in traditional production systems.
- The processes being used to maintain this diversity.
- The social, economical, cultural and environmental factors influencing farmers to maintain diversity in traditional production systems.
- The people maintaining this diversity in gender, age, ethnic and social or economic status in the community.
- The "adding value" options to local agricultural biodiversity in a given social, economical and ecological context.

On-farm conservation will be most effective when targeted to specific areas with significant plant genetic resources and with communities who are willing to participate in conservation programmes. Urgam valley (Chamoli district) in Uttarakhand is one such suitable site for on-farm conservation of landrace diversity of the traditional crops. Most of the traditional crops, viz. amaranth, barnyard millet, fingermillet, buckwheat, horsegram, blackgram, barley (the hull-less types), *Perilla frutescens* are still under cultivation and supplement the major dietary energy in these agro-ecosystems with valuable intra-specific diversity besides the two major crops rice and wheat. There is ample forest resource base to support the farmland as an integral component of traditional agroecosystems in the Himalayas. Similar valleys, viz. Henwal and Chamiyala-Dharam Ganga valleys in Tehri district, and Vyas and Upper Gori Ganga Valley in Pithoragarh, Uttarakhand are other suitable sites for implementing on-farm conservation programmes.

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including the fragrance and colour, the skin cream can be launched as a dermaceutical product.

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Intercropping between *aonla* and *dhanicha* for better soil productivity

CSWCRTI (Research Centre) Agra. Among green-manure intercrops in between *aonla* rows, *dhaincha* was found best in producing the maximum green biomass (12 tonnes/ha) and maintaining maximum moisture in profile, i.e. up to 14.5 cm /100 cm profile at this station in degraded ravine lands. Maximum average fruit yield of *aonla* (10 kg/ tree) was also obtained in *dhaincha* plot. And maximum improvement in soil organic carbon was recorded with *dhaincha* (0.48%), followed by cowpea (0.42%), and greengram (0.38%).

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Conserving resources, augmenting livelihood of small holder

CSWCRTI (Research Centre), Koraput. Efforts were made in tribal areas of Orissa to conserve resources and augment livelihood of small holders through multi-tier cropping systems in Eastern Ghats. Total biomass (above-ground and roots) added to the top soil due to growing of green-manure crop, was estimated to be 39.3 tonnes/ha on fresh and 8.3 tonnes/ha on dry weight basis. Runoff from plots (all under green-manure crop *dhaincha*) having papaya/drumstick with or without *Gliricidia* ranged from 30 to 32%. Control plots recorded 1 to 3% higher runoff. Soil loss from plots having papaya/drumstick/*Gliricidia* ranged from 25 to 26 tonnes/ha. Control plots yielded 1-2 tonnes/ha more soil loss.

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Cost-effective conservation of plant genetic resources in Himalayan region

NBPGR, New Delhi. The National Gene bank at the National Bureau of Plant Genetic Resources has nearly 0.3 million accessions stored as seeds in 12 long-term modules maintained at –18°C since 1997. Investigating cost-effective methods of seed storage, therefore, has been a priority area at NBPGR. To achieve this, a survey was conducted to identify a site in the Himalayan region with natural conditions of low temperature and relative humidity throughout the year, to carry out seed conservation in a cost-effective manner. This resulted in identification of Khardung La, which is on the road to Siachen glacier with temperature ranging from –31°C to 12°C. The highest temperature of 12°C is recorded during days from June to August for few hours. After selecting the site, a total of 149 accessions belonging to 43 crops were processed for conservation. Data were recorded for initial seed viability, seed moisture content and seed health in collaboration with Defence Research and Development Organization, Field Research Laboratory, Leh. Sealed packets of the selected seeds were transported to Khardung La, a high mountain pass (elevation 5,359 m) located in the Ladakh region, Jammu and Kashmir.

The germplasm identified for conservation included some accessions with poor seed viability and higher moisture content to study the influence of these factors also, on the longevity of stored seed material. The seed material was kept in hermetically sealed aluminium foil pouch in wooden box. The stored seed samples were retrieved initially after a gap of 10 months and later after 24 and 48 months for monitoring of seed viability. The monitoring results indicated that most of the accessions stored following the Genebank standards (i.e. with more than 85 % viability and 5-7 % moisture content), retained the initial viability. Accessions kept with low initial viability (22-65%) and higher moisture contents (8-10%) showed further decrease in their viability. This suggests that seeds stored following genebank standards with regard to quality of seeds, stored effectively, retaining their initial viability. Therefore, the seeds kept under naturally low temperature conditions would store effectively maintaining their viability, similar to artificially maintained low temperature conditions, facilitating cost-effective and safe storage of seed and thereby conservation of Plant Genetic Resources. Efforts are now in progress to establish a permanent structure at a suitable site in the Himalayan region for storage of seed of important Plant Genetic Resources as safety duplicates.

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An indigenous biopesticide enhances tomato yield

IARI, New Delhi. The yield loss in tomato, *Lycopersicon esculentum*, crop (due to fruit-borer *Helicoverpa armigera)* is from 22.39 to 37.79%. About 90% farmers rely primarily on synthetic pesticides for control of pests of tomato crop. In spite of repeated sprays farmers are not able to manage its pests. And because of growing concerns about health and environmental safety, the use of toxic, carcinogenic, and/or environmentally damaging chemicals is being discouraged at present. Indigenously developed bio-pesticides are environmentally sound; nature friendly and economically feasible, therefore inclusion of traditional knowledge in the pest management programme may be assured, as it reduces dependence on chemical

pesticides and deterioration of ecology. One such cow urine-based formulation was prepared using neem, *Azadirachta indica,* and other easily accessible ingredients and tested against insect pests of tomato crop. The studies showed that 8% of this formulation controlled more than 80% of tomato fruit-borer in the laboratory.

In field, 2 sprays of this formulation @ 3% at nursery stage and 4 sprays @ 5 and 10% at flowering, fruiting and maturing stage, gave promising results in controlling tomato fruit-borer, leaf minor, mites and whitefly pests and gave good yield with zero input. It also controlled significantly damping off; early blight and buck eye rot diseases.

The observed yield in indigenously treated tomato fields with zero inputs**,** was 36 tonnes/ha as compared to 15 tonnes/ha in check plots and 17 tonnes/ha in organically treated plots.

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Improving fertilizer-use efficiency in grape

NRC Grape, Pune. A growth stage-wise fertilizer application strategy based on drip (fertigation) in grafted Thompson Seedless grape has been developed. This technology resulted in 60% saving in fertilizer use over the conventional method of soil application, thus improving fertilizer use efficiency and reducing salinity hazard and pollution of groundwater. Fertigation resulted in better utilization of the nutrients. Advice to farmers on the need for stage-wise nutrient application in more number of splits through fertigation to reduce cost of cultivation, sustain the crop yield, to reduce the chemical load in the underground soil and water is advocated. This is well accepted and widely practised now.

Leaf petiole analysis at bud differentiation and flowering stage for knowing the status of nutrients and their right quantity application in NPK has made good impact in application of fertilizers. The farmers were educated on the need for maintaining potassium, calcium and magnesium balance in the system to manage bunch stem necrosis disorder in vineyards.

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Soil erosion map of Rajasthan generated

CSWCRTI (Research Centre) Dadwara, Kota. The soil erosion map of eastern Rajasthan has been generated from soil loss value estimates for each of 10 km grid point using universal soil loss equation (USLE). The values for USLE parameters, derived from soil survey data sheets of the NBSSLUP, and erosion plot studies conducted by this Centre, were used. The GIS mapping tools were used to prepare the map. Despite relatively low annual rainfall, water-induced erosion is a serious problem in the region. About 66% area has annual soil loss more than 10 tonnes/ha and about 15% of the area showed severe erosion rates with soil loss rates exceeding 40 tonnes/ha/year. The relatively higher rates of erosion per unit of rain energy are primarily due to poor ground cover during monsoon and slope steepness of the rolling and hilly terrain.

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National Active Germplasm Site for Lac Hosts

IINRG, Namkum. The National Bureau of Plant Genetics Resources, New Delhi, has recently designated the Indian Institute of Natural Resins and Gums, Ranchi (IINRG), as National Active Germplasm Site for Lac Hosts. Dr Mangala Rai (Secretary, DARE and DG, ICAR) inaugurated this site formally.

Though lac insects are reported to occur on over 400 host plant species, only a small fraction of them could be considered to be of commercial potential and only a limited number of species(<10) were actually exploited commercially. The institute lays emphasis on lac hosts showing high productivity potential and has accumulated a good number of collections of important and potential lac host species. At present the institute holds 97 collections of 47 species of lac hosts, especially those of the major lac hosts, viz. *palas*, *kusum* and *ber*.

