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# CENTRAL ARID ZONE RESEARCH INSTITUTE

## HIGHLIGHTS OF RESEARCH

### 2001

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#### **NATURAL RESOURCES APPRAISAL AND DEGRADATION ASSESSMENT**

Comprehensive geomorphological, hydrological, soil and vegetation surveys were undertaken in select tehsils of Hanumangarh and Ganganagar districts in Rajasthan, and in Jamnagar district in Gujarat, to assess the natural resource status and to study the land use patterns in these areas. Stratigraphical and palaeo-environmental investigations were carried out in the fringe areas of Gujarat. There was no evidence to support the view that the Thar extended to Tajpura-Dabka area in Mahi basin. Wasteland mapping at 1:50,000 scale was done through visual interpretation of IRS-1C LISS-III geocoded data and field surveys, for the districts of Hanumangarh and Bikaner.

Maximum nutrients were found occurring in the soils under woodland, followed by irrigated lands, while the minimum nutrient status was recorded in the rainfed areas. Long-term climate variation studies indicated an increasing trend in rainfall @ 0.5 mm year<sup>-1</sup> in Jodhpur.

#### **CONSERVATION OF PLANT BIODIVERSITY**

The collection of medicinal plants at the Institute has grown to a hundred species mark, with the addition of 10 new species this year. A simple technique of multiplication of *Echinocactus* has been developed. New accessions have been added to grass germplasm, through collections made from Gujarat. About 1345 kg breeder seed was supplied to 48 agencies.

#### **CROP IMPROVEMENT**

Of the 51 clusterbean lines and selections tested, 99-18, 99-15, 99-14, 99-1 and 99-48 proved promising. High level of mung bean grain yield was obtained when crop was sown in 1st week of July. Out of 25 mutants of cowpea tested, CHM 98-11, CHM 99-91, CHM 98-14, CHM 98-15, CHM 98-13 and CHM 98-10 were found promising.

In advanced moth bean trial, strain CZM-99 with erect compact growth habit and less contraction of YMV matured in 60 days, with 249.3 kg ha<sup>-1</sup> seed yield. In the initial hybrid and population trial of pearl millet, MPT 606 recorded the highest grain yield of 2061 kg ha<sup>-1</sup>. Under CAZRI-ICRISAT collaborative programme for transfer of downy mildew resistance, 26 BC2 F1s were made by crossing individual plants of recurrent parents.

Among the perennial plants, half sib plant progenies of *Tecomella undulata* established in 1984 showed more than 80% survival, with TU-3 attaining the maximum height (4.29 m). In *Acacia albida*, established in 1988, tree height ranged from 4.67 to 5.94 m.

In trials with pasture grasses and legumes, the dry matter yield of *Cenchrus ciliaris* genotypes ranged from 1762 to 4713 kg ha<sup>-1</sup>. The fodder yield of lablab bean

genotypes ranged from 3990 to 9340 kg ha<sup>-1</sup>. There was no significant variation among genotypes of *Clitoria ternatea* for fodder yield.

Biochemical changes following infection by YMV in resistant and susceptible moth bean genotypes were studied. Total soluble sugar and starch decreased more in the susceptible genotype. Increase in proline after YMV infection was more in resistant genotype. In clusterbean and cowpea, the total phenols in leaves and roots increased after *Macrophomina phaseolina* infection.

### **INTEGRATED FARMING SYSTEMS**

Micrometeorological investigations indicated highest solar interception (6%) with pearl millet-*Prosopis cineraria* intercropping. Pearl millet productivity was high in intercropping with jujube, following by *P. cineraria* and *A. nilotica*.

The water use efficiency in mung bean crop was estimated to be 2.25, 3.82 and 3.24 kg ha<sup>-1</sup> mm<sup>-1</sup> under rainfed, 50% ET and 100% ET irrigation conditions, respectively, indicating a reduction in water use efficiency beyond 50% rate of irrigation.

### **SILVICULTURE AND AGROFORESTRY**

Among the exotic *Prosopis* species, the Peruvian species attained maximum height, while *P. alba* exhibited maximum collar diameter and biomass accumulation potential.

