17. Research for Tribal and Hill Regions

The ICAR through its institutes located in the North-west Himalayas, North-east Himalayas and Andaman and Nicobar Islands evolved technologies to meet need of tribal and hill farmers.

These technologies are intended to improve socio-economic status of target groups, and will help them acquire special skills through vocational training in traditional and non-traditional crops, agro-forestry, apiculture, horticulture, animal husbandry, poultry and fisheries.

NORTH-WEST HIMALAYAS

Varietal release: Eight hybrids/varieties, namely Maize Hybrid 39, Vivek Maize Hybrid 43, VL Matar 47, VL Masoor 514, VL Masoor 133, Vivek Matar 11, VL Tamatar 4 and VL Shimla Mirch 2, were released for various agro-climatic regions of the country.

Psychrotolerant *Pseudomonas poae* from Uttarakhand Himalayas: Two cold-tolerant phosphate-solubilizing bacteria (RT5RP2 and RT6RP) were isolated from rhizoplane of wild grass grown at 3,100 and 3,800 m above mean sea-level, respectively, at Rudraprayag, Uttarakhand. *Pseudomonas poae* RT5RP2 and RT6RP were able to solubilize 102.5 and 114.1 µg/ml of P after 7 days of incubation at 4ºC, respectively, with a progressive decline in *p*H. Besides phosphate solubilization, these were able to produce IAA and HCN at 15 and 4ºC.

Varieties released

Variety	Adaptation region/ Agro-ecology	Salient features
Maize Hybrid 39	For commercial cultivation in Zone I (UA, HP, J & K and NEH region)	Single-cross hybrid (extra-early maturing, 85-90 days) with yellow, semi-dent grain. It gave 21.93% higher yield than the best check Vivek Maize Hybrid 17
Vivek Maize Hybrid 43	Zone III (Eastern UP and Eastern states of the country) and Zone V (Central Western India)	Yellow, semi-flint grain, single-cross hybrid (extra-early maturing, 85-90 days) showed consistent yield superiority of 24.04 to 32.92% in Zone III and 31.85 to 52.28% in Zone V to Vivek Maize Hybrid 17
VL Matar 47	Timely sown rainfed areas of Uttarakhand hills	A high-yielding, medium-tall field pea variety (142-155 days duration) with yield superiority of 10.62, 13.36 and 24.85% to the checks VL Matar 42, Pant 4 and IFPD 1-10, respectively, in Uttarakhand hills under organic conditions. It has 21.04% protein content and is resistant to powdery mildew and moderately resistant to rust diseases
VL Masoor 514	Timely sown rainfed conditions of Uttarakhand hills	Bold-seeded lentil, showing yield superiority of 16.04 and 11.19% to the best checks VL Masoor 507 and PL 05 in Uttarakhand hills under organic conditions. It has 21.13% protein content, and is moderately resistant to wilt and rust diseases
VL Masoor 133	Timely sown rainfed conditions of Uttarakhand hills	Small-seeded lentil having 22.28% higher yield than VL Masoor 125 and 27.12% than PL 05 in Uttarakhand hills under organic conditions. It has 24.06% protein content, and shows resistance to wilt and moderate resistance to rust diseases
Vivek Matar 11	Uttarakhand hills and also identified for Zone I (Uttarakhand, HP and J & K)	Garden pea variety of medium maturity (132-135 days), has attractive long green curved pods with high number of sweet and bold seeds per pod. It is highly resistant to powdery mildew and is suitable for cultivation under both organic and inorganic conditions
VL Tamatar 4	Uttarakhand	Open-pollinated tomato variety, suitable for cultivation under organic and inorganic conditions and also for protected cultivation. It has longer storage life and is suitable for distant market. Moderately resistant to seedling rot, fruit rot and blight diseases
VL Shimla Mirch 2	Uttarakhand	Suitable for cultivation under both organic and inorganic conditions. Fruits are dark green, medium, bell-shaped which turn red on ripening

UA, Uttarakhand; HP, Himachal Pradesh; J&K, Jammu and Kashmir; UP, Uttar Pradesh

Cold-tolerant bacterial consortia: Under AMAAS project based on compatibility, eight cold-tolerant bacterial strains have been selected among the twelve elite strains for the development of eight bacterial consortia. The developed consortium could be utilized to alleviate the cold stress effect of wheat crop.

NORTH-EAST HIMALAYAS

Crop improvement

Rice: Two upland and lowland rice varieties were developed and released through the State Variety Release Committee of the Meghalaya. The upland varieties, namely Bhalum 3 and Bhalum 4, are late-maturing (140-148 days), high-yielding rice for mid to low altitudes. Grains are long and kernel is white. Yield advantage of these varieties over previously released Bhalum 1 is 20-22%.

The lowland varieties Megha SA1 and Megha SA 2 also late maturing (150-160 days), are long grain, medium aromatic rice genotypes suitable for mid-to-low altitude lowland ecosystem. Unlike traditional Basmati genotypes, these genotypes retain medium level basmati type aroma. Kernels of Megha SA2 are red and, on controlled polishing give characteristic look of pounded rice. Yield is about 66% higher than local Joha. About 2 tonnes breeder seed was supplied to different states in the NE region.

