

Research for Tribal and Hills Region

The Indian Council of Agricultural Research (ICAR) through its institutes located in North-West Himalayas, North-East Himalayas and Islands evolved 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, agroforestry, apiculture, horticulture, animal husbandry, poultry and fisheries.

NORTH-WEST HIMALAYAS

The research carried out at the institute located at Almora in North-West Himalayas led to:

Varietal release: Ten varieties/hybrids of different crops were released for various agro-

Varieties released			
Variety	Adaptation region/ Agro-ecology	Duration	Salient features
Vivek Maize Hybrid 33	Uttarakhand, Himachal Pradesh, Jammu and Kashmir (J&K) and NEH region	Extra-early (85-90 days in hills)	Outyielded HIM 129 and Vivek Maize Hybrid and showed tolerance to <i>Helminthosporium turcicum</i> leaf blight and <i>H. maydis</i> leaf blight
VL Madira 207	All over the country except Gujarat and Tamil Nadu	85-95 days	An improved plant type with high harvest index compared to VL Madira 29 and K 1. Exhibited resistant reaction to grain smut
VL Soya 59	Rainfed, timely sown areas of Uttarakhand hills, J & K and Himachal Pradesh	120-125 days	It has superior quality low linolenic acid and showed significant yield superiority to best check VLS 47. It showed moderate multiple resistance against pod blight (anthracnose) and target leaf spot, and moderate resistance to frog-eye leaf spot, in north-western hills
VL Soya 63	Rainfed, timely sown areas of Uttarakhand hills, J & K and Himachal Pradesh	115-120 days	It showed high multiple resistance against pod blight (anthracnose) and target leaf spot, and moderate resistance to frog-eye leaf spot in north-western hills
VLS 65 (Bhat)	Uttarakhand Hills	120-123 days	First Bhat (black soybean) strain developed by selection from the local germplasm of Uttarakhand hills, which can fulfil local Bhat requirement for Uttarakhand hills. It has moderate resistance against frog-eye leaf spot, pod blight

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Variety	Adaptation region/ Agro-ecology	Duration	Salient features
VL Gahat 15	Rainfed, timely sown areas of North and Central India	95-100 days	It has resistance to anthracnose and leaf spot diseases (< 10%) and shows better digestibility than checks AK 21, AK 42 and PHG 9
Vivek Matar 10	Zone I (J & K, Himachal Pradesh and Uttarakhand) and Zone IV (Punjab, Uttar Pradesh, Bihar and Jharkhand)	115-125 days	It has shown higher yield than national checks Arkel and VL 7 in Zone I and Zone IV. Also shows more pod length and seeds/pod and less pods/half kg than the check Arkel
VL Bean 2	Uttarakhand mid-hills	46-50 days	A high-yielding bush-type variety with soft string less and long flashy pods. It gave 21.29% higher yield than VL Bauni Bean 1
VL Moongphali 1	Rainfed, timely sown areas of Uttarakhand Hills	125-130 days	It shows yield superiority to best check Sulamit. Moderately resistant to tikka disease
VL Massor 129	Timely sown, rainfed conditions of Uttarakhand Hills	148-151 days	Significant yield superiority to checks VL 125, L 4076 and Pant L 05 under organic mode. It is moderately resistant to root rot and wilt diseases

climatic regions of the country.

Seed production: A total of 23.38 tonnes breeder seeds of 51 released varieties/inbred lines, 5.1 tonnes TL seeds of released varieties and 1.61 tonnes nucleus seeds of 42 released varieties was produced. Out of breeder seeds produced, 17.4 tonnes was supplied to different seed-producing

agencies to take up further multiplication.

Registration of genetic stocks: Seven maize inbred lines were registered with National Bureau of Plant Genetic Resources for high tryptophan and lysine content. Marker-assisted selection was used to develop these lines, viz. VQL 3, VQL 5, VQL 8, VQL 12, VQL 16, VQL 17 and VQL 30.

