



National Agricultural Technology Project

ARID AGRO-ECOSYSTEM

Research Highlights 2002

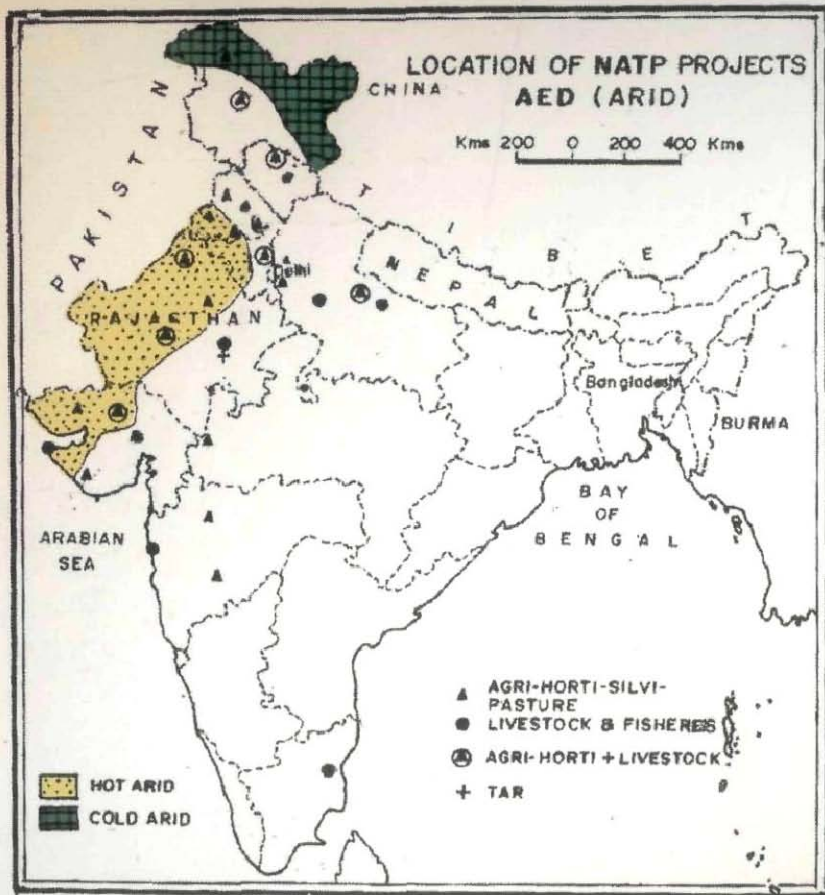
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Central Arid Zone Research Institute
Jodhpur - 342003



COVER PAGE

Improved pasture of *Cenchrus ciliaris* with *Stylosanthes hamata* and *Leuceana leucocephala*

Feed block machine for making feed block of the grass and straw for easy transportation and handling of fodder particularly during drought

National Agricultural Technology Project

ARID AGRO-ECOSYSTEM

Guidance

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Contributions : All investigators of lead and cooperating centers

Acknowledgements : National Director, PIU, NATP, New Delhi

Biotechnology and crop Improvement

Breeding for biotic and abiotic stress: physiological efficiency in mung bean, moth bean, cowpea and clusterbean (R.C. Sharma, RAU, Bikaner; Jaivir Singh, CCSHAU, Hisar; S.B.S. Tikka, GAU, S.K. Nagar and D. Kumar, CAZRI, Jodhpur)

- Yellow mosaic virus resistant genotypes of cowpea (IC-20558, IC-18321, P 25-40 and IC-39853), mung bean (MB-132-1, Jawala, MB-110-1 and RMO-426-1) and clusterbean (RGC-1021, IC-116902, IC-116565, IC116570, IC116619 and CAZG-99-13) have been identified.
- Drought tolerant genotypes of moth bean (9), summer cowpea (4), Kharif cowpea (5) and mung bean (7) were selected.