Tomato: A new high-yielding variety (Selection 9A resistant to bacterial wilt), suitable for long distance transport, has been successfully tested in the farmer's field in Manipur.

Success story

Rapeseed in rice fallow in Manipur

Low cropping intensity in monocropping of rice cultivation could be increased by sowing rapeseed just before or after the harvest of rice, depending upon the availability of remnant soil moisture which is key to success of this system. It also avoided tillage cost as well as labour for dibbling. During 2009-10, a total area of 40 ha was covered under zero tillage rapeseed cultivation by 100 farm families. Influenced by the achievement of rapeseed variety M 27 cultivation in rice fallows by fellow farmers, 165 farm families too followed the same in 65 ha area during 2010-11. The average operational area per farm family under zero tillage rapeseed variety M 27 ranged from 0.33 to 0.43 ha. Bee-keeping units were introduced into the rapeseed field @1 box/farm family. The yield of rapeseed ranged from 7.1 q/ha to 10.80 q/ha with an average yield of 8.85 q/ha. Most of harvests were sold out and the remaining seeds were milled for oil extraction through home scale oil expeller. Farmers could fetch a gross profit of ₹ 4,320-16,200 depending upon their cultivated areas. An additional income of ₹ 298-406 was also obtained from subsidiary honeybee rearing. Zero tillage cultivation of rapeseed gave higher yield than that in the conventional farmers' practice leading to improved income of farmers.

Success story

Vegetable farming—a boon for drought-affected farmers in Manipur

In Manipur, rice-growing farmers suffered heavy losses due to drought during *kharif* 2009. The initiative taken under Horticulture Mission for North Eastern and Himalayan States (Mini Mission I) by Manipur Centre created tremendous impact in the Ngairangbam Mayai Leikai village of Imphal West district in Manipur. The ICAR team took up demonstrations on farmers' field with early cauliflower variety Himlata followed by medium cauliflower variety White Flash and also the late variety Candid. After earning huge profit within 9 months period, the farmers were convinced that vegetable farming is more remunerative as compared to rice monocropping.

Turmeric: A high-yielding advance breeding line of turmeric (RCMT 7), very rich in curcumin, has been developed for cultivation in Manipur.

Agroforestry

Productivity of horti-agri system in the mid-hills of Meghalaya: Three horti-agri systems with fruit trees, namely peach, guava and Assam lemons (*Citrus limon*), are being evaluated for their productivity in the sloppy terrain. Maize variety RCM 1-1 was cultivated in the inter-row and inter-terrace spaces of the tree species. Performance of the three indicated that peach + maize was the most remunerative ₹ 57,300, followed by guava + maize (₹ 54,300) and Assam lemon + maize (₹ 48,700). Reduction in yield of maize was the maximum under peach compared with the other tree crops. Among the three fruit trees, peach gave the highest yield.

Animal health

Surveillance, monitoring and investigation of disease outbreaks

- *Clostridium perfringens* isolates recovered from different sources were typed on the basis of their toxin gene detection by PCR. A total of 10 isolates were recovered from diarrhoeic samples of cattle and goat. All the isolates were positive for alpha toxin gene *cpa* (324bp) and 2 isolates from goat were positive for beta2 toxin gene *cpb*2 (567bp). The isolates were identified as *C. perfringens* type A.
- Four shiga toxin genes (s*tx*1) positive *Escherichia coli* strains were isolated from the five intestinal samples collected during the post-mortem of quails and turkey birds. A total of 50 rectal swabs of quails and turkey birds were collected for regular screening of *E. coli*. Out of these samples, 9 *E. coli* were isolated but the isolates were negative for toxin genes.
- Bacteriological examination of suspected cases of mastitis in cow revealed three *Streptococcus*

agalactiae from these samples, and confirmed by biochemical and CAMP test.

- *Pasteurella multocida* was isolated from 5 lung tissue samples and 1 nasal swab sample of pigs. The isolates were confirmed based on cultural, morphological, biochemical tests and PCR-based detection of *P. multocida* specific *KMT1* gene and identified as serotype D by detection of *dcbF* gene.

Fisheries

Introduction of Amur carp in NEH region and its propagation in captivity: A genetically improved variety of common carp – Amur (Hungarian strain)– was introduced in fish farm, Barapani, Meghalaya, in early 2010. The breeder's seeds of initial average weight 14.5 g, reared under mid-altitude condition at the institute fish farm complex, attained maturity in about 14 months period. The first breeding trial with this new variety was conducted successfully in 2011 when the atmospheric temperature varied between 16°C and 18.3°C. The fertilized eggs took 78-83 hr to hatch. Water temperature ranged between 19°C and 22.8°C, while its *p*H varied between 6.5 and 6.8.