The Institute will be laying emphasis on organized development of lac host field gene bank of existing collections and also take a major initiative for augmenting lac host biodiversity collection of the Institute. A master plan has also been drawn for the long-term development of lac host field gene bank in the institute. This has become the need of the hour in view of the eroding host biodiversity due to qualitative changes in forest cover. The institute has recently planted 25 varieties belonging to Central Arid Zone Research Institute, Jodhpur for comparative performance evaluation of lac cultivation.

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Ber–Aloe vera intercropping fetches better returns

CSWCRTI, Resarch Centre, Agra. *Aloe vera* was cultivated in the interspaces of matured *ber* trees that were planted in 8m × 4m spacing. Planting distance of *Aloe vera*, 0.5m × 0.5m and 1 m space was left out after every two rows of *Aloe vera*. When raised as an intercrop with *ber*, plant height, spread and yield of *Aloe vera* were 68 cm, 70 cm, and 47 tonnes/ha/year, respectively, and yield of *ber* fruits was around 7.5 tonnes/ha/year. As a result, gross income and net income from the *ber- Aloe vera* system was estimated to be Rs 1,23,000 and Rs 73,000 respectively.

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Diversifying cropping system through remunerative forage crops

IGFRI, Jhansi. Diversfication of existing cropping systems through remunerative forage crop is suggested.

Hill zone: In mid-Himalayan hill zone, maize (fodder) – wheat realizes significantly higher net monetary rerturn which is 85% higher than the most adopted sequence (Maize–wheat).

North-west zone: (i) In *Tarai* area of Uttarakhand and West Uttar-Pradesh, paddy-wheat-maize (fodder) + cowpea (fodder) realizes highest net monetary return and superiority of 29% over paddy-wheat.

(ii) In semi-arid situation of Haryana, pearl millet (fodder) – wheat–greengram realizes 40% higher net monetary return than cotton–wheat.

(iii) In arid region of Rajasthan, *guar* (F) + pearl millet (F) – oat (F) – cowpea (F) fetches significantly higher net monetary return which is 99% higher than the most adopted *(guar* (G) – wheat (G) – fallow).

Centre zone: (i) In semi-arid situation of Bundelkhand, groundnut – berseem – maize (fodder) provides 44% higher net monetary return than groundnut–wheat–greengram.

(ii) In Kaimur plateau region of Madhya Pradesh, sorghum (F) – berseem–rice–wheat–greengram.

(iii) In central zone under Vidarbha region of Maharashtra, lucerne (perennial) realizes 84% higher net monetary than soybean–wheat–greengram. However, maize (fodder) – berseem – sorghum (fodder) gives 54% higher net montary return than soybean (grain)–wheat (grain)–cowpea (grain).

(iv) In irrigated situation in Gujarat, NB hybrid + cowpea/ lucerne realizes 58% higher net monetary return than maize (f)–potato (t)–pearlmillet (g).

North-east zone: (i) In Eastern zone of Uttar Pradesh, significantly higher net monetary return was realized with NB hybrid (perennial) + berseem which was 48.0% higher than rice–wheat–greengram.

(ii) In subhumid situation of Orissa, pearl millet (f) – oat maize (f) + cowpea (f) realizes highest net monetary return with the superiority of 80% over groundnut–mustard–greengram.

(iii) In NEH plains region under Jorhat (Assam) situation, NB hybrid (perennial) gives 120% higher net monetary return than sesame (g)–rapeseed–greengram.

(iv) In Jharkhand under Ranchi situations, NB hybrid + berseem realizes higher net monetary returns than fallow–rice.

(v) Under Indo-gangetic plains of West Bengal, rice–oat–sesame was superior for net monetary return with increase of 63% over rice–mustard–groundnut.

South zone: (i) Under semi-arid situation of Andhra Pradesh, NB hybrid + cowpea / berseem was superior for net monetary return with increase of 10% over redgram–tomato–sorghum + redgram.

(ii) In rain shadow area and moderate rainfall situation (600-700 mm) of Tamil Nadu, NB hybrid perennial realizes 300% higher net monetary return than maize (f) + cowpea (f) + maize (f) – sorghum (f) + cowpea (f).

(iii) In coastal Western Ghats, NB hybrid perennial realized 180% higher net monetary return than upland rice (G) –cowpea (vegetable)–okra.

(iv) In semi-arid region of Karnataka under Tiptur situation, NB hybrid perennial provides 142% higher net monetary returns than maize + cowpea – maize + cowpea.

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New fisheries research vessel launched

CIFT, Cochin. Shri Sharad Pawar (Hon'ble Union Minister of Agriculture) and Dr Mangala Rai (Secretary, DARE and DG, ICAR), shared their vast experience on the occasion of 'Matsya Kumari II launch' at the Boat Building Yard of Kerala Shipping and Inland Navigation Corporation Ltd., Cochin.

The vessel has a length overall of 17.7 m, maximum breadth of 6.00 m, depth of 3.00 mm and maximum draft of 2.00 m. The Gross Registered tonnage of the vessel is 66. Installed engine power of the vessel is 325 hp @ 1800 rpm. It is capable of a free running speed of 9 knots. The vessel is provided with modern navigation and fish finding instrumentation. Endurance of the vessel is 9 days. This vessel is classed by Indian Register of Shipping with the class notation + SU "FISHING VESSEL". It is equipped for both bottom and mid-water stern trawling and long-time fishing operations. It is provided with a Blast Freezer with a capacity of 150 kg at – 55 °C and Refrigerated fish-hold with a capacity of 2 tonnes at – 20 °C, for onboard preservation and storage of catch. Rolling landing platform provides for hygienic onboard handling of the catch. The vessel provides air-conditioned accommodation for 2 scientists and 10 crew members. The cost of the vessel is Rs 23.2 million. The vessel will be put to use for onboard investigations on fishing gears, fish behaviour, conservation of resources through fishing gear interventions, processing and preservation of fish and marine environment.

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National Research Centre for Women in Agriculture

for Agricultural sustainability, food and economic security, and equity

Bhubaneshwar, Orissa. During the preparation of Eighth Five-Year Plan a great need was felt to plan agricultural research and extension programmes for empowerment of women with consideration of agricultural sustainability, food and economic security, and equity. The Working Group on Agricultural Research and Education, constituted by the Planning Commission for the formulation of the Eighth Five-Year Plan (1992-97), recommended the establishment of a National Research Centre for Women in Agriculture (NRCWA) during the Plan period. Accordingly, the Indian Council of Agricultural Research established the NRCWA in April 1996 at Bhubaneshwar with a sub-centre at Bhopal. The sub-centre works mainly on developing farm tools and equipment for increasing productivity, reducing drudgery and occupational health problems of farm-women and also for popularization of women friendly farm equipment and technologies.

MANDATE

- Carrying out basic, strategic and applied research to identify gender issue and test appropriateness of available farm-technologies/programmes/ policies with women perspective.
- To do training and consultancy for promoting gender mainstreaming in research and extension for empowerment of farm-women and capacity building of scientists, planners and policy makers to respond to the needs of the farm-women.

OBJECTIVES

- To conduct basic, strategic and applied research on gender issues in agriculture and allied fields.
- To create and maintain database on gender specific information about men's and women's role in food production and agriculture deveopment for effecting technologies, programmes and policies.
- To test the appropriateness of farm technologies and programmes and policies in terms of gender sensitivity in collaboration with relevant national and international organizations and suggest suitable modifications.
- To develop drudgery reducing options for decreasing the workload and increasing the efficiency of women.
- To develop gender sensitive modules and methodologies for transfer of technology.
- To develop gender sensitive training modules and materials and impart trainings, seminars and workshop for capacity building of scientists, researchers, planners and policy makers for gender mainstreaming and practical application of gender related technologies.
- To develop and publish gender sensitive materials, create network linkage through journals and information sharing.
- To develop system of managing and sharing gender related knowledge to support institutions and government in their efforts to mainstream gender in policy and programmes; and
- To develop effective evaluation and monitoring arrangements for gender mainstreaming.

INFRASTRUCTURE

The Centre has well equipped laboratories for conducting gender responsive research on agronomy, entomology, horticulture, post-harvest technology, seed technology, nutrition, ergonomics, animal sciences and fisheries. The Centre has an ARIS Cell with latest computers, internet and analytical softwares. The Centre has about 13-ha farm area to conduct technology validation trials and demonstrations including vermicompost, mushroom and spawn production, net-house, greenhouse, zero energy cool chamber and fish ponds.

The library has 1,000 books and 47 national and international journals of different disciplines related to

agriculture and gender. Other upcoming facilities include a training hostel, women technology park and gender data centre. The sub-centre, is equipped with an ergonomics laboratory at CIAE, Bhopal.