Yellow mosaic virus resistant cowpea (var.-1C-20558)

Selection of improved genotypes and development of sustainable production system for kala zeera (*Bunium persicum* Bios) (A.M. Munshi, SKUAS & T, Srinagar; Rajesh Uppal, HPKV, Palampur and N.S. Chauhan YSPUH&F, Solan)



- Improved Kala Zeera genotype (SKU-KZ-86-1) with a potential yield of 140-145 kg ha⁻¹ and 4 % essential oil have been identified.
- Pre-winter sowing, 2,50,000 plant ha⁻¹ and 60 kg N, 80 kg P and 20 kg K ha⁻¹ is suitable for Kala Zeera cultivation.

Improved Kala Zeera genotype

Raising yield ceiling in oilseed through physiological approaches and resistance breeding (H.C. Pathak, GAU, S.K. Nagar; Y.P. Yadav, CCSHAU, RRS, Bawal and Z.S. Solanki, RAU, ARS, Mandore)

- Nineteen castor genotypes resistant to Fusarium wilt and seven resistant against nematodes were identified.
- Physiologically efficient genotypes of Taramira (DITA-1, TC-31, BTM-31 and T-27) were identified.
- Genotypes of sesame viz. EC-370867, ES-22, ES-379-8-84 and TC-299 tolerant to the caterpillar *Antigastra catalaunalis* have been identified.



Sesame genotype tolerant to *Antigastra catalaunalis* vs local check

Development of propagation techniques for *Capparis decidua* (Rakesh Bhargava, CIAH, Bikaner)



- Semi-hardwood cuttings treated with $7500 \mu\text{g ml}^{-1}$ IBA along with $1000 \mu\text{g ml}^{-1}$ thiamine were most suitable material for propagation of *Capparis decidua*.

Hormone induced sprouting in *Capparis decidua*

Genetic improvement of economically important plants/shrubs of arid region (Manjit Singh, CAZRI, Jodhpur; P.R. Kothari, RAU, Bikaner and S.N. Jamini, GAU, S.K. Nagar)

- High yielding accession of Senna (*Cassia angustifolia*) and Henna (*Lawsonia inermis*) have been collected from Rajasthan and Gujarat.
- Germination of kair (*Capparis decidua*) seeds can be improved by soaking in distilled water for 24 hours before sowing. Use of Seradex B2 increases rooting in the cuttings of 'kair'.
- Protocol for vegetative propagation of guggal (*Commiphora wightii*) using stem cutting has been standardized.



Normally occurring guggal (*Commiphora wightii*) in arid zone

Water Management

Water-requirement and irrigation scheduling of different agri-silvi-horti system (R.K. Beniwal, RRS-CAZRI, Bikaner; M.K. Kaul, ARS, RAU, Ganganagar; Naresh Kaushik CCSHAU, ARS-Bawal; L.R. Patel, GAU, S.K. Nagar and C.J. Singh, PAU, RRS Bhatinda)



- Yield of clusterbean and mung bean with micro sprinkler irrigation was maximum at 40 and 100% ETC respectively .
- Growth (height and collar diameter) of *Dalbergia sissoo* was higher than *Emblica officinalis*, *Psidium guajava* and *Prosopis cineraria* at 100, 70 and 40 % depletion ETC.

Citrus grown with drip

Watershed management technology in hot arid region (K.S. Panwar, CCSHAU, Hisar; M.A. Khan, CAZRI, Jodhpur; R.H. Ghaghada, GAU, Junagarhm, B.S. Deora, GAU, S.K. Nagar and G.D. Singh, RAU, Fatehnagar)

Western Rajasthan

- Four improved 'tanka' of 20,000-litre capacity each have been constructed.

Eastern Rajasthan

- Strip cropping in 3:1 ratio of pearl millet: cluster bean is ideal for production.
- Saccharum munja, Tephrosia purpurea and Crotalaria burhia were highly effective for sand dune stabilization.
- Grasses and pearl millet grown between Prosopis cineraria plantations produced higher biomass and grain yield.



