16. Research for Tribal and Hill Regions

The Indian Council of Agricultural Research (ICAR) through its institutes located in North-west Himalayas, Islands and North-east Himalayas evolve technologies to meet the needs of tribal and hill farmers.

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

NORTH-WEST HIMALAYAS

The research work carried out at institute in North-west Himalayas led to:

Varietal release

Eleven varieties/hybrids of different crops were released for different agro-climatic regions of the country.

Seed production

A total of 21.9 tonnes breeder seed of 47 released varieties/inbred lines was produced. Organic seed (0.495 tonne) of wheat, pea, lentil, horsegram and French bean was also produced. In addition, around 1.2 tonnes nucleus seed of 33 released varieties was produced. Breeder seed (20.795 tonnes) was supplied to different seed-producing agencies to take up further multiplicaiton.

Nutritive biscuits from fingermillet

Fingermillet is an important foodgrain of Uttarakhand. Its grains are a rich source of mineral and dietary fibre. For increasing dietary fibre and micronutrient availability in biscuits, fingermillet flour was blended with gluten powder or wheat

New varieties released

Variety	Adaptation region/agro-ecology	Duration	Salient features
Vivek Maize Hybrid 21	Commercial cultivation in Zone I, II and IV	Extra-early (85–90 day)	Resistant to leaf blight

Vivek Maize Hybrid 21 is an extra-early maize, showing resistance to leaf blight (*left*). VL Arhar 1, suitable for cropping system in hills, possesses protein content 21.4% and 25.9% for whole seed and *dal* respectively (*right*)

New varieties released (contd...)

Variety	Adaptation region/agro-ecology	Duration	Salient features
Vivek Maize Hybrid 23	Cultivation in organic conditions of Uttarakhand	Extra-early (90–95 days)	Registered 9.9 and 27.3% yield superiority to Vivek Hybrid 9 and Vivek Sankul 11 respectively. Resistant to leaf blight
VL Masoor 126	Timely sown rainfed conditions of Jammu and Kashmir, Himachal Pradesh, Uttarakhand and north-eastern hills	126–150 days (mid-hills), 195–205 days (high hills)	Small black-seeded variety, moderately resistant to wilt and rust; and resistant to grey mold
VL Matar 42	Eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal and Asom	Medium maturity (145–155 days)	Field pea genotype having higher protein content (25.8%) and superior in cooking quality parameters, possesses higher resistance to pea rust and powdery mildew
VL Gahat 10	Timely sown organic conditions of Uttarakhand hills	Medium maturity (113–117 days)	Horsegram variety resistant to stem rot and anthracnose
VL Arhar 1	Uttarakhand hills	Early maturity (120–125 days)	Dark brown, matures 24 days earlier to the checks, hence suitable for the cropping system in hills. Exhibits high degree of resistance against wilt and alternaria leaf blight. Protein content 21.4% and 25.9% for whole seed and *dal* respectively
VL Toria 3	Organic conditions of Uttarakhand hills	85–145 days	Resistant to pod and leaf blight. Total oil is higher by 21.6%/ha over best check PT 303
VL Barley 85	Organic conditions of Uttarakhand hills	155–160 days	High-yielding, rust resistant

SUCCESS STORY

Crop diversification for food, economic and nutritional security

Diversification towards vegetables and fruits by reducing allocated area under food crops may cause scarcity of food in adverse climates. Therefore, emphasis has been laid on crop diversification to enhance farm income as well as sufficient foodgrain production in Bhagartola village. The area under vegetables and fruits has been increased by 6 and 5%, respectively, while other farming components like protected cultivation and fisheries also occupied a notable area. This increase in vegetable area coupled with better production management techniques, resulted in Rs 8.60 lakh and Rs 14.60 lakh/ha income during 2005-06 and 2006-07. At the same time, area vacated from food crop did not reduce total food production because of introduction of high-yielding, improved varieties that gave 26% higher yield than the local varieties.

