The mid-term review team (MTR) for INDO-UK Project on Forage Production visited IGFRI during March 10-14, 1997. The purpose of the team was to take a strategic overview of progress to-date and to make recommendations for the future of the project. The team was led by Mr. Mike Wilson, Senior NR Advisor, BDCOD. The members of the team were Mr. Vijay Pillai, Economic Advisor, BDCOD, Dr. Roger Smith, Tropical Agricultural Research Consultant and Dr. Don Loch, Principal Scientist, Department of Primary Industries, Queensland, Australia. The resource persons were Dr. Bhag Mal, Director, IGFRI and Technical Coordinator, Prof. Roger Haggar, Technical Coordinator and Ms. Maureen Peerson, Project Manager, British Council.

The MTR Mission congratulated the two Technical Coordinators for the good progress made in the project during last three years and appreciated the progress, in the given timeframe, in the areas of training, consultancies and procurement of equipment which has started showing positive impact. The experts praised the recent changes made in the IGFRI research strategies in focusing more attention to the needs of poor farmers in rainfed areas.

The MTR team recommended ODA for continued support for the remaining tenure of the project on the basis of this review.

**Indo-UK Project Activities**

- Dr. Bhag Mal visited London from January 28 to Feb. 1, 1997 in connection with preparation of draft document for Mid Term Review of this Project.
- Dr. Michael Chadwick, ODI, visited IGFRI from Feb. 10-13, 1997 as consultant in the field of GIS.
- Dr. A. Thomson, Aberystwyth, visited during Feb. 16-23, 1997 to impart training in the field of presentational skills.
- Prof. R.J. Haggar and Dr. Tom Farrington, ODI along with Dr. Bhag Mal, Dr. V.S. Upadhyay and Dr. K.S. Kohli of IGFRI visited Dahod from Feb. 20-22, 1997 to discuss future collaborative programme between KRIBHCO, BAIF, WOTR and IGFRI.
Soft awned Heteropogon

Heteropogon contortus (Black spear grass) is one of the most palatable, nutritious and predominant grass species of Bundelkhand region but presence of hard, pointed awns at the time of flowering/maturity pose a great problem for cattle feeding.

A few strains having soft awns have been identified among the germplasm collected during exploration. In addition to soft awn these strains have other desirable traits, viz. high tillering and semi-prostrate growth habit. (A.K. Roy and D.K. Agarwal)

Induced tetraploid lines of Berseem

The problem of narrow genetic base in Egyptian clover (Trifolium alexandrinum) commonly known as berseem is the major impediment in varietal improvement. To overcome this problem induced tetraploid lines involving 15 diploid genotypes have been developed. These lines, stabilized by rigorous and recurrent selection are being grown in C6 and C7 generations.

The induced tetraploids show distinct morphological characters viz., broad, thick and hairy leaves with serrate margin, thick stems, inflorescence, large seed and late maturity as compared to diploids. Some of the tetraploid lines recorded 7-10% superiority over national check 'Wardan' for green fodder yield and crude protein content in the station trial at IGFRI. Tetraploid line JHTB-93 has shown superior performance in North-West zone in multi-location trial. (A.K. Roy and D.R. Malaviya)

Nitrogen cycling

The requirement of N is very high in cereal forages. Yield of forage crops is often limited due to poor N supply in soils for various reasons like low organic matter, excessive losses, low external N inputs and inefficient N cycling.

Experiments to understand the N cycle and control the flow of 'N', are being conducted at this Institute. Measurement of nitrogen leaching using lysimeter in maize + cowpea-berseem production system has indicated that up to 100 kg/ha nitrogen may be lost from the soil costing around Rs. 1000/- per ha/year. On the basis of rainfall distribution and field observations it has been confirmed that in kharif season under rainfed conditions this loss is maximum during mid July to the end of August. (A.K. Patra, Pradeep Behari and J.B. Singh).