RESEARCH AND DEVELOPMENT

The NRCWA, during the past five years, has conducted research against the following targets:

Documenting gender issues, roles and relations in diverse contexts and situations in the country

Gender disaggregated data were collected on different socio-cultural aspects and work participation from Orissa, Andhra Pradesh, Madhya Pradesh, Kerala, and Haryana. The Centre has also processed data from secondary sources for bringing out inferences on participation of women in agriculture in different states of India. The implications from gender analysis brought out that utmost attention needs to be paid by research organizations for women who are middle-aged, educationally backward, malnourished and belonging to scheduled-caste, scheduled-tribe and backward communities. The women in Kerala and Orissa need improvement in productive time use through farm diversification activities. Wage differences, between men and women labourers, were common in all the selected farming systems and women of Kerala were most affected. In Orissa poor mechanization in farming was common which needed the urgent attention of scientists, extension functionaries and policy makers. The plight of women in the prevailing dinning styles, collection of fuel, fodder and water, diseases and consumption of betel and tobacco are some social issues connected with farming households.

Collaborated projects

A collaborative research project on 'Studies of women in agriculture in India with special reference to crop production technologies', was carried out with Central Research Institute for Dryland Agriculture, Hyderabad. Pilot study on approaches to engendering agricultural research was taken up in collaboration with Chaudhary Charan Singh Haryana Agricultural University, Hisar; and Kerala Agricultural University, Vellanikkara. The Centre also collaborated with Maharana Pratap University of Agriculture and Technology, Udaipur for studies on empowerment of women in agriculture. The studies led to the identification of new themes for research, policy formulation and training. Great potentiality exists in strengthening the economic life of women by drawing implications from research and training on drudgery reduction, skill upgradation, and diversification. The road map for research for *Vision 2025* is an important outcome.

Multicentric research directions

Multicentric research approach was implemented for agricultural research and extension in Kerala, Haryana and Orissa. Studies on 'Management of coastal eco-system affected by super cyclone in Orissa' was carried out in collaboration with Central Rice Research Institute, Cuttack. Women empowerment programme in agriculture was taken up in Udaipur, Hisar, New Delhi, Pantnagar, Parbhani and Dharwad centres. Experiences gained from above projects have helped the Institute to plan and implement gender responsive projects covering cross-cutting issues. Location specific factors affecting the life of women and varying impact of technology were identified.

Rural women's economic and social status, database information

Gender data base consists of socio-economic profile, time utilization, extent of involvement of women in agriculture including duration in agriculture, tools and equipment used by men and women in various farming operations, operation of improved farm-equipment, physical discomfort and involvement in household activities. A study was conducted among 10,059 farm-women in 279 villages of 12 districts of Madhya Pradesh and the

Gender related statistics *

- Male work participation rate (WPR) increased from 51.55 to 51.9% and Female WPR increased from 22.54 to 25.66% between 1991 and 2001.
- In absolute terms while the size of male work force has increased by over 10 million between 1991 and 2001, the addition to the size of female work force has nearly doubled.
- Mizoram has the highest (47.6%) female work participation rate.
- Among states/ union territories, Nagaland has the highest (55.68%) percentage of cultivators among male workers, while Himachal Pradesh has highest (86.2%) percentage of cultivators among female workers.
- Bihar has the highest (63.2%) female agricultural labourers among female workers.
- Himachal Pradesh has the highest (89%) cultivators and agricultural labourers taken together among female workers.

** Estimated from Census, 2001.*

findings documented. Data were also compiled from secondary sources like *Census* on the use of tools and implements, wage differential, intra-house access to and control over resources, home management activities, access to local development programmes and basic amenities, health hazards, diseases and vices prevalent among men and women in selected farming systems of Orissa, Kerala and Haryana.

Empowerment of women in aquaculture technologies helped the participating farm-women in increasing income generation from carp fry rearing, carp culture, ornamental fish production and integrated fish farming. The nursery rearing in small rural pond has amply demonstrated its utility in income generation in short duration. Farm-women (140) have successfully adopted the technology. The different models of integrated fish farming, viz. fish-cum-poultry, fish-cum-duckery and fish-cum-duckery-cum-horticulture generated new worthwhile experience for the farm-women and proved new avenues of self-employment. Ornamental fish farming units (9) were established in 8 villages involving 36 women and scheduled-caste youth.

Farm-women (630) belonging to 25 villages were trained in different aquaculture practices, viz. pond preparation and management, carp nursery management, ornamental fish breeding and rearing, training on aquarium setting, feed management, common carp breeding and diversification of carp culture by introducing *Puntius gonionotus*.

Reducing drudgery of farm-women and their social empowerment

Considering the drudgery faced by women in rice transplanting, a study on transplanting of rice by women - an assessment of drudgery components, was conducted with the aim of developing technologies and farm implements suitable to reduce the drudgery.

During the process of paddy transplanting women

- bent 11 times in an hour
- work, on an average, for 6.11 hr/day in standing water, and
- remain in bending position for 5.37 hr

The Centre identified and refined drudgery reducing implements, viz. CIAE hand ridger, CIAE fertilizer broadcaster, CIAE refined seed-drill, PAU refined seed-drill, Naveen dibbler, refined TNAU 4-row paddy drum seeder, CRRI 2-row rice transplanter, CRRI 4-row rice transplanter, CIAE IEP cono weeder, sickle, OUAT pedal operated paddy thresher, CRRI paddy winnower and CIAE hanging type cleaner to make them women friendly, increase utilization efficiency of inputs, ensure timeliness in field operations and reduce turn around time for next crop, increase productivity of worker-machine system, conserve energy, improve quality of work and also quality of produce and enhance the quality of work life of agricultural women workers. The (600) farm-women were empowered for the use of 22 improved agriculture implements for reducing the drudgery in different farm operations.

Developing methods for quantitative measurement of non-remunerative work

Studies on 'agricultural and household economy of tribals of Orissa' indicated the extent of burden of women for self and family. Quantification of gender related variables and gender analysis in selected farming systems were carried out. Studies on 'women in agriculture with special emphasis on crop production technologies' indicated the contribution of women in crop production and dairying. The ergonomic assessment of farming operations was carried out with a view to refining the farm implements.

Case studies were taken up in different locations to understand the diverse socio-economic conditions of women in rural areas. The involvement of farm-women in agriculture and allied activities in Madhya Pradesh pertaining to time spent by women on household work, season-wise, was carried out. Changes in the socio-economic level of farm-women through fisheries interventions were analysed.

Understanding strategies affecting rural women and their potentials for change

To develop gender sensitive extension models data were gathered. The data on intense involvement of tribal women in agriculture in one hand and their socio-economic vulnerability in the other hand suggested changes in the structural and functional aspects of the extension organizations associated with agriculture. The study recommended that the service providers in this sector must consider the needs and problems of the tribal farm-women on priority so far as agricultural development in the tribal areas is concerned. Care must be taken to understand exactly the extension needs of the farm-women, areas of capacity building and other related services associated with agricultural development. Emphasis should be given on the creditability, and socio-cultural compatibility of the change agents for making extension services very effective. The potentials and needs of farm-women are also being identified through different research programmes of the Centre.

Development of awareness generation and training tools

The Centre conducts awareness meetings, exhibitions, radio talks and television programmes to help the stakeholders realize the importance and approaches to women empowerment. Training tools including lectures, group discussions, technical bulletins, booklets, leaflets, folders, posters, and CDs were brought out.

Developing trainers' training modules

The Centre developed the training modules, 'Training module for gender sensitization in agriculture and engendering agricultural research and extension' which were published and circulated among the ICAR Institutes, State Agricultural Universities and other government agencies concerned with women development.

Potential of Self-help Groups as tool for sustainable livelihood of farm-women

Self-help Groups (SHGs) approach and skill development trainings have helped the farm-women to establish different enterprises. Farm-women (600) were organized into self-help groups(40) for providing them with skill trainings in different enterprises. After receiving trainings members of women self-help groups have set up enterprises in the areas of pisciculture, mushroom cultivation, poultry rearing, vegetable growing, floriculture, vermi-composting, preparation of different articles from coir and value addition of fruits and vegetables. The potential of SHGs particularly the SHGs of scheduled-caste women in integrated fish production was studied. The factors for success of women self-help groups were identified. The impact of the above interventions on drudgery reduction, adoption of technology, income generation and family nutrition were analyzed.

Dietary and nutritional status

Nutritional status of women in coastal agro-eco-system affected by super cyclone in Orissa was studied. Anthropometric measurements of farm-women revealed that 50% farm-women were having poor nutrition and 10% women had body mass index (BMI) less than 17 implying that they were having chronic energy deficiency. The economic condition of the family, nutritional knowledge of the farm-women and adversity of super cyclone were crucial factors of prevailing malnutrition. Nutritional status of children of age group (1 to 15 years) was studied through anthropometric measurements and clinical examination which indicated high degree of under nutrition and malnutrition.

To enhance food and nutritional security to the farm families and for combating malnutrition among infants a low-cost weaning mix was developed with sweet potato as base and locally available materials, viz. potato and green leafy vegetables. Awareness generated amongst farm-women on family nutrition and low cost nutritious recipes motivated them to understand the importance of balanced diet.