SUCCESS STORY

Fodder production from dual-purpose wheat during winter under irrigated condition

Livestock is an integral part of hill farming. Cow, sheep, goat, buffalo and yak are the important livestock of hilly regions. Due to the peculiar geographical conditions and agro-ecological nature of such regions, food as well as fodder/feed security at local level is of utmost importance, particularly during winter months. Though quite a good number of fodder trees are available in these areas, they get severely affected by low temperature and frost during winters. Cultivated fodder also has very limited scope, as only 10% of the area is irrigated where vegetables and cereal crops get preference over fodder crops. Therefore, possibility of cultivation of fodder crops is negligible in hilly areas. Under such conditions, crop varieties offering both fodder and grains will be a viable solution. Wheat



varieties serving the dual-purpose have been developed which provide green fodder at early stages of growth (particularly during winter months) and subsequently also provide grains. Farmers can cut the early vegetative crop for fodder and later, the crop grows to produce grains for food.

Sowing time: September last week to second fortnight of October
Seed rate: 100-120 kg/ha
Fertilizer: 120: 60: 40 (N: P₂O₅: K₂O) kg/ha.

Additional 20 kg/ha N after cut of green forage
Cutting time for green fodder: 70 to 90 days after sowing
Conditions: Irrigated conditions
Varieties: VL 616 and VL 829

Advantage: 4-6 tonnes/ha fodder production can be obtained during winter months without significant reduction in grain yield (4.0-4.5 tonnes/ha)

NORTH-EAST HIMALAYAS

Major achievements of the Institute located at Umiam in North-East Himalayas are:

Improved varieties of upland rice: Two new upland genotypes RCPL 1-115 and RCPL1-116 maturing in 145 days with good yield potential were developed. Both the genotypes are tolerant to acidic soils and brief moisture stress, and moderately tolerant to leaf and neck blast. Grains possess sufficient dormancy to withstand the effect of rain which frequently occurs at maturity stage.



RCPL 1-116, a variety of rice, is suitable for Mizoram, Nagaland and Manipur regions

Similarly, a cold-tolerant genotype developed by the Institute was recommended for release as NEH Megha Rice 3 by the State Seed Sub-Committee of Meghalaya. The genotype, maturing in 140-145 days with yield advantage, is for high altitude (up to 1,950 m) areas of Meghalaya. The genotype also meets the quality requirements of typical *japonica* rice.

Development of 4-row pre-germinated paddy seeder for hilly region: The paddy seeder has the advantage of line sowing in hilly areas with narrow terraces having widths up to 1 m. The main advantage of the paddy seeder is that it reduces the seed rate by almost half from about 125 kg/ha required for broadcasting in dry cultivation to about 60-80 kg/ha for line sowing using seeder. Two persons are needed in the field for carrying the machine and turning at the row end. It can cover up to 0.3-0.5 ha area in a day and the seed rate is about 60-80 kg/ha. By using this equipment, the cost of paddy cultivation can be reduced.

Large cardamon dryer: A batch-type tray dryer having about 600 kg capacity was designed and developed at this institute in collaboration with the other ICAR institute. The dryer was installed and evaluated at Sikkim Centre. It takes about 12 hr to bring down the moisture content of cardamon

fruit from 625% (db) to 50% (db). A heat exchanger based on diesel fuel was designed and developed as source of energy to drying equipment. The best temperature for drying the cardamon fruit was 55-60 °C. Overall quality of the dried product was very good, without any loss in colour, flavour and aroma.

Semen preservation and artificial insemination in pigs: Semen evaluation methodology was standardized for fresh and preserved spermatozoa particularly, assessment of sperm membrane integrity, membrane permeability, mitochondrial membrane potential, DNA damage by various fluorescent staining methods.

For dissemination of superior germplasm and to develop upgraded pigs in a participatory mode through artificial insemination (AI) technology in field condition, 26 villages were selected and survey work was done. A total of 180 farmers were trained on scientific breeding, heat detection methods, reproductive management and awareness on artificial insemination in pig. Good quality semen was extended in BTS (Beltsville Thawing Solution) media and preserved at 18°C up to 48 hr for insemination in field condition. A total of 189 pigs were inseminated (field demonstration) in different villages and obtained the pregnancy

SUCCESS STORY

Success of hatching turkey eggs by indigenous broody hen

Modern turkey varieties lack broodiness character and hence cannot hatch poults on their own. Indigenous broody hens available with farmers could successfully hatch out turkey eggs with a hatchability percentage of 85.78 ± 2.37 on total eggs set basis in 28 days. Although a local broody hen can hatch 12-15 chicks from their own eggs, they could ideally hatch 10 poults in one sitting since the eggs of turkey are bigger in size than chicken eggs. However, special care must be taken to prevent the mortality of young poults during first two to three weeks of age due to starve outs and infections.