Phosphorus dynamics and management in alkali soils

Studies on alkali and adjoining normal soil samples covering twelve districts of U.P. revealed that on an average, alkali soils contained 2.4 times higher Olsen-P and 3.4 times higher water soluble-P than adjoining normal soils. Highly positive correlations were observed between available P indices and pH, ESP, ECe, CO3, and HCO3 and availability of P was found to increase sharply above 9.75 pH. Ammonium chloride-P, Fe-Al-P, Ca-P, unknown-P and residual-P fractions constituted 2.65, 8.28, 65.5, 10.45 and 13.19 per cent of total inorganic-P in salt affected soils compared to 1.25, 11.54, 60.42, 8.46 and 18.49 per cent, respectively in normal soils.

The results of incubation study indicated a decrease in Olsen-P with amendments and leaching. The maximum decrease was observed with pyrites. The leaching of water soluble P stopped after 10 days with gypsum but continued up to 30th day in pyrite amended soils. Gypsum application increased the per cent recovery of Ca-P while pyrite application increased the per cent recovery of Fe-Al-P. During entire 30 days of incubation, leaching of P was 41.5, 29.5 and 11.9 mg in pyrite amended, gypsum amended and unamended soils, respectively. (S.M. Misra).
Dear Readers,

For the fast developing dairy industry in India, one of the main concerns is to feed the high yielding milch animals economically on herbage based ration to minimise competition with human beings for needed nutrients, owing to land and input constraints. The successful development of an efficient forage production strategy involves two biological systems, viz., soil-plant and plant-animal in a dynamic manner. The researches carried out during the past three decades opened up the possibilities of achieving a high level of productivity under optimum level of inputs and has changed the forage production scenario in India. Production of dairy and other animal products at cheaper and economic rates would require green nutritious forages for prolonged period and saving on grain concentrates by greater utilization of crop residues and other agro-industrial bye-products as animal feed under different management conditions.

It is imperative to develop appropriate technologies for regenerating degraded, non-arable lands primarily for environmental improvement but at the same time harnessing the bio-mass thus produced for sustained livestock production. To make these systems more remunerative for the people/communities participating in this task, introduction of allied agricultural activities like sericulture, apiculture, improvement of native fruit trees, minor timber, etc. should be encouraged.

Over the years, many constraints in effective transfer of technologies generated by this Institute have been identified. Among these, the most important one is the lack of availability of required quantity of the good quality seed of cultivated fodder crops, grasses and other pasture species. There is, thus, an urgent need to identify suitable sites/specific seed production pockets for each crop, involving farmers' participation and other Government and non-Government organisations to take up seed production responsibility for this group of crops on a scientific basis. IGFRI in collaboration with other agencies has conceived a forage seed production and distribution network and efforts are being made to implement the activities to bring forage seed production and supply system on a sound footing.

A comprehensive approach to integrate forage production with the existing farming/cropping systems and livestock production coupled with environmental conservation has a special significance in the fast changing socio-economic situations. Awareness to this effect in this less organised sector has begun in later part of the century and it is hoped that it shall further intensify in the next few years. HRD activities are also picking up now in this particular area and are expected to be stepped up further. IGFRI with its team of dedicated workers is taking a lead in this direction and commits itself in this endeavour by mobilizing users' participation in meeting the future technology and manpower requirements.

(BHAG MAL)
CROP IMPROVEMENT

The Division of Crop Improvement was formed in the year 1996, when the erstwhile Divisions of Plant Improvement, Plant Protection and Plant Physiology & Biochemistry were merged in a major reshuffle to facilitate multi-disciplinary approach of forage crop improvement. The parent Division of Plant Improvement was established in the year 1967, under the leadership of Dr. K.L. Mehra. From 1967 to 1986 various cognate disciplines like Genetics & Cytogenetics, Plant Pathology, Plant Physiology, Entomology and Nematology were added to this Division. The Division is presently headed by Dr. S.T. Ahmad and is represented by forty two scientists of different disciplines, involved in crop improvement programme.