TRANSFER OF TECHNOLOGY

The trainers' training, organized by NRCWA for different stakeholders likes scientists/ extension functionaries of the ICAR institutes/ SAUs/state departments of agriculture, horticulture, animal husbandry and fisheries, is a regular capacity building programme. The Centre organizes seminars, workshops, short-courses, winter schools and model training courses for different category of clientele. Several farmers' training programmes, focused group discussions and participatory appraisal are held in the project locations for enhancing knowledge and skill upgradation on areas like eco-friendly pest management, entrepreneurship development, post-harvest handling of vegetables, value addition, pisciculture and nutrition education and more than 5,000 farm-women have been trained so far.

Publications and Media

Besides the regular publications, viz. Annual Report, the Centre has published Proceedings of the seminars, workshops, training modules, bulletins, folders and got prepared video films on various aspects of women in agriculture including gender sensitization in agriculture.

New initiatives

- Creating a repository of gender disaggregated data and documentation
- Technology testing and refinement
- System development and management for gender responsive agriculture, and extension approach
- Drudgery assessment and reduction
- Efficient resource management
- Gender mainstreaming

In the context of globalization and emerging trade issues and understanding of women participation in agriculture, standardization of production process, quality of the products, nutritional aspects and environmental and social labeling the Centre has to play a leading role in equipping the Indian farm-women for competition in the domestic and global markets. The NRCWA aims to further strengthen the research and training programmes with this perspective.

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New varieties of rice and pulses released

SVBPUAT, Meerut. The Uttar Pradesh Variety Release Committee has released an export quality basmati rice (*Oryza sativa*) and 4 varieties of chickpea (*Cicer arietinum*), viz. Sadhbhawana, Surya, WCG 10 and Vallabh Kallar Channa1. These were developed at Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut.

Vallabh Basmati 21 rice

Its characters are parentage Khalsa 7/Pusa 1121//Type 3, days to maturity (120 days), plant height (110 cm), elongation after cooking excellent, water absorption (350 ml), amylose content (23%), head rice recovery (60%), long slender grains, kernel length after cooking (13 mm), aromatic with good quality, moderately resistant to major insect and diseases, e.g. sheath root, neck blast and rice tungro virus, yield potential 5 tonnes/ha, and released for cultivation in 14 districts of four divisions, i.e. Saharanpur, Meerut, Moradabad and Bareilly of western Uttar Pradesh designated under Agriculture Export Zone (Basmati Rice).

Sadhbhawana chickpea

It is a mutant of variety C 235 and bold-seeded, semi-spreading habit, deep red pigmented stem, branch and leaf margin, flowers in 75 days and

matures in 120 days, yield (2.0 tonnes/ha), *dal* recovery (70%), moderately resistant to root rot, stem virus and wilt, early vigour results in higher yield and yield potential 1.2 tonnes/ha even when sown on 5 February.

Surya (WCG 2) chickpea

It is a mutant of variety G 130 and its branches arise near the ground surface. Its characters include early vigour, white flowers, flowering in 75 days and maturity in 135 days, protein content (22.9%), *dal* recovery (70%), moderately resistant to wilt, root rot, collar rot, dry root rot, stunt virus etc, suitable for rice fields, and yield potential 2.1 tonnes/ha.

WCG 10 chickpea

It is a mutant variety of G 130 and its characters are bold-seeded (100-seed weight, 25.4 g) deep green stem, hairy and composite leaves, pods hairy, green and large, flowering in 73 days and maturity in 147 days, moderately resistant to wilt, root rot, dry root rot and stunt virus, protein content 22.8%, quality pulse recovery (70%), suitable for the late sowing conditions, and productivity 2.1 tonnes/ha.

Vallabh Kallar Channa 1 (WCG 3)

It is a mutant of variety C 235. Its characters are semi-spreading habit and medium bold grains, deep red pigmentation on stem, branches and margin of leaves, flowering in 80 days and matures in 133 days, average yield (1.9 tonnes/ha), yield potential (2.9 tonnes/ha), *dal* recovery (70%), protein (23%), recommended for cultivation in saline soils, and tolerant to wilt and other local pests and diseases.

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New Guinea grass and heteropogon varieties released

IGFRI, Jhansi. A new variety of JHGG 04-1 Guinea grass was developed at IGFRI and was identified for release by Central Sub-Committee on Crop Standards in All India basis. The variety possessed superiority over checks for green fodder yield (587.3 q/ha), dry matter yield (147.2 q/ha) and crude protein yield (13.4 q/ha). The variety has adaptability to rainfed condition and resistance to drought under semi-arid condition.

Heteropogon variety IGHC 03-4 was developed at IGFRI and was found suitable for identification and release on All India basis. This variety possessed superiority over checks for green fodder yield (243.4 q/ha), dry matter yield (86.5 q/ha) and crude protein yield (6.3 q/ha). Since there is no variety in this grass and the variety is highly suitable for range land and community grazing land in drought prone areas, this variety is highly desirable for the areas under notification.

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New vegetable legumes released

HARP, Ranchi. The new varieties of garden pea, vegetable cowpea and dolichos bean were released after concerted breeding efforts, made at Horticulture and Agroforesty Research Programme (HARP).

Swarna Mukti garden pea

The Swarna Mukti (IC 523085) garden pea was released by the Central Variety Release Committee for commercial cultivation in Jharkhand, Bihar and Rajasthan. This mid-season variety was developed through hybridization between hoticulturally desirable and powdery mildew susceptible female line HC 17-11 and powdery mildew resistant male line FC-1 followed by pedigree selection in segregating generation. The variety is resistant to powdery mildew. The pods are long (8.91-9.42 cm), light green and 7-8 seeded and yield 48-52% light green, sweet and tasteful peas. On an average, the shelled fresh peas contain 5.12% total sugar, 9.5 mg/100 g ascorbic acid (vitamin C) and 1.4% soluble protein. The Swaran Mukti garden pea comes to flowering in 58-60 days and pods becomes ready for first harvest in 83-85 days after sowing. The green pod yield potential of the variety in 20-25 tonnes/ha.

Swarna Suphala vegetable cowpea

The Swarna Suphala (IC 202932) vegetable cowpea was released by the Central Variety Release Committee for commercial cultivation in Karnataka and Kerala. This variety was developed through direct use of elite germplasm line IC 202932, collected from NBPGR, New Delhi, and showed its resistant reaction to rust and cowpea mosaic viral diseases under field conditions. The pods of this pole type variety are medium long (32.65-36.21 cm), heavy (9.2-11.0 g), whitish and pulpy. The variety comes to flowering in 35-40 days and the pods become ready for first harvest in 50–55 days after sowing. The fresh pod yield potential of the variety is 21-25 tonnes/ha. The variety is suitable for cultivation both in the summer and rainy seasons.

Swarna Utkrisht dolichos bean

The Swarna Utkrisht (IC 397649) dolichos bean, released by the Central Variety Release Committee for commercial cultivation in Jharkhand, Bihar and Uttar Pradesh, was developed through pure line selection from the germplasm line collected from Thakurgaon under Burmu block in Ranchi, Jharkhand. This pole type variety comes to flowering in 98–100 days and the fresh pods becomes ready for first harvest in 118–120 days after sowing. The straight, flat and fleshy pods are borne in bunches in long inflorescences. The pods are 11.51–12.41 cm in length, 2.40–2.91 cm in width, 1.02–1.05 cm in girth and 18.06–19.51 g in weight. The green pod yield potential of the variety is 35–40 tonnes/ha.

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New varieties of spices released

SVBPUA&T, Meerut. The Uttar Pradesh Variety Release Committee released 3 varieties of spices, viz. Vallabh Priya turmeric, Vallabh Chiniki fenugreek, and Vallabh Nikki colocasia, developed by selection from gemplasm maintained at the Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut.

Vallabh Priya turmeric

It is recommended for plains as well as for hills. This is superior to other varieties in yield (27.95 tonnes/ha), having high essential oil (content 0.38%) and resistance to leaf blight. It becomes ready for harvest between 250 and 260 days.

Vallabh Chiniki fenugreek

It is recommended for plains as well as hills. Farmers accept its high yield (1.90 tonnes/ha).