Harvesting of vegetable pea—diversification with vegetable

Improved varieties for ensuring higher yield

SUCCESS STORY

Protected cultivation – a boon to farmers

The structural cost of greenhouse is Rs 85/m^2 of floor area. Mr Girish Pandey, a farmer of Dhaspad village, was not earning adequately by producing vegetables in open due to erratic climatic conditions. Proper motivation led him to construct a polyhouse in which he planted tomato cv. Manisha and harvested 0.76 tonne tomato and marketed in small town of Danya. He earned a net income of Rs 8,000 from his 80 m polyhouse.

flour or both the products. This technology is ready for transfer to local entrepreneur for commercial exploitation.

ISLANDS

The research findings of the institute located in Islands are:

Integrated farming system models

Component analysis of developed integrated farming system (IFS) models under different resource conditions in humid tropics of Bay Islands indicated that cropping contributed more to net returns (69 to 83 %) in hilly and sloping hilly uplands, whereas livestock components (cattle, poultry and fish) contributed more to net returns (49 to 66 %) in medium upland valley and lowlying valley areas. On an average, net returns from IFS was Rs 1.0-2.5 lakh/ha under various resource situations. Bacterial load in fish-cum-poultry-cum-duck system revealed that *Samonella* sp. in the pond gets increased during monsoon and further increased during the summer, revealing unsuitability of pond water for household purpose.

Crop diversification through broad bed and furrow-based farming system

In valley areas of Bay Islands, cropping system on the beds and furrows of broad bed and furrow (BBF) revealed that 1 ha of BBF gave a net return of Rs 198,000 from radish – chilli on the beds and rice–ratoon (azolla + fish : singhi + magur) – groundnut in the furrows. Benefit : cost ratio of lowlying paddy land improved to 2.77 from <1 and cropping intensity increased from 100 % to 300 – 500 % on the beds and 300 % in the furrows.

Early flowering mango clones

Out of 32 local early flowering mango clones, 15 clones exhibiting higher qualitative characters were collected and were found free from post-harvest diseases like anthracnose. Polyembryonic characters were found in all these clones even in the seedling progeny. Identification of gene expression using RAPD and ISSR markers were also done. Fifty saplings were planted in the main field for evaluation.

Natural resource management through integrated farming system

SUCCESS STORY

Women and youth empowerment through quail rearing in bay islands

For promoting quail farming under 'Production to Consumption System', quail farming technology was started with 6 SHGs from South and North Andamans and a group of youth with an aim to develop hub system (Hatchery, Feed Mill, Parent Stock) to facilitate satellite units. They were provided with inputs of 200 quail chicks per unit. The quail shed, feeders and waters were made with the locally available materials like bamboo, palm, arecanut tree leaves and trunks. The eggs from farmers' stock were hatched in hatchery of institute, for its recycling which has become a constant source of income for SHGs. The quails were active with no mortality throughout the rearing period and quail rearing is gaining popularity owing to larger consumer acceptance of its egg, meat and pickle. It has become a very remunerative livelihood option with net income ranging from Rs 5,000 to 6,570 per month with a benefit : cost ratio of 2.8.

Conservation and characterization of indigenous goat

Two breeds of goat (Local Andaman and Teressa) belonging to Andaman and Nicobar islands were phenotypically characterized for the first time. The maximum body weight (kg) was in Teressa goat (male 34.92±4.26; female 32.36±1.47) followed by Malabari (male 30.44±7.09; female 27.68±1.69) and Local Andaman goat (male 28.21±0.95; female 23.45±0.70). Sexual dimorphism in Local Andaman goat was also found statistically significant ($p<0.05$) for circumference of abdomen, neck, chest and hoof and for length of horn and tail.