<table>
<thead>
<tr>
<th>SECTIONS</th>
<th>MANDATE</th>
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<tbody>
<tr>
<td>- Plant Genetic Resources</td>
<td>Improvement of forages for yield, quality, persistence, adaptability/tolerance to biotic and abiotic stress situations.</td>
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<tr>
<td>- Plant Breeding</td>
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<tr>
<td>- Genetics and Cytogenetics</td>
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<td>- Plant Physiology &amp; Biochemistry</td>
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<tr>
<td>- Biotechnology</td>
<td></td>
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<td>- Plant Protection</td>
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SPECTRUM OF RESEARCH ACTIVITIES

Emphasis is on formulation and execution of research programmes suitable for actual users. The programmes are discussed at divisional and Institutional level. The major concern is to build up and maintain the biodiversity of indigenous and exotic germplasm of cultivated and pasture/range species and to develop superior varieties for different input and stress situations through conventional and biotechnological means. Adequate facilities exist in the Genetics & Cytogenetics, Bio-Technology, Plant Pathology, Entomology, Nematology and Plant Physiology & Biochemistry laboratories. A mid term storage module for forage germplasm is being installed. Besides this, more than 15 ha land is available to this division at CR Farm for conducting research in arable and non-arable situations.

RESEARCH ACHIEVEMENTS

Over the past three decades the division has evolved superior varieties in cultivated fodders and range grasses suited to various agro-climatic zones as well as identified suitable parents for desirable gene transfer.

PLANT GENETIC RESOURCES.

- Over a period of time a large number of indigenous and exotic germplasm has been collected, evaluated and has been conserved for providing base material in the varietal development programme of cultivated and pasture/range species. Presently six thousand seven hundred and eighty two accessions of varied groups of forage species available with this unit are being exploited in the varietal improvement programme.

PLANT BREEDING

- The multi-disciplinary efforts in developing superior varieties in important forage species suited for different situations have resulted into a number of new varieties which have been released after multi-locational trials. Many more such material is at different stages of testing prior to their release.

The crop improvement programme is aided by cognate disciplines by way of generating information on basic and applied aspects -

CYTOGENETICS

- Tetraploid (2n = 4x = 36), Hexaploid (2n = 6x = 54) and Aneuploid (2n = 6x-1 = 53), cytotypes have been identified in Pennisetum pedicellatum. The productivity traits showed an increase with increase of ploidy level. A new perennial race has been found to be an octoploid (2n = 8x = 72).
- Species relationships have been worked out in Atylosia-Cajanum complex. Trispecific hybrids have been raised.
- Incorporation of desirable traits from wild Avena maroccana and A. sterilis to cultivated A. sativa has been achieved through amphiploid and back cross breeding.
- Induced tetraploid lines have been established in berseem.
PLANT PROTECTION

- Status of pests and diseases was identified in cultivated leguminous, cereal forages and range species etc. Extent of quantitative losses due to pests have also been determined.
- Sources of resistance in major forage crops like in cowpea for root rot, leaf hopper, yellow mosaic virus, anthracnose; in lucerne for downy mildew, rust, aphid and weevil; in berseem for root and stem rot; sorghum for leaf diseases and shoot fly; in cluster bean for leaf blight have been identified.
- Evolved pest and disease management strategies in major forage crops with main emphasis on cultural, biological methods, botanicals and chemical seed treatments. Further, integrated pest management has been worked out for different systems.