Vallabh Nikki colocasia

It can be cultivated by following

A nutritionally rich and rust-resistant VL Gehun 892 notified

VPKAS, Almora. VL Gehun 892, a high-yielding, disease-resistant wheat was notified by Central Sub-Committee on Crop Standards, Notifications and Release of Varieties for Food Crops for late sown restricted conditions of Himachal Pradesh and Uttarakhand. It has been developed by modified bulk pedigree method from the cross WH 542/PBW 226. It has an average yield potential of 37.6 q/ha and has shown an overall yield superiority of 8.4, 7.7 and 3.6% over the checks Sonalika, HS 420 and HS 295 respectively. In agronomic

experiments, VL Gehun 892 performed better and gave 2.99% higher yield under late sown conditions whereas the reduction in the yields of two checks, HS 295 and HS 420 was 14.93 and 14.89% respectively. It possesses higher degree of resistance against yellow rust pathotype 46S119 and 78S84, under natural and artificial epiphytotic conditions as well as possessed moderate resistance to brown rust. VL 892 wheat is nutritionally rich with higher Zn (35.7 ppm), Cu (4.79 ppm) and Mn (49.8 ppm) than best check Sonalika (33.1 ppm), HS 295 (4.61 ppm) and Sonalika (48.7 ppm) respectively.

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standard cultural practices. The corms of each clone were sown between 15 February and 15 March at 60 cm × 25 cm distance of row-to-row and plant to-plant resepectively. It gives average yield of 28.18 tonnes/ha with NPK (100:80:80) kg/ha and seed rate 1.0-1.5 tonnes/ha.

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New potato hybrids for plains and hills

CPRI, Shimla. Two new potato hybrids, viz. Hybrid SM/93-237 and Hybrid J 93-86, were recommended for cultivation in the plains and hills of India in the Group Meeting of Potato Workers at the Rajendra Agricultural University, Pusa, Bihar.

Potato hybrid SM/93-237

The Hybrid SM/93-237, a late-blight-

resistant line has been developed for the hilly regions where late blight is a perpetual menace. The hybrid possesses very high degree of resistance to late blight which causes 30 to 80% damage to the crop. This hybrid has white oval-oblong tubers with pale yellow pulp. The hybrid showed its superiority to two important varieties, viz. Kufri Jyoti and Kufri Giriraj, now predominantly being grown in the hills. The resistance for late blight in Kufri Jyoti and Kufri Giriraj has eroded over the years and it is expected that together with recently released variety Kufri Himalini, hybrid SM/93-237 will replace the varieties Kufri Jyoti and Kufri Giriraj. The breeder seed of the hybrids is likely to be available in the next 2-3 years following its notification in the Central Sub-Committee on Crop Standards, Notification and Release of Varieties of Horticultural Crops.

Potato hybrid J 93-86

The Hybrid J 93-86, an early bulking potato line for fitting in rice-wheat system, is a high-yielding white tuber hybrid maturing in 75 to 80 days. It was recommended for release for cultivation in the plains, specifically for Haryana, Punjab, Rajasthan, Uttar Pradesh, Gujarat, Bihar, Madhya Pradesh and West Bengal. The

cultivation of this hybrid as a sandwich crop between rice and wheat in the Indo-Gangetic plains is expected to increase the area of potato needed for meeting the targeted production of 49 million tonnes by 2020 AD. The hybrid showed superiority to an early maturing variety Kufri Ashoka and is likely to give added benefit to Indian farming community by way of providing increased area and remuneration of potato crop. Hence, this hybrid is likely to be a good replacement of existing varieties Kufri Ashoka and Kufri Chandramukhi and may help in increasing potato area in the country.

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VL matar 45 – new field pea strain identified

VPKAS, Almora. VL Matar 45 (VL 24 × VL 46), a timely sown strain with an average yield of 14.21 q/ha over 9 loctions in All-India Co-ordinated Trials as compared to 9.62 q/ha and 8.72 q/ha of checks DMR 7 and Rachna, respectively, during the 3 years of testing (2004-05 to 2006-07), was identified for release in Uttarakhand, Jammu and Kashmir, Himachal Pradesh and North-Eastern States under rainfed conditions by the AICRP on MULLaRP (ICAR). This variety possess resistant to wilt disease. It has 21.4% protein. The plants are semi-erect, indeterminate in growth with light green foliage. The grain are round, yellow with (18.2 g) grain weight.

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New researches in grape

At the NRC for Grapes, Pune, efforts are being made to provide technologies for improvment of grape cultivation, harvesting, packaging etc.

Longer freshness to grapes

The main concern in export grape is pesticide residues, sulphur dioxide injury and berry decay. To overcome this problem, the NRC for Grapes has identified the post-harvest pathogens from grapes, stored at low and ambient temperature. A natural strain of *Trichoderma harzianum* was identified as a potential antagonist. The Centre has developed a package of practices involving pre-harvest sprays of this widely used beneficial antagonistic fungus and packing grapes with lower doses of sulphur dioxide (SO_2) generating sodium metabisulphite (commercially available as 'Grape-guard'). The use of this technology minimizes pesticide residues and sulphur dioxide injury while effectively protecting grapes against the post-harvest decay and retaining the freshness of grapes for longer duration when compared with those treated with fungicides.

Dogridge and 110 R rootstocks of grape useful for cultivation

The saline conditions in grape growing areas of Maharashtra are adversely affecting plant-health. To identify suitable methods for combating the adverse effects of soil and water salinity and drought on vine productivity and fruit quality resarch was conducted. The results showed that Dogridge and 110R rootstocks impart drought and salt-tolerance to the popular commercial scion varietes, viz. Thompson Seedless and Tas-A-Ganesh. Rootstocks reduced the sodium and chloride concentration in the vine tissues under saline condition. Dogridge rootstock were recommended for cultivation under the soil/water salinity and drought conditions and accepted very well by the grape growers all over the country. As a result of this work, all the new cultivation is by and large coming on rootstock irrespective of table or vine grapes. More than 1,000 ha area is under rootstock. The Centre is supplying more than 0.2 milion rootstock/year to the growers.

Improving water use efficiency in grape farming

A growth stage-wise drip irrigation schedule was developed which uses variable levels of water for irrigation at different growth phases. This technology resulted in considerable saving of water via 141% increment in water use efficiency as compared to uniform irrigation at 80% replenishment of pan evaporation. An irrigation schedule for sustaining productivity under drought condition was also developed.

New standards for quality planting material of grapes

Bud sticks, buds and rooted cuttings are the plant materials used in grape industry. New standards are being drafted based on deficiencies both in the existing standards and plant material. At the Centre, efforts were being made to screen the planting material at nursery stage itself for its genetic purity by DNA finger printing and freedom from disease and insect pests, especially mealybug, anthracnose, viruses like leafroll virus and disorder resembling Rugose Wood Complex. Mother clones of each type have been identified based on DNA fingerprinting, being maintained and multiplied as per the standard protocols. Technology for commercial multiplication of rootstocks and in its original place grafting have been standardized by the Centre.

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A new lima bean line for nutritional security of tribals

HARP, Ranchi. Lima bean, also called butter bean, is an important minor vegetable legume whose shelled-immature seeds are consumed as cooked vegetable. The immature fresh seeds are rich in protein (7.9%), carbohydrate (22.2%), vitamin C (79 mg/100 g), calcium (102 mg/100 g), phosphorus (165 mg/100g), magnesium (51 mg/100g) and potassium (460 mg/100g). Considering the nutiritional value of this vegetable, two germplasm lines, one from Karnataka and the other from Tamil Nadu, were collected and evaluated at Horticulture and Agroforestry Research Programme (HARP) Ranchi. This pole type and white flowered Karnataka Line HALB-1 comes to flowering at 55–60 days after sowing and pods become ready for first harvest at

around 90–100 days after sowing with a crop duration of around 180–200 days (July-January). This line yields 0.93–1.01 kg fresh pods/plant with a total of 12–15 pickings. On an average, the pods are 5.94 g in weight, 8.42 cm in length and 1.93 cm in width. The pods contain 3-4 flat and white seeds. The recovery of edible portion i.e., the fresh immature seeds is around 50%. The shelled fresh immature seeds were highly preferred by the consumers as a very palatable cooked vegetable. This line can be grown at a spacing of 60 cm (plant-to-plant) × 100 cm (row-to-row) with a support of vegetative growth on wire trellises or on bamboo structures or an dried branches according to the availability of materials. Due to its high nutritive value, better yield potential and easy-to-grow nature, this lima bean line, HALB-1, can be recommended for large-scale cultivation in Jharkhand for providing nutritional security especially to the tribal people of this state.

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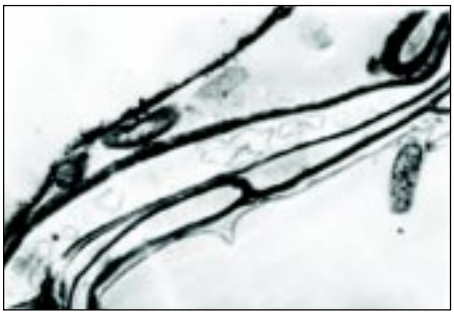
Micro-organism helps in high temperature stress tolerance in plants

CRIDA, Hyderabad. *Pseudomonas* strain (P6) was identified after screening several strains isolated from different agro-ecological regions of India under the ICAR network project on 'Application of Microorganisms in Agriculture and Applied Sectors' (AMAAS) and testing at elevated temperatures. Sorghum (SPV 462) seedlings were grown in plant cups (150 ml) containing sterile red soil. Seeds treated with cell suspension (10^8 cfu/ml) of *Pseudomonas* and control (uninoculated) were sown in plastic cups @ 5 seeds/cup. Five days after the germination, 5 of the cups were transferred to an illuminated growth chamber with a diurnal cycle of 50° C during day and 32° C during



night temperature. Another half cups were maintained at 28° C during day and 23° C during night temperature. The light intensity was maintained similar (6000 lux) in both treatments.