Coral diversity

The total species recorded from Andaman and Nicobar (2004 – 2006) islands were 192 under 57 genera in 15 families. Many species of corals of Diglipur area, North Andaman was exposed after Tsunami due to elevation of land mass and died. Corals bleaching was noticed due to increase of surface temperature; bleached corals died and partially bleached corals recovered slowly. Predation by crown of thorns, siltation of coastal waters, effluent discharge, unfavourable environmental conditions, human interference like coral mining, are some of the factors responsible for damage and destruction of corals

Broodstock development and breeding of damselfishes

Of the recorded 105 species of reef fishes, about 15 varieties of damselfishes species are harbouring in Andaman and Nicobar islands. *Amphiprion percula* could be successfully bred and reared in captivity.

NORTH-EAST HIMALAYAS

The research work conducted at institute located in North-East Himalayas led to:

New rice genotypes

Two cold-tolerant short-duration (~ 90 days) rice genotypes, viz. MC 34-10-6-1-26 and MC 34-1-22-64, with yield potential of 6.0 tonnes/ha were developed for post-flood cultivation in NEH region. Another rice genotype, RCPL 1-129, was also developed for shifting cultivation (*jhum*) areas, yielding 1.8 tonnes/ha at farmers' fields without any fertilizer or crop management input.

A rice genotype MC 34-10-6-1-26 of short duration, having cold tolerance, developed for post-flood cultivation in NEH region

Germplasm collection

Fiftysix accessions of maize were collected from so far unexplored areas of Ukhrul district of Manipur. Eighty accessions were also collected from Nagaland.

New genotypes of guava and strawberry

Three guava genotypes, viz. Hybrid 1, Hybrid 7 and Selection 11, were found to be quality genotypes for the north-eastern region. Fruit weight of these genotypes varied from 110 to 160 g/fruit, TSS from 11.0 to 11.8%, acidity from 0.31 to 0.40% and

Ofra variety of strawberry recommended for Meghalaya

ascorbic acid content from 205 to 255 mg. These genotypes are ready for multilocation trial.

Strawberry varieties recommended for different locations are: Ofra for Meghalaya and Sweet Charlie for Sikkim and Manipur.

Micropropagation technique for banana and strawberry

Micropropagation in banana (Giant Cavendish) and strawberry has been standardized for mass production and distribution of quality planting material.

Mushroom cultivation

Cultivation of various mushroom species, viz. *Agaricus bisporus, Pleurotus* spp., *Volvarella* spp., *Lentinus edodus* and *Calocybe indica,* in polypropylene bags (size 500 mm × 160 mm) using sawdust incorporated with paddy straw has been standardized with other locally available raw materials under local conditions. A quantity of 5–6 kg dried (weight) mixture yielded 3 kg *Lentinus edodus* within 6-8 months.

Botanicals in control of ginger soft rot

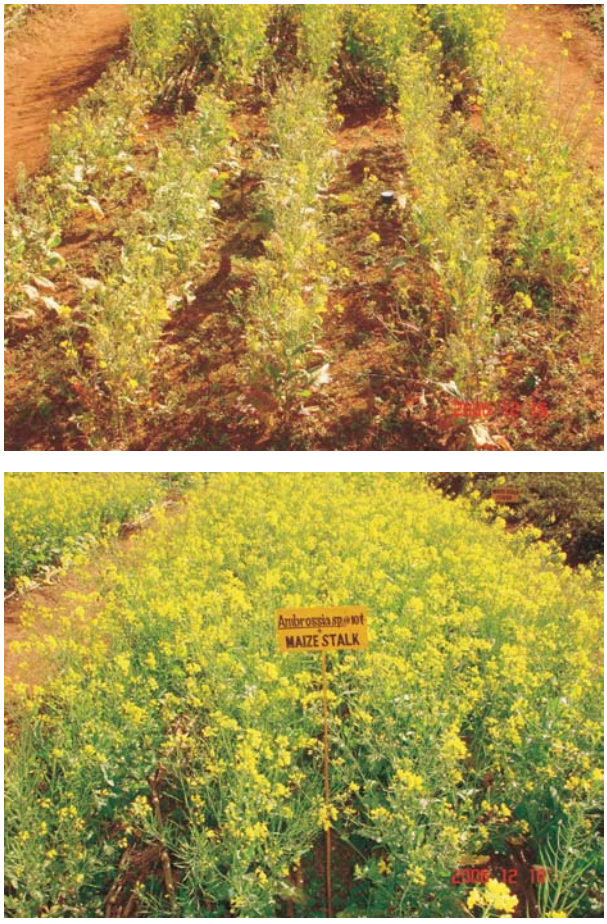
Soft rot of ginger accounts for 20-30% of yield loss, besides affecting the quality of seed. Mother rhizome treated with botanical extracts formulation (GF_1) at 4% concentration for 12 hr before planting completely managed the soft rot of ginger with nearly 30 % increase in ginger yield.