VARIETIES DEVELOPED/IDENTIFIED

<table>
<thead>
<tr>
<th>Leguminous fodders</th>
<th>Varieties</th>
<th>GFY (t/ha)</th>
<th>Areas for cultivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berseem</td>
<td>Wardan</td>
<td>65-70</td>
<td>Whole country</td>
</tr>
<tr>
<td></td>
<td>JHB-ISB-86</td>
<td>55-70</td>
<td>South Zone</td>
</tr>
<tr>
<td></td>
<td>JHB-146</td>
<td>65-80</td>
<td>Central, NW Zones</td>
</tr>
<tr>
<td>Cowpea</td>
<td>Bundel Lobia-1</td>
<td>25-30</td>
<td>Whole country</td>
</tr>
<tr>
<td></td>
<td>Bundel Lobia-2</td>
<td>25-30</td>
<td>North Zone</td>
</tr>
<tr>
<td>Guar</td>
<td>Bundel Guar-1</td>
<td>25-35</td>
<td>Whole country</td>
</tr>
<tr>
<td></td>
<td>Bundel Guar-2</td>
<td>30-40</td>
<td>Whole country</td>
</tr>
<tr>
<td></td>
<td>IGFR1-1019-1</td>
<td>30-35</td>
<td>Whole country</td>
</tr>
<tr>
<td>Fieldbean</td>
<td>Bundel Sem-1</td>
<td>25-35</td>
<td>Whole country</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grasses and Cereals</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oat</td>
<td>Bundel Jai-822</td>
<td>44-50</td>
<td>Central Zone</td>
</tr>
<tr>
<td></td>
<td>Bundel Jai-851</td>
<td>40-50</td>
<td>Whole Country</td>
</tr>
<tr>
<td>Cenchrus</td>
<td>Bundel Anjan-1</td>
<td>30-35</td>
<td>Whole country</td>
</tr>
<tr>
<td>Dinanath grass</td>
<td>Bundel Dinanath-1</td>
<td>55-60</td>
<td>Whole country</td>
</tr>
<tr>
<td></td>
<td>Bundel Dinanath-2</td>
<td>60-65</td>
<td>Whole country</td>
</tr>
</tbody>
</table>

PLANT PHYSIOLOGY AND BIOCHEMISTRY

- Drought tolerant strains/varieties of oats have been identified.
- Dichanthium annulatum, Stylosanthes scabra, Chloris guyana and Avena strigosa were found tolerant to salinity.
- Technology for increasing seed yield through foliar application of nutrients and hormones in berseem, lucerne, cowpea and siratro have been developed.
- Biochemical mechanism for anoxia in Bracharia spp. was worked out. Disease resistance mechanism in cowpea, berseem and stylo have been worked out at enzymes and isozyme pattern level.

BIOTECHNOLOGY

- Regeneration protocol for raising plants from tissue cultures have been developed in Cenchrus ciliaris, Dichanthium annulatum, Panicum maximum and Medicago sativa.
- Plant regeneration from anther derived callus have been established in D. annulatum which aims towards genetic manipulations of sexuality/apomixis.
- Somaclonal variants in D. annulatum were developed. The regenerated plants established in field exhibit variation in growth habit (prostrate/semi-erect/erect types) bearing broad and long to small and curly leaves. Some of the somaclones were superior in forage yield and exhibited resistance against rust disease.
- Screening of Cenchrus global germ plasm collection revealed C. priurei and C. echinatus have sexual types of embryosacs exclusively. C. ciliaris (2 lines) exhibited both sexual and apomictic types of embryosacs revealing their facultative/sexual mode of reproduction.
Somaclonal variation in marvel grass

Tissue culture regenerated plants of marvel grass (*Dichanthium annulatum*) exhibited a wide range of variation. Plants with creeping-erect growth with broad, large to small and curly leaves have been developed. Some somaclones are superior in forage yield and exhibited resistance against rust disease. These plants will be promising material for reclaiming/improving waste-lands. *(M.G. Gupta, S. Gupta and U.S. Mishra)*

Sexual types among apomictic germplasm of *Cenchrus* species

*Cenchrus prieurii* and *C. echinatus* exhibited exclusively sexual types of embryosacs and two lines of *C. ciliaris* (species earlier known to be an obligate apomict) were found to be facultative apomictics. The occurrence of sexual reproduction would open wider opportunities of varietal improvement in *Cenchrus* species. *(M.G. Gupta, S. Gupta, B.V. Bhat, V. Bhat and U.S. Mishra)*

Allelogenic litter biomass of tree species : A source of nutrients and soil conditioner