Luxurious pearl millet cover by contour bunding

Natural Resource Management

Development of techniques for management of gypsiferous and impeded soils of arid areas (A.K. Sharma, CAZRI, Jodhpur; A. Das, GAU, Arrej; B.S. Jhota, HAU, Hisar; B.L. Verma, RAU, Bikaner and K.K. Mehta, CSSRI, Karnal)

- *Acacia senegal*, *Colophospermum mopane*, *Prosopis cineraria* and *Tecomella undulata* trees raised in gypsiferous soils showed a survival of 92 to 98 %.
- Micro-catchments and application of FYM as soil amendment increased the survival of trees in gypsiferous soils of Barmer.

Microcatchment on degraded gypsiferous soil



Develop agri-silvi-horti production system for marginal lands in arid conditions (S.S. Hiwale, CIAH-RRS, Godhra; D.P.S. Nandal CCSHAU, Hisar; T.T. Kumbhar, MPKV, Rahuri; S.B.S. Tikka GAU, S.K. Na gar and P.L. Saroj, CIAH, Bikaner)

- Intercropping of okra (*Abelmoschus esculentus*) with anola (*Emblica officinalis*) gave highest net income of Rs. 72,565 ha⁻¹ followed by anola + til (Rs.22,687 ha⁻¹). But intercropping of castor, sesame, green gram, cowpea and okra in the existing plantations of *Ailanthus excelsa*, *Hardwickia binata* and *Dalbergia sissoo* gave lower yield than their sole cropping.
- *Leucaena leucocephala* recycled maximum nitrogen (84.26 g N tree⁻¹) whereas maximum phosphorus and potassium (26.2 and 218 g K tree⁻¹ respectively) were recycled by anola.
- Performance of pearl millet, sorghum and clusterbean was better when grown with *Prosopis cineraria* as compared to *Syzygium cuminum* but the opposite was true for turmeric cultivation.



Intercropping of Okra with Anola

Design, development and evaluation of green house to suit cold desert conditions for crop production (Ashwani Kumar, CIPHET, Ludhiana and V.K. Sharma HPKV, Palampur)

- Ten types of green houses with soil trench, mud wall, cavity wall, inverted V type, quonset, round arch, saddle roof, double span, trench type and polytunnels were constructed and found suitable for cold desert conditions.

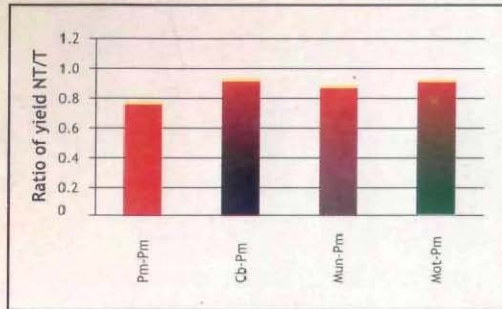
- Higher temperature (4.5 to 12.2°C) and RH (1.7 to 11.1%) inside the green houses conditions over ambient, permitted crop growth even during adverse period.
- Capsicum and brinjal yielded 3.5 times higher inside the green house than for open. Yield of tomato, cucumber, french bean, cabbage and cauliflower inside the green house were 0.77 to 2 times higher as compared to open field.



Excellent Tomato crop in Lean type greenhouse in cold desert

Integrated Plant Nutrient Management

Manipulation of soil fertility with crop residues, ley farming, and crop sequencing for eco-friendly higher production (S. Kathju, CAZRI, Jodhpur; I. J. Gulati, RAU, Bikaner and S.C. Gill, CSWRI, Bikaner)

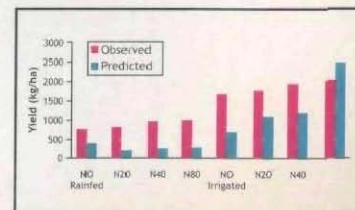


Ratio of pearl millet (pm) yield in cluster bean (cb), moong bean (mb) over moth bean (mb) based cropping system under tillage and no-tillage

- Higher pearl millet yields were obtained with composted crop residues in comparison to their direct incorporation.
- Yield of pearl millet in rotation with clusterbean was higher (equivalent to 40 kg N) as compared to its continuous cropping.
- A new method for assessing plant residue quality to indicate their decomposition in soil has been developed.