Uninoculated plants died completely by 7-8 days while seeds treated with the bacterium survived up to 18 days. In the seedlings kept at 28° C, there was a marginal increase in growth of inoculated seedlings compared to control which was attributed to the growth promotion effects of *Pseudomonas* . However, there was a significant difference in the shoot and root biomass of control and treated seedlings exposed to elevated temperatures. Treated seedlings produced almost comparable biomass as that of seedlings incubated under normal temperatures (28° C), while uninoculated seedlings produced 50% lower biomass.

To understand the mechanism of this protection, the leaves of the inoculated and control plants were extracted in phosphate buffer and the extract was subjected to total leaf count for determination of sugars and SDS-PAGE for detection of heat shock proteins. Inoculated plants accumulated proline (80µg/g FW), which was found only in traces in control. Likewise, high molecular weight proteins were detected with molecular weight of 30 to 100 KDa in treated plants subjected to stress, which were not found in the untreated plants; and in seedlings incubated under normal conditions. The membrane integrity was also considerably higher in inoculated plants

Technology for growing winter mushroom

NRC for Mushroom, Chambaghat. Winter mushroom (*Flammulina velutipes*) is grown on mixed sawdust wetted thoroughly with water for 16-18 hr supplemented with 5% wheat bran and mixed thoroughly. The wet substrate (2kg) is filled in each polyproplene bag. The bags are plugged with non-absorbent cotton by inserting a PVC ring in the mouth of the bag. The filled bags are sterilized in the autoclaves for 90 to 120 min at 22 Ibs/inch^2.

After the bags have been sterilized and cooled down to room temperature, they are inoculated with 4% wheat grain based spawn.

The spawned bags are placed/arranged in incubation rooms and temperature between 23° and 25°C is maintained for mycelial growth. Mycelia spread over the whole bag after 20-25 days. When mycelial spread has completed up to 90% of the bag space, the plug is pulled off, the neck of the bag is unfolded and the surface of the media is made smooth for fruiting. Bags are then placed in the dark at a temperature of 10°-14°C and the humidity is maintained at 80-85%. Primordia are formed in 10-14 days after reducing the temperature. When the fruit bodies are 14-18 cm long, these are harvested. They are packed in PP bags or can be sun-dried. After harvesting second flush appears in about 15 days.

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when subjected to elevated temperatures. Transmission Electron Micrography research showed that the organism enters the root system and colonizes the endorhizosphere. The strain was identified as *Pseudomonas putida* through 16 S r DNA analysis.

These preliminary results showed that *Pseudomonas putida* strain P6 can induce temperature tolerance in sorghum seedlings through induction of high molecular weight protein synthesis, causing accumulation of proline as an osmolyte and helping seedlings maintain higher membrane integrity under temperature stress. This is the first ever report on implicating microorganisms in alleviating high temperature stress effects in plants. It opens up avenues to develop inoculants for field use for *rabi* crops like wheat where high temperatures during seed filling affect grain yields.

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Kradi, semi-soft cheese, manufacturing technology

NDRI, Karnal. Kradi is prepared by coagulating milk, a traditional dairy product of Jammu and Kashmir, and is consumed either as a fried spiced item or a culinary dish. For its preparation, a technology has been standardlized at this Institute after thorough market survey of this product in different regions of Jammu and Kashmir, and after subjecting the market samples to descriptive sensory analysis, physico-chemical, microbiological, textural, mechanical, funtional and instrumental colour analysis.

The standardization trials with 2 RSM (4 factors CCRD) designs were carried out to develop manufacturing technology with culture NCDC 167 and NCDC 144 respectively. The optimized product developed was found better than market samples of any region in comparison to sensory analysis, physico-chemical, microbiological, textural, mechanical, funtional and instrumental colour analysis. The vacuum-packed product had shelf-life of 15 to 20 days at 25 °C while non-vacuum-packed product 12 to 15 days at 25 °C. The vacuum-packed product had shelf-life of 3.5 to 4 months at 5°C while non-vacuum packed product 2.5 to 3 months at 5°C. The vacuum-packed product had a shelf-life of more than 6 months at –20 °C while non-vacuum packed product had a shelf-life of 4 to 5 months at –20 °C. The technology will greatly help in popularizing this indigenous product of Jammu and Kashmir region.

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Amorphophallus spp. as a source of food and medicine

ICAR Research Complex for NEH Region, Lembucherra. A survey was conducted in 10 tribal villages of Bhishramganj Block, West Tripura, to collect the wild edible species of elephant foot yam. The survey was conducted in cultivated fields, wastelands, homestead gardens and periphery of forest lands.

Amorphophallus muelleri, a species of elephant foot yam, has been found growing vigorously in West Tripura and has tendency to produce bulbils on the leaf midrib. No

Zero-day-juvenility in planting material of fruit crops

CIAH, Bikaner. The realization of the importance of the technology by the farmers is the key factor for its wide spread and quick disemination among the benificiaries. Keeping in view the importance of vegetatively propogated planting material of fruit crop over the seedling plants which generally come into bearing after passing a long juvenile phase of 5-8 years or more in the many fruit tree species. A zero-day-juvenility concept has developed in vegetatively propogated plants of several crops such as *ber*, mulberry, pomegranate, lime, lemon, *karonda* and fig. The concept involves root formation, shoot growth and flowering or fruit setting simultounsly

in the saplings during multiplication stage of propogation either through cuting or buding techniques.

The concept of zero-day-juvenility has been developed through manipulation of propagation environment by altering the tempreature, humidity, photoperiod and light intensity under Hi-Tech glasshouse facility. Farmers face losses of different kinds such as variability, long juvenile phase, uneven fruiting in the seedling planting material.

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cormel on the corms was found. *A. paeoniifolius* was found to produce cormels. It produced bigger size corms when compared with *A. mulleri.* Both species were found in their natural habitat. Plants were harvested for sprout (May-June) and petiole (July-August) also. Matured corms and bulbils were harvested in November–December. With regard to quality, *A. muelleri* was found with high amount of calcium oxalate, which was responsible for the acridity as compared to *A. paeoniifolius.*

Corms of *A. mulleri* were used for indigenous medicine preparation. The corm were peeled and cut into small pieces. Under the hot sun, the pieces were dried and pounded into powder. Powder made into small-sized balls with the addition of water. This ball was encapsulated with pulp of seeded banana and again sun-dried. The dried balls were taken for controlling stomach disorders and piles.

Amorphophallus spp. dried cake was popular among tribes in Tripura. The tribals of the studied area were found to be consuming *Amorphophallus* corms and bulbils in their own way. Hence, these species could be cultivated as a source of food and medicine.

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Mineral mixture pellets for higher productivity of sheep

CSWRI, Avikanagar. Majority of sheep flocks in the Rajasthan are maintained under extensive rearing management on grazing resources with little supplementation of agricultural byproducts or tree leaves or natural grasses during scarcity period. These resources are deficient in essential minerals in semi-arid Rajasthan. The imbalances or deficiencies of these minerals affect reproduction, growth and health in sheep resulting in economic loss to farmers. To overcome the economic losses from deteriorating production and reproduction due to mineral deficiences, viz. Ca, P, Cu and Zn, identified by well-planned survey and analysis of feed and fodder resources commonly fed to sheep in 5 agro-climatic zones of semi-arid Rajasthan, area-specific mineral mixture has been developed for enchancing the overall productivity of sheep.

The work was initiated on development of ideal method or tool for supplementation of mineral mixture. After extensive work for development of module of supplementation, pellets of 5g incorporating the required minerals were prepared with the help of molasses as binder and tested in field flocks for its suitability at different locations. A series of demonstrations in field were laid for supplementation of mineral mixture to sheep maintained under extensive range

Medium density mango orcharding pays more

CISH, Lucknow. High density orcharding is one of the ways to increase the productivity of the orchards. The pre-requisites for the high density orcharding are to develop dwarfing rootstocks and controlling the tree size. However, dwarfing rootstock has not yet been standardized in mango. Therefore, the only possible way for getting sustainable production and increase the productivity of mango in the country is to control the tree size and accommodating more number of plants per unit area and managing them by adopting judicious training and pruning.