Entomopathogenic nematodes for bio-control of maize stem-borer

An entomopathogenic nematodes (EPNs), *Heterorhabditis* was isolated from soils and mass multiplied on laboratory hosts *Galleria mellonella* and *Corcyra cephalonica*. *Heterorhabditis* @ 5 million ijs/ha was found effective in controlling maize stem-borer 70% in the fields. The same was also used at farmers' fields for the control of the maize stem-borer.

New technique of *in-situ* soil-moisture conservation for terraced and slopy land

A simple and very low cost technique of *in-situ* moisture conservation was developed for *rabi* crop (mustard) using residue of preceding maize crop grown during rainy season and *Ambrossia,* a weed, as external input ensuring double cropping under both upland terrace and flat upland situations. Biomass of a local weed *Ambrossia* sp. was applied between rows of standing maize 20 days before its harvest in September to recharge *in-situ* soil-moisture profile by preventing run-off from the field at the later part of rainy season. Immediately after harvest of maize, its stalk was spread all over the field just above the applied *Ambrossia* and kept as such till sowing of mustard. This way *Ambrossia* sp. and maize stalk act as double mulch not only to provide optimum soil moisture for sowing of mustard in October but also to recharge the soil profile for support growth and development of mustard during the whole growing season. Mustard was sown in October between maize rows by removing maize stalk and put back between mustard rows on the same day immediately after sowing and kept till harvest of mustard. This ensured good germination of mustard, growth and 5-fold increase in mustard yield over control under terrace and flat upland situations.



Control plot without cover of mustard (*top*) and mustard plot under maize stalk cover + *Ambrossia* sp. (*bottom*)

Induced breeding of *pengba* (*Osteobrama belangeri*)

Osteobrama belangeri locally known as *pengba* is an endemic medium carp of Manipur. Induced breeding using Wova FH was standardized to propagate this endangered fish population.

Diagnostics

The polymerase chain reaction (PCR) protocols for rapid identification of *Brucella abortus, B. melitensis* and *B. suis* based on the repetitive genetic

SUCCESS STORY

On-farm trial with improved pig production technology

Developed germplasm (Hampshire × Khasi local) of pig along with improved package of practices was tested in 3 villages (Saiden, Upper Shillong and Mawkriah). The average daily body weight gain of indigenous and improved pigs was 62.56 and 114.95 g, respectively, under traditional production system, while it was 85.73 and 237.95 g under the improved production system. Thus, an advantage of 137 and 207% was achieved with the improved pig production system. Artificial insemination (AI) technology in pigs was refined to suit the local needs and tested at farmers' fields. The farrowing rate with AI was 65% and the litter size at birth was 8.5 under field conditions. Hormonal induction of estrus was also carried out in pigs under field conditions with follicle stimulating hormone and the success rate was 70%.

Improved pig at farmer's field

element IS*711* were standardized using the specific published primers. The overall seropositivity for brucellosis in cattle in north-east region was 17.5 %. A PCR-based method was standardized for the rapid detection of *Campylobacter jejuni*.

Region-specific mineral mixture

The extent of mineral deficiency in dairy cows in Mizoram was quantified and based on the data, a state-specific mineral mixture feed formula was evolved. Blood serum samples of cows and the soil and fodder samples were collected from different areas of Mizoram and analyzed for macro- and micro-minerals. Based on deficiency in blood a mineral mixture composition was developed for cattle of Mizoram.

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