Development of nutrient management strategies for cropping system in Indian arid zone: application of simulation models and medium range weather forecast (D.V. Singh, CAZRI, Jodhpur; C.V.S. Sastri, IARI, New Delhi; A.K. Shukla, PDCSR, Modipuram, C.P. Singh, CCS, HAU, Hisar and S.S. Hundal, PAU, Ludhiana)

- Days to reach 50% flowering were accurately predicted using CERES millet model for Jodhpur condition but were under predicted for Hisar conditions.
- Total biomass production was under predicted for Jodhpur conditions and over predicted for Hisar conditions using CERES-millet model. Grain yield predictions using Ceres's millet model were lower under low input conditions at both the centres. However, predictions were better under irrigated as compared to rain fed conditions.



Observed and predicted grain yields (kg/ha) of pearl millet

Integrated Pest Management

Develop integrated pest management package for the arid agri-horti-silvi-pastoral system (M.P. Singh CAZRI, Jodhpur; J.P. Bhanot CCSHAU, Hisar; G.M. Patel, GAU, S.K. Nagar and R.K. Joshi, RAU, Sri Ganganagar)



Infestation of gram pod borer

- Spray schedule of neem seed kernel extract at 5% followed by Nuclear polyhedrosis virus (NPV) @450 larval equivalents ha⁻¹ and endosulphan @1200 ml ha⁻¹ was effective against gram pod borer.
- Chickpea cultivated under 'khejri' showed remarkably lower incidence of dry root rot and Helicoverpa.
- Mung bean, moth bean and clusterbean grown under 'kinnow' showed higher incidence of pests and pathogens.

- Soil application of 15 days pre-incubated *Trichoderma* (10 kg) in FYM @ 200 kg ha⁻¹ and seed treatment with *Trichoderma* @ 10g kg⁻¹ were effective against dry root rot of chickpea.

Socio-Economics of Arid Zone

Socio-economic feasibility of agri-horti-silvi-pastoral system in arid zone-a diagnostic survey (D.S. Nandal, CCSHAU, Hisar; Mrs. Usha Rani Ahuja, CAZRI, Jodhpur; M. Tripathi, GAU, S.K. Nagar and A.S. Saini, HPKV, Palampur)

- Arid regions of western Rajasthan, Gujarat and southern parts of Haryana receive less/erratic precipitation with high evapotranspiration due to high solar radiation and wind speed. The region faces frequent droughts. Overgrazing due to high animal population, wind and water erosion are serious land degradation processes.

For livelihood and survival under such adverse conditions, agrihorticulture, silviculture and silvipasture are more suitable for these regions.

Biotechnology and Animal Improvement

Improving lambing rate in sheep through embryo and other breeding technologies and production of rams (S.M.K. Naqvi, CSWRI, Avikanagar; S.S. Sharma, RAU, Bikaner and J.S. Poonia, CCSHAU, Hisar)

- Munjal sheep is a prolific breeder with 17% twinning rate and 90% survivability. Six month lamb weighs about 27 kg while an adult sheep produces 2 kg wool yr⁻¹

- Embryos (24 Nos.) have been checked for quality and preserved
- Lambs (24 Nos.) have been produced through embryo transfer.



Munjal sheep with twins

Improving reproductive efficiency of sheep, camel, goat, cattle and buffalo (J.P. Mittal, CSWRI, Avikanagar; S.S. Sharma, RAU, Bikaner; Aminuddin, NRCC, Bikaner; G.M. Siddiqui, GAU, S. K. Nagar and I. S. Lohan, CCS HAU, Hisar)



Patanwadi sheep

- Age at first mating in Malpura, Patanwadi, Dumba sheep and Kutchi, Zalawadi goats is 12-18 months while it is 18-24 months in Marwari, Jaisalmeri, Kheri sheep and Marwari, Sirohi goats.
- Plasma calcium and glucose were high during Cervico-vaginal prolapse while serum cholesterol was also high in Pyometra and repeat breeders in buffalo.