Local broody hen with freshly hatched out turkey poults

rate of 79.4% and farrowing rate of 77.8% with average litter size of 8.2.

For the first time in India, the Institute has produced piglets out of AI with frozen semen. Boar semen was successfully frozen using conventional method of freezing that does not involve costly equipment like programmable cell freezer. The motility of frozen-thawed semen ranged from 30 to 40% and a sow was inseminated with frozen-thawed semen, conceived in single insemination, and farrowed with 10 piglets including one mummified foetus. All the live born piglets are doing well. The average birth weight of piglet was 1.05 kg that ranged from 0.85 kg to 1.25 kg. The standardized technology shall have immense applicability in breed improvement programme of pigs and to produce superior germplasm pigs at farmer's field, even in remote areas.

Pathogenic organisms from livestock and their products: PCR-based protocols for rapid detection and confirmation of infectious bacterial pathogens of livestock and poultry in the North-eastern region were standardized. The organisms included *Escherichia coli*, *Salmonella* sp., *Listeria* sp., mesophilic *Aeromonas*, *Brucella*, *Campylobacter* sp., *Pasteurella* sp., *Clostridium perfringens* and *Vibrio* sp. The protocol for Capsular PCR Typing of *Pasteurella multocida* was standardized. *P. multocida* serogroup D was confirmed by PCR-based detection of *P. multocida* specific *dcfF* gene (657 bp) as an etiology of pig pneumonia. Spontaneous cases of swine abortion were investigated and confirmed as *Brucella* based on detection of 16S rRNA gene of *Brucella* sp. by PCR. These isolates were further confirmed as *Brucella suis* by PCR method targeting species specific IS711 gene sequence. PCR-based detection of *Campylobacter jejuni* based on 16S rRNA, *flaA* and *hipO* gene was standardized. Several pathogenic genes were detected, namely *cdtA*, *cdtB*, *cdtC*, *iam*, *virB11*, *pldA*, *racR*. A Pulse Field Gel Electrophoresis study for characterization of *C. jejuni* isolated from poultry showed the variation in the type of *C. jejuni* occurring in poultry. Western blotting protocol for identification of immunogenic proteins in *C. jejuni* was standardized. Immunogenic proteins could be identified with molecular weight between 50 and 75 kDa.

ISLANDS

Significant findings of the Institute located at Port Blair in Andaman and Nicobar Islands are:

Water resource development: A three-tier strategy was developed for water resource development, namely development of plastic film-lined tanks on the top of the hills, recharge structure-cum-well system in the mid-hills and



Lining of tank reinforced plastering on silpauline (top); finished lined tank (bottom left); check dam in Kaju Nallah watershed (bottom right)

development of open dug-wells in the valley areas. Such systems are very useful for utilization of water during dry periods. Lining of hill top tanks are being planned to be taken up both in South Andaman as well as Nicobar.

Rice: The Institute has released five varieties of rice, namely CARI Dhan 1, CARI Dhan 2, CARI Dhan 3, CARI Dhan 4 and CARI Dhan 5, through State Seed Sub Committee for A & N Islands. These varieties mature in 120,121,120,123 and 150 days respectively. Out of these, two varieties (CARI 4 and CARI 5) were specially developed for coastal salinity conditions and other three for normal soils.

Role of associated bacteria in bioactivity of marine sponges from Andaman

Two sponge specimens were collected by skin diving from North Bay which were subsequently identified as *Stylissa* sp. and *Iricinia* sp. Of the 62 strains isolated from sponges, eight isolates from *Stylissa* sp. showed significantly higher weighted inhibitory efficiency than the sponge itself, while none from *Iricinia* sp. had such property. Of the bacterial isolates associated with *Stylissa* sp., 21 (70%) produced antibiotics. Genomic DNA was isolated from the two isolates associated with *Iricinia* sp. which showed significant antibacterial activity than the sponge extract.