*Acacia bivenosa*, *A. senegal*, *Tecomella undulata* and *Hardwickia binata* produced 850.7, 890.8, 201.5 and 550.8 g seed plant<sup>-1</sup>, respectively, by the end of 8th year. In agri-horticulture system, cultivation of moth bean cv. Maru Moth between Indian gooseberry gave a grain yield of 260 kg ha<sup>-1</sup>. In the silvi-pastoral system with *Cenchrus setigerus* and *Eremopogon tomentosus* grasses and *Mimosa hamata* shrubs, a forage yield of 258 kg ha<sup>-1</sup> was obtained under severe drought conditions.

The dry top-feed yield of 12-year old *Colophospermum mopane*, *Dichrostachys nutans*, *Azadirachta indica*, *Hardwickia binata*, *Albizia lebbeck* and *Ziziphus rotundifolia* raised on degraded land was 2, 2, 8, 2.5, 3.5 and 1.75 kg tree<sup>-1</sup> respectively. The improved pasture of *Cenchrus diliaris* could sustain 308 animal days ha<sup>-1</sup> compared to 150 in protected natural pasture. *Cenchrus setigerus* in the interspace of *Commiphora wightii* gave a dry forage yield of 2002 kg ha<sup>-1</sup>.

Among the five tree species planted for reclamation of degraded land, performance of *A. tortilis* and *A. nilotica* was better in terms of height and canopy.

### **POMOLOGY**

High temperature and low humidity during fruit development period caused poor fruit set in Indian gooseberry. Twelve-year-old plants of cv. Kanchan produced 106 kg fruit per plant, while Krishna produced but only a few fruits. Cross combinations of pomegranate continued to perform well in terms of fruit size, colour, softness of aril and juice percentage.

## **RODENT CONTROL**

A new anticoagulant difethiolone tried against *Meriones hurrianae* and *Tatera indica* at 0.5 mg active ingredient kg<sup>-1</sup> body weight gave 100% mortality in single exposure.

## **ARTIFICIAL RECHARGE OF GROUND WATER**

A percolation tank of 28,000 m<sup>2</sup> surface area and 1,12,000 m<sup>3</sup> rain runoff/storage was constructed on a natural stream in Sojat tehsil of Pali district. The abnormally high initial rate of infiltration (67-98 mm day<sup>-1</sup>) was reduced to 20 mm day<sup>-1</sup>. The static water level in wells near the zone of influence rose by 2.5 m in one season.

## **SURFACE AND SUBSURFACE HYDROLOGY**

Studies were conducted on predictability of Green and Ampt's infiltration equation. The prediction of runoff was quite satisfactory. Ground water recharge studies were also conducted

## **MANAGEMENT OF SALINE SODIC AND CONTAMINATED WATER**

Increasing the dilution of industrial effluent and contaminated well water increased the seedling length in Indian gooseberry, wheat, cowpea and sesame. 25% IE gave 90% germination in Indian gooseberry, while 100% and 75% CWW gave the lowest seed germination (30%).

## **SOIL AND WATER CONSERVATION AT JHANWAR WATERSHED**

The earthen embankments constructed at farmer's field at 5% slope, and covered with dead vegetation, helped in arresting 12.6 t silt at upper stream.

## **OPTIMUM LIVESTOCK PRODUCTION**

Animals born as twins attained early maturity and first kidded at the age of 568.4 ± 51.15 days. Maximum body weight gain in 6 months was observed in F2 generations of Marwari and Jamunapari kids. No physiological or morphological adverse effects were perceptible in animals provided with 1200 ppm sodium nitrate and 2 ppm sodium fluoride daily. The quality of final product of multi nutrient feed blocks comprising of wheat bran and crushed cotton seed was good, due to high fibre, protein and lipid contents.

## **CHEMICAL ANALYSIS OF *TECOMELLA UNDULATA* AND *CASSIA ANGUSTIFOLIA***

Three crude compounds coded as Tu-6, Tu-7 and Tu-8 were isolated by chromatographic separation from the leaves of Rohida. The average content of sennoside -B in leaves of 3 years old senna plants was estimated to be 2.13%.