Natural Resource Management

Fish production using brackish-water in arid ecosystem (A.R.T. Arasu, CIBA Chennai; A.K. Jain, CIFE, Mumbai; S.K. Garg, CCS-HAU, Hisar and K.L. Jetani, GAU, Okha)

- In brackish water ponds, *Penaeus monodon* shrimp and Seabass fish fry were reared with 92% survival and an average

weight of 38 g and 12 g respectively in 140-150 days in Udaipur (Rajasthan), Nokha (Gujarat) and Hisar (Haryana).

- Grey mullet fish could be grown to 1.4 g in 39 days in winter at 12-18 °C in waters up to 45 parts per thousand salinity.

P. Monodon harvested from saline water pond at Dhormai, Bharatpur



Environmental stress and its amelioration through shelter management (P.K. Nagpal, NDRI, Karnal; A.K. Patel, CAZRI, Jodhpur; C. Bhakat, NRCC, Bikaner ; V.K. Choudhary, RAU, Bikaner and R. Gulyani, CSWRI, Avikanagar)



Traditional animal shelter

- Traditional thatched roof animal shelters made of aak (*Calotropis procera*), bul (*Aerva persica*), bordi (*Ziziphus nummularia*), babul (*Acacia nilotica*), kheemp (*Leptodinia pyrotechnica*) and siniya (*Crotolaria burhia*) reduce the temperatures by 2-4 °C.
- During winter, Marwari goat produced more milk in Pucca shelters than in thatched or open shelters.

Small farm rural poultry production (T.S. Johri, CIAR, Izatnagar; B.S. Chhikara, CCS, HAU Hisar; R.S. Choudhury, RAU, Bikaner and Kuldeep Khanna, GAU, Anand)

- The average body weight of birds at 20th week was 1602 g in CARI- Nirbheek and 1359 g in Upcari. However, the egg production in forty weeks of age was more in Upcari (63 eggs) as compared to 57 eggs in CARI Nirbheek.

- All genotypes maintained at 30%, 40% and 50% of supplementary feeding laid eggs earlier compared to control birds:
- The average body weight at 20th week was 1124 g in Naked-neck and 1034 g in Kadakanath. The egg production up to 44th week of age was also highest in Naked-neck (75 eggs) and lowest in Aseel (61 eggs).



Backyard poultry rearing is remunerative

Integrated Animal Nutrient Management

Pasture improvement and legume introduction: soil plant-animal relationship (K.P. Tripathi, CAZRI, Jabalpur; J.N. Gupta, IGRI, Jansi; Pramod Pundhir, RAU, Bikaner and B.R. Sood, HPKV, Palampur)



Pasture improvement with legume and tree component

- The land utilisation, fertiliser use efficiency and net return ha⁻¹ were significantly higher in grass-legume inter-cropping than grass alone:
- Fescue with Lucerne + Red clover produced 117 to 304% more green biomass and 105 to 181% more dry biomass than the natural pasture.
- Legumes, grasses + legumes and fertilization increased activities of phosphatase and dehydrogenase enzymes. The activity was decreasing with soil depth.

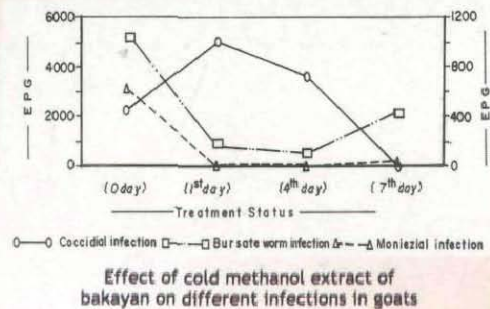
Integrated Pest Management in animals

Identification and evaluation of medicinal plants for control of parasitic diseases in livestock (P.S.K. Bhagwan, CSWRI, Avikanagar; V.S. Vihan, CIRG, Makdoom; Mahesh Kumar, GBPUAT, Pantnagar; R.M. Tripathi, GAU, S.K. Nagar; H.C. Tripathi, IVRI, Izatnagar and C. Varshney, HPKV, Palampur)

- Hot chloroform extract of seeds of Tribulus terrestris (Gokhru) and alcoholic extract of Azadirachta indica (Neem)

bark exhibited anti-parasitic action at 500 $\mu\text{g ml}^{-1}$ in in-vitro trials against *Haemonchus* spp.