The study showed that estimated fruit yield was 11.0 tonnes/ha in the traditional system, whereas 41.48 tonnes/ha was recorded from medium density plantation, which was about four times more than traditional density. Medium density orcharding is found to be appropriate for farmers. In this density, after 20 years, deep pruning/ heading back of branches can be done to counteract the problem of overcrowding and induce new growth. Thus medium density planting can be managed successfully up to 40 years and effective production 4-5 times more can be obtained as compared to traditional density, if good management practices followed. Calculation of inputs and out puts showed that after 14 year of orchard establishment, there was net profit of Rs 4,33,577 per ha from medium density as compared to only Rs 77,490 per ha from traditional density.

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management. Overall picture emerging from the study showed that supplementation of mineral mixture pellets daily in sheep maintained on community grazing lands induced 60 to 65% of anoestrus sheep into oestrus within 15 to 20 days and increased milk yield by 10 to 15% in lactating sheep besides other benefits of better feed intake and general health of animals.

The research showed that critical mineral supplementation costing Re 0.25/day/animal brought about sizable improvement in production, reproduction and economic returns to the farmer. The technology has wide spread-field applicability.

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Dual-purpose spent mushroom substrate

NRC for Mushroom, Chambaghat. The spent mushroom substrate (SMS) compost, was found to be a good nutrient source for agriculture and its addition in nutrient poor soil leads to an improvement in soil texture, water-holding capacity and nutrient status.

The utilities of Spent Mushroom Substrate (SMS) include ability to adsorb the organic and inorganic pollutants and biodegrade them in non-toxic forms thus can help in reclamation of chemically contamined soils. The research proved its role as bioremediative agent for degradation of the systemic and non-systemic fungicides, and insecticides of organophosphate and synthetic pyrethroid nature commonly used in agriculture. The microbes thrive on SMS also have high biodegradation potential for agricultural pesticides. The results, based on laboratory and on-farm conditions, showed that on mixing SMS @ 20%, v/v with contaminated soil, it degrades more than 50% of the available fungicides, and insecticides within 30 days. The concentrations of different fungicides and insecticides reach the minimal level after 4-6 months of SMS mixing in soil. The *Aspergillus* spp., *Brachysporium* spp. and *Trichoderma* spp., and unidentified bacteria were recorded to play major role in pesticides degradation in the SMS mixed soil. It was also recorded to have great effect on heavy metals like lead (Pb) and cadmium (Cd) availability in soil and negligible concentrations of these two could be recorded after 3-4 months of SMS mixing.

The availability of these 2 heavy metals reduces to 1.8 to 5.50% just after mixing of SMS in contaminated soil. Thus the spent mushroom substrate has the ability of serving the dual purpose of nutrients source to the growing plants and remediating contaminated soils from harmful chemicals.

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Aril extractor developed for easy processing of pomegranate

CIPHET, Ludhiana. At present in the country, there is no mechanical method or machine, commercially available for safe separation of arils from the pomegranate. The Central Institute of Post-Harvest Engineering and Technology (CIPHET) has developed the pomegranate (*Punica granatum*) aril extractor, a hand tool for breaking of pomegranate and consequently easy separation of arils from its peel. The result of the hand tool was found to be encouraging as it makes the task of safe separation of arils from the peel and sheath effortless. CIPHET is willing to license the design of this hand tool for its commercial manufacture and the negotiations for this are going on with prominent hand tool manufacturers in Punjab. It works as important gadgets for saving the fruits and vegetables while harvesting and cutting from damage. Use of proper hand tool not only safely removes the fruit from tree or branch but also effectively recovers the edible portion from it. It helps in preventing the storage losses as single damaged fruit can also lead to damage to the whole lot.

The first step in processing of pomegranate is to extract or separate the arils (juice-enclosed seeds) from its peel and other non-edible parts of the fruit.

The traditional method for extraction of aril from pomegranate involves cutting the fruit in pieces and then removing the arils by hitting on the fruit by wooden mallet. This method also cuts some arils and shortens their shelf life. For juice the separated arils are pressed in the screw press or basket press. Juice extracted is clarified by chemical methods because peel contributes high amount of tannins and other undesirable biochemical.

The fresh arils may have a promising market, if packed in attractive package for direct consumption or further processing into various products. The tool

consists of fruit holders having knife arrangement in such a way that it only penetrates into the peel. Pomegranate fruit has to be held between the pair of holders, and the holders are turned by hand in opposite direction to each other. Due to rotating action of the holders, fruit is broken into two irregular halves as a simultaneous effect of compression with twist on the peel. During this action the whole fruit experiences a shearing effect; and inside arils get loosened which are easy to separate. About 20-25% arils get separated in the process of irregular breaking due to shearing action on the inner sheath and outer peel, and fingers can easily separate rest of them. The hand tool is designed considering the medium-size of fruit because the maximum distribution of medium-sized fruit is observed on pomegranate plant.

The hard peel of pomegranate fruits makes it difficult to release the arils, thus limiting its consumption as fresh fruit.

In India, pomegranate is grown in Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Tamil Nadu, and Uttar Pradesh, as a commercial horticulture. Large quantities of fruits are consumed in fresh form, however many products like pomegranate juice, RTS beverage, squash, jelly and anardana (dried arils/seeds) can be prepared on commercial scale.

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Breaking the seasonal barrier in rohu breeding

CIFA, Kausalyaganga. The Institute has been able to break the seasonal barriers in the breeding of the freshwater fishes, as it has successfully bred rohu for the first time in the country.

The breeding season of carps is between May and August depending on the onset of monsoon. Therefore, the stockable fish seed is available to the farmers earliest by October. This research work will enable the farmers to have the fingerlings (80-100 mm) by mid-April for stocking in their ponds and utilize at least 5 months earlier as the growing period. As the suitable environmental conditions for fast growth of fish prevail between April and October, farmers and entrepreneurs will be highly benefited from the new technological development.

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NORV Database for new plant varieties

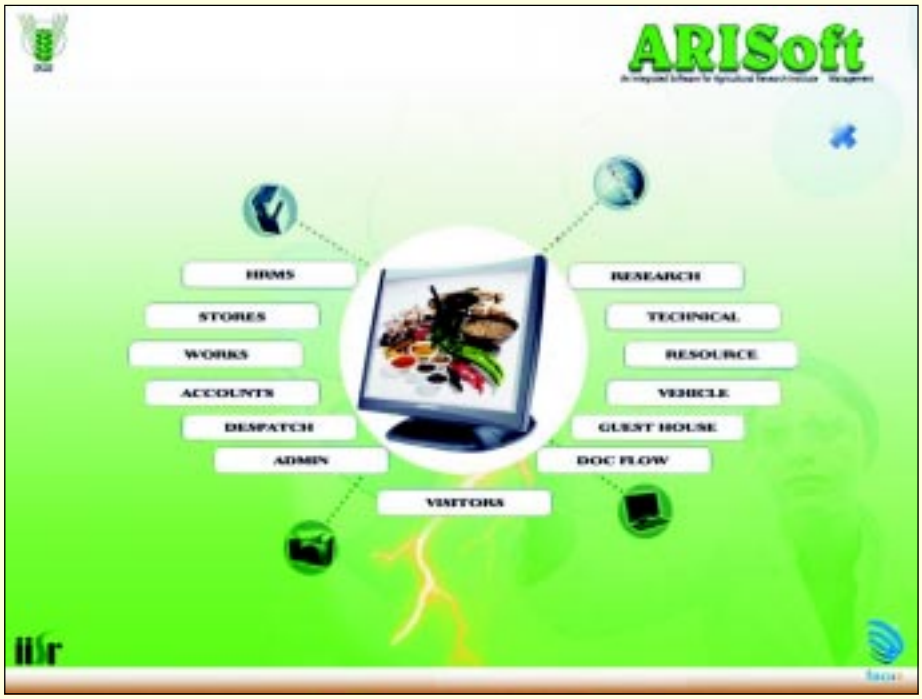
NBPGR, Delhi. Notified and Released Vareities database contains the detailed information like pedigree, important traits, yield parameters, availability of the seed in the National Gene Bank besides general information like year of release, notification number, name of developing institute(s) etc.

Presently, information of about 4,328 centrally released varieties, 1,431 state release varieties and 814 from institutes/universities etc. is available in this database. This database is only for authorized users.