## **POST-HARVEST TECHNOLOGY OF ARID FRUITS**

Recipes for papaya jam and Indian gooseberry squash have been standardised. Indian gooseberry products murabba, jam and squash did not keep colour beyond 4 months under room temperature, but there was no change in taste or flavour and no fungal attack occurred.

## **INTEGRATED PEST MANAGEMENT**

Application of mustard cake and summer irrigation brought down the plant mortality due to dry root rot in clusterbean and wilt incidence in cumin. A total of 152 pearl millet entries were screened for resistance against downy mildew. Fourteen of the 18 released hybrids and their parents and 45 CAZRI lines had <5% DM incidence. Annual incidence of powdery mildew (*Oidium erysiphe*) was studied on jujube and collateral host *Euphorbia hirta*. Exposure of root knot nematode larvae to marigold, tumba and castor leaf extracts caused maximum mortality.

Species composition and seasonal fluctuation in termite population was studied in jojoba. Pest incidence studies were undertaken in different farming systems. Aqueous extracts (1 and 5%) of neem seeds increased the larval duration in *Bemisia tabaci*, but decreased pupal period. Grubs of *Chrysoperla carnea* were observed to predate upon seed bugs in sesame and pearl millet.

## **SOLAR DEVICES**

For dehydrating vegetables, cereals and dairy products, direct and indirect type of solar dryers have been developed. A multi-basin, fibre-reinforced plastic solar still has also been designed. Other solar gadgets tested include a stationary solar device capable of maintaining temperature for longer duration, and solar dryer with built-in storage unit. Evaporative cooling treatment was the best passive technique for comfort conditioning, but required high amount of water. A solar polish making machine was designed and fabricated. A new apparatus was designed and fabricated for silk screen printing of CdS and CdTe films. Studies were undertaken to find the efficient substitute material for solar gadgets. A solar cabinet dryer has been fabricated to enhance drying of multinutrient animal feed blocks.

## **SOCIO-ECONOMIC STUDIES**

A shift to nuclear families over the joint families in the command areas of Rawatsar was found. Utility of credit in terms of its impact on the income of farmers was positive in case of small farmers, but insignificant for large and medium farmers, in the villages under Luni Panchayat Samiti. In Sarecha and Shikarpura villages, the cost ha<sup>-1</sup> of cultivation of pearl millet, mung bean and sesame was estimated at Rs. 2396, 3138 and 3015, respectively; and the net returns of Rs. 1698, 6097 and 5703 ha<sup>-1</sup>, respectively. The yield of vegetables in the IVLP villages was found to be highly correlated with seeds, pesticides, labour, fertilisers and farm yard manure.

## **TECHNOLOGY ASSESSMENT AND REFINEMENT**

Indigenous technology knowledge (ITK) was listed for foot and mouth and gastritis diseases of animals, and for checking termite attack in crops. ITK for safe storage of pulse crops and onion was also listed. High adoption gap was recorded existing for various cultivation practices for wheat and mustard crop in the rural areas. Inability of the women to maintain and repair the smokeless hearth was identified as the major constraint in adoption of the device.

## **TECHNOLOGY TRANSFER AND TRAINING**

Demonstrations were conducted for popularisation of package of practices for crop production in Satheen village. Under the DDP-TOT project, twelve kisan nurseries were developed by farmers in 8 villages. Budding of improved cultivars was done on 1200 local jujube plants in 5 villages in Bikaner district. Gum production technique using plant growth regulator was disseminated. Several tankas were constructed in villages for irrigating horticultural plants. Composting of pearl millet and mustard residues with improved methods was demonstrated at Pandit-Ji-Ki Dhani. Solar cattle feed cookers were installed at farmers' places. Programme was taken up to stabilise dunes on cultivated lands. Seven trainers' training programmes were organised for extension and development personnel. Farmers' trainings were organised by KVK and ARS of RAU with the support of CAZRI faculty. Eight exhibitions were organised to popularise the technologies developed by CAZRI. About 1400 farmers and students visited the Institute in different groups.