- Hot ether extract of Karanj (*Pongamia pinnata*) and cold methanol extract of bakayan (*Melia azedarach*) @ 20 mg ml^{-1} gave 80% mortality of *Haemonchus* spp.
- In-vivo studies in goats showed that cold methanol extract of bakayan, reconstituted in gum acacia, (@50-mg/kg b.wt), proved good anthelmintic and reduced the faecal egg count of coccidiosis from 22620 to nil, brusate from 1040 to 440 and moneizial from 620 to 40.
- A dose of 3 mg ml^{-1} IVR-1A + IVR-12A (ratio 1:1) caused irreversible paralysis in *Fasciola gigantica* worms.



Effect of cold methanol extract of bakayan on different infections in goats

Post Harvest and Value Addition

Evaluation of locally available feed and fodder to improve quality and formulate complete economic rations with high roughage diets (R.C. Jakhmola, CSWRI, Avikanagar; Amar Singh, IARI, New Delhi; A.K. Samanta, IGFRI, Jhansi; G.R. Purohit, RAU, Bikaner, V.K. Sharma, HPKV, Palampur and A.K. Nagpal, NRCC, Bikaner)



Feed block

- Animal feed block machine, which could compress 3-3.5 times and produce feed block of 2.5 kg was developed. The colour and texture of these blocks remains unchanged for 6 months.
- The dry matter intake was high in sheep fed on feed blocks of Ardu and Bajra kadbi leaves, however, effect on digestibility was variable.
- Guar phalgati-Khejri leaves based feed could meet the protein and energy requirement of camel calves.

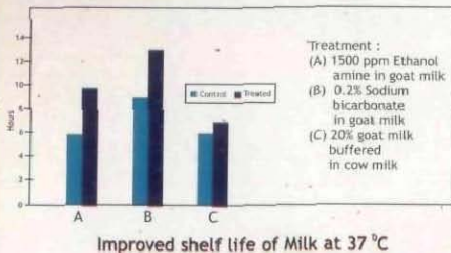
Processing of different hair and wool for value added products (A.K. Pokharna, CSWRI, Avikanagar; Sarfaraz Ahmed, SKUAST, Srinagar and R.B. Sharma, HPKV, Palampur)

- Camel hair: Forty per cent calf hair blended with viscose staple fibre was found suitable for bulk processing.
- Goat hair: Yarn of 0.56 nm could be produced having 148 fibres in cross-section with goat hair of 72.7 μ diameter, 9.59g tex⁻¹ bundle tenacity and 21.3% breaking elongation.
- Pashmina goat fibre: It was feasible to blend dehaired Pashmina fibre with Merino tops and Angora wool to produce final woven products.
- Angora Rabbit wool: Blending of Angora rabbit wool with Merino in 30:70 ratio is appropriate to produce shawls of 2.15 x 1 m.



Dehairing of Pashmina fibre

Improving the shelf life of milk and milk products of camel and goat (Raghvendra Singh, NRCC, Bikaner and M.S. Khan, CAZRI, Jodhpur)



- Shelf life of goat milk could be extended by 4 hr using 0.2% Sodium bicarbonate or 1500 ppm Ethanolamine.
- Marwari goat milk paneer with 13-14% yield is soft, slightly salty and has no goatee odour.
- Lassi and Dahi could be made using specific starter cultures with camel milk.