To authenticate the information available in this database, one can query at http://www.nbpgr.ernet.in under NORV database on 21 fields, including Crop Name, Variety Name,

ARISoft: for multifarious functions

IISR, Calicut. Indian Institute of Spices Research has developed and implemented 'ARISoft', novel office automation software for the first time under ICAR. This software was developed by outsourcing to a private software firm based at Kochi which worked in close collaboration with a team of IISR staff members. 'ARISoft' is a fully integrated system that automates the multifarious functions and day-to-day operations in an agricultural research institute. The software has Linux based programmes exclusively developed using Open Access Software. It comprises the following modules, viz. Document Flow, HRMS, Stores, Works, Accounts, Despatch, Technical, Vehicle, Guest House, Visitors and Intranet messaging. The software has the following features:



- Automation of movement of all documents and indents, using common e-forms provided in the intranet through a predefined path in the network. Each department head is provided a module for accepting documents/indents and verifying them before forwarding to the next point. There are facilities to create, edit, or delete the node/route by the system administrator. The security of any transaction is ensured through secure passwords, digital signatures and other industry standards.
- The software includes provision to track the current status of any document/indent (inward/outward) from anywhere in the network using the search facility. Besides current status of budget of any project, leave, GPF, personal loans etc. are available at one's fingertips.
- The software facilitates generation of automated pay roll, automated personnel history sheets and easy preparation of bills. It is also bundled with tools for preparing quick reports like comparative statements, asset registers, ledgers, financial statements and routine reports to be sent to Council etc.
- Tools for generating stock numbers, bar coding of equipment, repair and maintenance of equipment are also integrated in the software.
- Perfect budget control can be achieved by using this software as the availability of funds under each head and expenditure details can be watched on a real time basis. Project based budgeting will be a reality once this software is implemented.

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Taxonomic Name, Parentage/ pedigree, Vernacular Name, Crop Group, Recommended area, Area of adoption, Distinguishing features, Yield Potential, etc.

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Decision tree in Visual Basic

CTRI, Rajahmundry. An attempt was made to develop an expert system to identify and retrieve the information on deficiency symptoms, predisposing factors and corrective measures of macro- and micro-nutrients for flue-cured tobacco by using one of the classification techniques in Data Mining, i.e. Decision tree at CTRI. Software of this expert system was developed in

Farmers motivated for rejuvenation trial

CISH, Lucknow. Farmers are highly motivated for rejuvenation trial of this Institute but its adoption is not increasing due to economic constraints. Forest laws also prevent adoption of the technology. The farmers adopting the technologies developed by the institute got about 103 kg yield/tree when compared with non-adopters with an average yield of 64 kg/tree. Polythene banding for the control of mealy bug is being adopted by 93% of adopted farmers successfully. Even after demonstrating technology of ripening of mango fruits with the help of ethrel, the farmers were not very enthusiastic towards its adoption. About 90% farmers use self-made harvester for harvesting the fruits while only 10% farmers used improved harvester developed by the Institute.

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Impact assessment of new agricultural technologies

NCAP, New Delhi. A 2-day national workshop on 'Impact Assessment of New Agricultural Technologies' was started at National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi on 30 January 2008. This was a part of the recently launched project 'Visioning, Policy Analysis and Gender (VPAGe)', supported under the National Agriculture Innovation Project (NAIP), by the Indian Council of Agricultural Research with NCAP as the lead Centre. The main objectives of this workshop were to (*i*) document the promising agricultural technologies, (*ii*) assess their adoption and initial impact, and (*iii*) plan the case studies for systematic impact evaluation.

Recommendations

- The participants unanimously agreed to undertake impact studies of recently developed technologies which have gone to farmers' fields, and for other improved technologies *ex-ante* framework was suggested.
- The scope of research impact assessment should be broadened and factors influencing spread of technology and realizing final impacts should also be studied.
- Selection of indicators for measuring research impact should be done carefully and these should amply capture sustainability, environmental, social and other issues, besides economic indicators. The indictors should demonstrate how research is contributing to inclusive agricultural growth
- The need-based technical backstopping should be provided for the studies on research impact assessment and appropriate mechanism should be used for dissemination of the results.
- All the PME Cells should complete all the requirements like constitution of the Cell, Memoranda of Understandings, submission of audit certificate of State Agricultural Universities, and bank account details for timely release of the funds.

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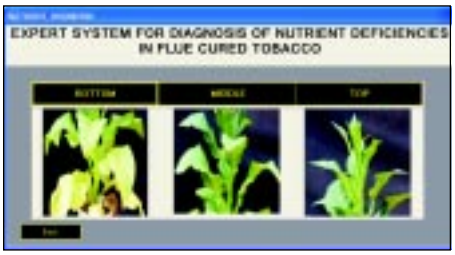
Visual Basic. Net and various forms were designed and the code was implemented, tested for execution of the same. Reports were designed using 'Crystal reports 9.0' by providing flexibility to the user to view the selected parameters and take the hard-copy. Interface was provided to the back-end to access the database from 'MS-Access' and store the new information into it.

To classify an unknown sample, the attribute values of the sample are tested against the Decision tree. A path is traced from the root node to a leaf node that holds the class prediction for that sample.

This Decision tree software enables the viewer to match its problem with the different symptoms



displayed on the system and identify the problem as well as remedial measures at many locations.With user friendly menus, it is easy to execute this system and retrieve the information as per requirements and take the hard-copy of the same.

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INDIA with a total area of 329 million/ha is the seventh largest country in the world. Traversing from east to west and north to south boundaries, one finds that nature has given us diverse climatic and edaphic conditions. We have snow covered mountains, extremely arid Thar desert, Chirapunjee in east with highest rainfall in the world , tropical and subtropical areas as well as 8,100 km long coastline.

About 57 % of the total land area in our country is under agriculture as against the world average of 11.5 %. Significant land use changes have occurred where, the net sown area increased from 118.75 million ha in 1950-51 to about 140.0 million ha by 1970-71, but for some minor variations (± 2 million ha) has remained static till date. Also, the net irrigated area in India increased from about 21 million ha in 1950-51 to 48 million ha by 1990-91, which in the last 18 years increased only by about 10 million ha. Similarly, the highest increase in the cropping intensity, from 111 to 130 % was achieved in the same period, i.e 1950-51 to 1990-91, and during the last 18 years the increase is only by 7 % and now it stands at 137%. The forest cover in our country is around 22.8 % as against the desirable 33 %. The degraded lands in our country are about 107 million ha.

Recently, the loss in productive potential of soils is attributed to an imbalanced use of fertilizers and chemicals, over-mining and poor replenishment of nutrients, loss of organic carbon, pollution, lack of biological activity, uncontrolled irrigation, water-logging, salinization etc. and in many regions the land use, which is not commensurate with the land capability.

In the context of regional agricultural development, Land Use Planning that is the sectoral allocation of land to optimize the postulated objectives under the existing environmental and societal opportunities and constraints, is considered basic. Hence, resource managers (development planners, decision and policy makers) are often concerned about minimizing the adverse effect of agricultural/land use (economic) activities on the quality of natural resources. For undertaking these complex tasks they need an exploratory Land Use Analysis and Decision Support System which use a rational, scientific analysis and evaluation of different land use options. This Decision Support System must evaluate land resources, socio-economic conditions of land users, current and future life style and policy options for land use planning.

An ideal land use system for such a programme should be targeted for increasing the agricultural production, conservation of soils, improving the productivity of water, ensuring livelihood, generating employment and above all for ensuring much-needed *Sujalam, Suphalam, Malayaja sheetlam*. Alongside using amelioration and amendments, we must identify and plan for large-scale plantation of stress-tolerant species for amelioration of acid soils, which are spread to nearly 25 million ha mainly in North-eastern region, West Bengal, Jharkhand, Orissa, Chhattisgarh, Kerala, Maharashtra and Himachal Pradesh and around 7 million

ha saline/alkaline lands. We should consider plantation of biofuels species like *jatropha* and *pongamia* in eroded/degraded lands. Similarly, plants of economic importance could be planted on hill slopes to check soil erosion and land slides, generate and enhance income and employment and improve soil health. For the arid regions developing a vegetation cover consisting of multipurpose tree species, viz. *Prosopis cineraria* (*khejri), Acacia* species, date palm, pomegranate, *Ziziphus* etc. and developing pastures using fodder grasses, would be ideal land use in most of the areas.

A system of multi-functional land use would thus provide an opportunity for promoting agriculture in and around the city as well. In an intensive agriculture the emphasis would be on reducing the agricultural sources of environmental pollution, judicious use of chemical inputs that are more compatible with the ecological capacities of the ecosystems, and on promoting the recycling of wastes as bio-energy and biochemical inputs.

It is important to develop a long-term perspective plan on type of land to be allocated for urbanization/ industrialization in various regions. Besides, proper urban planning need is to restrict conversion of prime agricultural lands to non-agricultural uses. The existing database on land use is highly inadequate. Therefore, strengthening of the database, using traditional cadastral surveys, modern remote sensing techniques, GIS and computerization of land records would be necessary. In fact, the available techniques for data collection should be complementary to each other. There is need for a strong monitoring mechanism to document the on-going land use changes either driven by market or policy or both.

Realizing the very basic need to draw a road map the Council has contemplated to have a national brainstorming meeting on land use in May 2008 at Nagpur. In a diverse country like ours, the land use systems for multifunctional agriculture shall be varied, best suited to local agro-ecological conditions but ultimately aiming for overall rural development.

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