Pond-raised Amur carp and selection of brooders for quality seed production

ANDAMAN AND NICOBAR ISLANDS

Germplasm and crop improvement

Four types of wild relatives of brinjal, namely *Solanum torvum* (edible), *S. indicum, S. surratence* and *S. vairum*, were collected. Ten accessions of *Solanum torvum* were found resistant to all kinds of wilts. The fruits are berries which are consumed as spiced food by natives and aboriginals of Islands. Three accessions of *S. virum*; syn. *S. khasianum* from the vicinity of mangroves were also collected, containing high amount of secondary metabolites like solasodine with insecticidal and antibacterial properties. *Solanum indicum* is the second most abundant wild relative of brinjal in islands after *S. torvum*. It is non-edible and acts as carrier of fruit-and-shoot-borer and wilt pathogen. *Solanum surratence* species contains alkaloids

Collection of wild relatives of brinjal

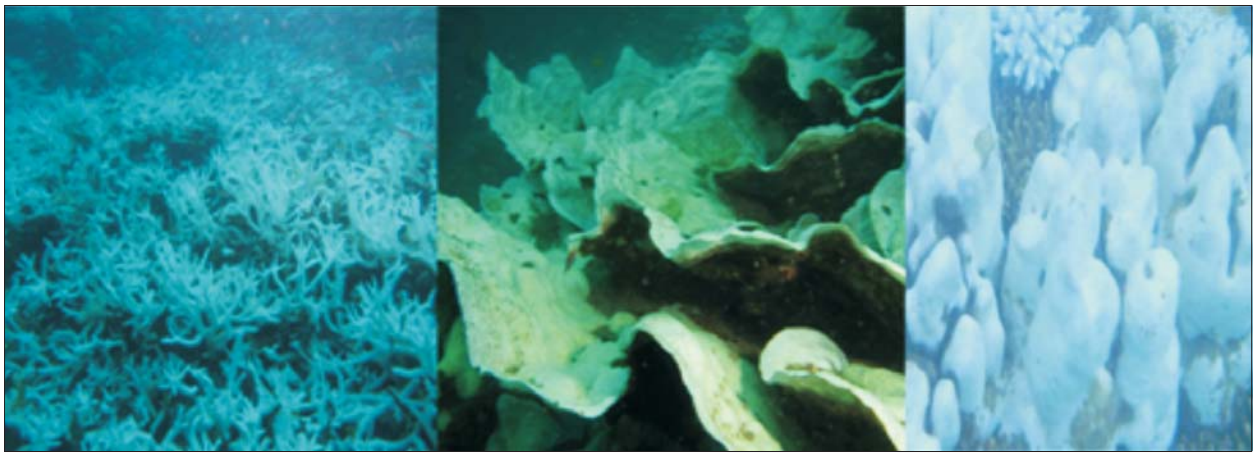
such as solasonine, solamargine, solasodine and beta-solamargine (fruit) and apigenin in flowers.

CARI-Pretty Green Bay ground orchid, CARI-Broad dhaniya and CARI-DA1 (Yamini) greater yam were developed by the Institute and released by State Seed Sub Committee, A&N Administration for the benefit of the stakeholders of this Islands. CARI-Pretty Green Bay was identified as potential terrestrial orchid and considered as export potential commodity owing to its good keeping quality and long attractive spike with many green florets. Its cultivation can be used as livelihood option in Islands. CARI-Broad Dhaniya, developed from local collections, has yield potential of about 8-10 tonnes/ha/year in normal soil conditions. CARI-DA1 (Yamini) greater yam shows potential to increase the production and productivity in the Islands as well as to reduce quantity of the import of tubers from the mainland.

Production technology

Irrigation management in *Capsicum* through drip irrigation under protected cultivation was standardized. Based on results, it can be concluded that drip irrigation at an irrigation water:cumulative pan evaporation (IW:CPE) of 0.75 can be recommended to farmers for realizing higher productivity during monsoon season wherever water availability may not be constraint as rain water can be harvested and recycled. However, during dry season drip irrigation at an IW:CPE of 0.50 may be recommended for higher water productivity wherever water availability for irrigation is constraint.

Impact of elevated sea surface temperature on corals: Andaman underwent mass bleaching, being maximum in the region during May 2011. The percentage of fully bleached corals was maximum at Havelock Island (Wall) (69.49), followed by South Button Island (67.28), Nicolson Island (56.45), Red Skin Island (43.39), North Bay (41.65) and Chidiyatapu (36.54). The branching corals (*Acropora* spp.) were the worst affected due to bleaching. In South Button, vast beds of *Acropora* spp. recorded almost 100% bleaching. The sea surface temperature (SST) during 2010 was higher than the average SST of each of the last three decades during January-October. During April-July, the increase was higher (0.75-1.25ºC) than the



Branching coral | Plate coral | Massive coral

Bleached corals observed during May 2011

rest of the months, which resulted in mass bleaching of corals, which hitherto have died. The surveys conducted in the subsequent months revealed that all the fully bleached branching corals were dead and were covered with filamentous algae. Development of filamentous algae indicates poor abundance of herbivorous fishes in these locations and consequently, the corals could no longer be serving as substrates for the fresh polyps.