Animal Biodiversity

Genetic characterization and conservation of important sheep and goat breeds (S.C. Gupta, NBAGR, Karnal; A.L. Arora, CSWRI, Avikanagar; A.K. Patel, CAZRI, Jodhpur; T.A.S. Gannai, SKUAT, Srinagar and Kamlesh Gupta, HPKV, Palampur)

- DNA isolation technique from cultured skin fibroblast cells has been perfected. The DNA yield was 500 ng from 1×10^5 cells.
- Long term (201 days) freezing at 86°C of processed skin fibroblast cells kills 25.9 to 38.4 % cells. The revival period of cultured cells in required confluence of 80-90% varied from 6.6 to 7.09 days.
- Genomic DNA of 56 sheep each of Jaisalmeri and Gaddi breed; 30 Parbatsar and 50 Gaddi goats were cryopreserved for posterity.

Institution Village Linkage Programme for Technology Assessment and Refinement

CSWRI, Avikanagar (*J.S.Mann, R.S.Mehta, A.Kumar, A.K.Pokharna, V.K.Solanki*)

- The grain and straw yield of pearl millet (ICMH-356) was 20% higher than control.
- Application of forate @ 25 kg ha^{-1} and seed treatment with chloripyrophos effectively controlled the white grub and termites in groundnut and increased the grain yield by 23%.
- Barley variety (RD-2035) gave 20% and 16.8% higher grain and straw yield respectively than the local.

However, application of 60 kg N and 20 kg P₂O₅ ha⁻¹ further increased the grain and straw yield by 15.4%.

- Vaccination against enterotoxaemia and sheep pox reduced mortality rates considerably.
- Dry matter intake of sheep increased when fed with enriched fodder by urea treatment.



Farmers visiting an IVLP demonstration field

CAZRI, JODHPUR (T.K.Bhati, D.C.Joshi, A.K.Patel, S.S.Rathore, Mrs.P.Tiwari, A.V.Rao, M.P.Singh, S.K.Lodha, Dinesh Mishra, and A.K.Purohit)



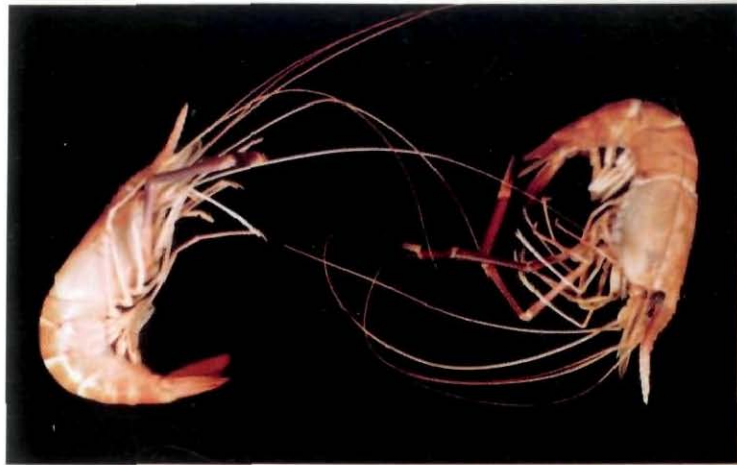
World Bank expert discussing with an IVLP farmer.

- Pearl millet (MH-169), moong bean (K-851) and cluster bean (Maru guar) performed better than the local.
- Mustard (Bio-902) yielded 43.4% more than the local. Application of neem cake (1 t ha⁻¹) along with 20 kg S ha⁻¹ further increased the yield of mustard by 29.7%.
- Spray of monocrotophos @ 0.036 % controlled infestation of caterpillars by 65.7% in mustard (Bio-902 and RH-30) and increased the yield by 25.5%.
- Mineral mixture @ 5-10 g animal⁻¹ day⁻¹ in sheep and goat increased milk and wool yield by 18%.

Avenues of Employment and Income Generation for Small and Marginal Farmers



Adoption of backyard poultry



Giant fresh water prawn production in brackish water

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Environment Management in Hot and Cold Desert



Traditional open air animal shelter in hot desert



Polyenrich type green house for growing vegetables in cold desert at Lari

Computer support : Bhupesh Vaid and Rishi Kala

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