Iricinia sp



Stylissa sp

SUCCESS STORY

Composite fish farming with grass carp

Shri Periaswamy is a farmer of Indranagar village of Manglutan Panchayat of South Andaman having 2 hectares of land. In 2006, he had constructed a pond (0.08 ha) with the financial support of Department of Agriculture, A and N Administration for utilizing the water for agricultural and allied activities. He purchased some fish fingerlings from Department of Fisheries and reared them. After a year he could not harvest the fish due to poor body weight because of low fertility and high stocking of fishes. He had attended the training programme which helped him a lot in gaining confidence.

The KVK and Fishery Science Division team visited his pond and found that the fertility of the pond was very poor, as the pond was newly constructed and no organic manure was used by the farmer due to lack of knowledge. As per the advice of the experts, he applied lime and cowdung as per the recommended dose. After testing the water quality, he was issued 150 fingerlings including 20 grass carps from Division of Fisheries of the institute. He provided feed with GNC and rice bran 1:1 ratio @ 3% of the body weight of the fish. Sufficient amount of local grass and banana leaf was also provided daily for the grass carp. The KVK-CARI team took the harvested fishes and sold @ Rs 100/kg, by which he earned Rs 12,900 from the sale of 129 kg fish and received Rs 5,400 from 18 grass carp fishes. After seeing his interest and dedication, the Division of Fisheries of the Institute selected him as a best fish farmer and awarded him during Kisan Mela organized in February 2009.



Harvested fresh fish

Sweet potato: Two varieties, namely CARI Swarna (light pink skinned, orange fleshed) and CARI Aparna (light purple skinned, white fleshed) both spreading type, have been released in the state. The varieties have high adaptability in hot humid tropical climatic conditions of Islands.

Coconut: Four varieties, namely CARI

Annapurna, CARI Surya, CARI Omkar and CARI Chandan, have been proposed for release in the state.

Microbial diversity: A total of 483 bacteria, 117 *Trichoderma* spp, 32 *Ralstonia solanacearum* and 35 fungal pathogens were isolated and maintained in slants. Novel strains of bacteria were identified as *B. subtilis*, *B. pumilus*, *B. amyloliquefaciens* and *Enterobacter cloacae*. The 16S rDNA-RFLP analysis with *Msp* I and *Hae* III revealed greater diversity among the isolates. Of the total species isolated, *T. asperellum*, *T. erinaceum*, *T. ovalisporum* and *T. brevicompactum* were recorded for the first time from Andaman and Nicobar Islands. The survey and identification showed that the climate condition of the Islands is congenial for multiplication and spread of *Colletotrichum* spp. and found that *Colletotrichum* spp present in almost all crops as pathogenic as well non-pathogenic form.

Broodstock development and breeding of damsel fishes: Brooders of damsel fish species, namely *Amphiprion akallopsos*, *Amphiprion ephippium* and *Premnas biaculeatus*, were collected from reefs and maintained in hatchery for the development of suitable breeding pair. The maroon damselfish, *Premnas biaculeatus*, could be bred repeatedly five times in captivity.

Rotifers in Andaman waters: The distribution and abundance of rotifers, a potential feed for larvae of damsel fishes in Andaman, was explored by a survey from brackishwater areas in South Andaman. Species like *Brachionus plicatilis*, *B. rotundiformis*, *B. urceolaris*, *B. murrayi*, *B. calyciflorus*, *B. falcatus* and *Kellicotia* sp. were identified. The presence of *Brachionus plicatilis* species complex is a notable character of the rotifers present in Andaman waters.

Performance of crossbred ducks: Backyard duck rearing is an integral part of various farming systems in the islands, and to improve the egg production in local ducks, several crosses were attempted. Considering the growth performance, the Pekin × Chara-Chembelli crossbred showed better performance than all other crosses, and can be used as a meat-purpose duck under backyard condition.

Database on animal genetic resources in islands: The website is targeted to a wide range of users which includes department of Animal Husbandry and Veterinary Services, policy makers, scientists and public. The main page of the database comprises links to webpages of CARI, A & N Islands, Veterinary resources etc. □