Trees, the primary producer and source of organic matter, supply the essential plant nutrients after decomposition. In this process various allelochemicals/natural products such as heterogenous amino acids, tannins etc. present in the litter become available to growing crops when applied to fields. In the present study litter biomass of three tree species namely *Mangifera indica*, *Syzygium cumini* and *Leucaena leucocephala* have been used. These natural products/allelogenic compounds increase the germination of field crops at very low concentrations-0.01 to 0.1%. However, with higher concentrations, the germination of most field crops is drastically reduced (from 85% to 14%). The application of urea in combination with litter biomass of MPTS increase the N supply in NO₃ depression. The combination - combined N (75% N through urea + 25% through litter biomass) has proved to be most beneficial in terms of net production and profit. *(Banwari Lal)*

News from Regional Centres

One week institutional training programme was organised at Regional Research Centre, IGFRI, Dharwad, Tegur Farm for 15 frontline workers of Indo-German Watershed Programme, Ahmedanagar, Maharashtra. Feedback from trainee participants is being analysed for future use.

The Regional Centre, Dharwad participated in short term training programme organised by Cattle Breeding and Training Centre, State Department of Animal Husbandry from Feb. 24 - March 1, 1997 for dairy farmers.

Hydro-meterological station at IGFRI Tegur Farm, Dharwad has been established in collaboration with National Institute of Hydrology, Belgaon. Instruments like weather cock, rain gauge, sunshine recorder, evaporation meter have been installed.

Dr. M.L. Madan, DD(AS), ICAR, New Delhi visited our Regional Research Centre located in the CSWRI, Avikanagar campus on March 22, 1997. He was taken around the experimental area and briefed about the activities of the centre by the Officer in-charge. Dr. Madan accompanied by Dr. R.N. Singh, Director C.S.W.R.I. took keen interest in the ongoing Network Collaborative Project on crop based animal production systems sponsored by ICAR. Dr. Madan appreciated the pasture based animal management system.
Meetings

- The meeting of Institute Management Committee was held on Jan. 9, 1997 under the Chairmanship of Dr. Bhag Mal, Director. Shri Ramashish Yadav, Shri Kulbant Rai Verma, Dr. S.M.A. Naqvi, Prof. S.M.A. Rizvi, Dr. A.K. Singh, Dr. Prohit, Dr. Vinod Shankar, Dr. V.S. Upadhyaya, Dr. P.S. Tomar, Shri A.P. Sharma, Shri D.D. Verma, Shri A.K. Shrivastava and Shri Sanjay Kant participated in the meeting.

- Dr. Bhag Mal participated in the ICAR-ODA Brain Storming Workshop at New Delhi during Feb. 5-7, 1997. This meeting was organized to discuss the future challenges in the agricultural scenario and to evaluate the strategies to face them.

- Dr. Bhag Mal participated in the Annual Seed Review meeting on Feb. 19, 1997 at New Delhi to formulate the breeder seed programme of different varieties to meet the requirements of seed at national level.

Honours/Awards

Dr. C.R. Hazra, Project Coordinator, AICRP (FC) has received Soil Conservation Society of India - Leadership Award, 1996 in recognition to his significant contribution in the field of Integrated Watershed Development, Forage Crop Improvement and Agroforestry Development.

Congratulations.

Transfer of Technology/Training

- A batch of 32 farmers and farm women from National Wasteland Development Project, Raigarh (MP) visited the Institute on Jan. 20, 1997 for technology appraisal. They were taken around the farm to acquaint them with forage production systems.

- Veterinary Officers from RVC Centre and School, Meerut visited the Institute during Feb. 11-12, 1997. They were shown research activities and were provided with literature.

- Twenty three forest gaurs from Regional Forest Office, Jhabua (M.P.), visited the Institute on Feb. 12, 1997 for training on a forage forestry aspects.

- Project Managers/Officers from Department of Agricultural Engineering, Comprehensive Watershed Development Project, Chidambaram (T.N.) visited the Institute on Feb. 13, 1997 for technology appraisal.

- A training programme was organised to demonstrate the performance of agricultural implements developed by this Institute to the farmers. The participating farmers took keen interests in different implements and tested them in their fields.
Kisan Mela

Kisan Mela organised on Feb, 15, 1997 at the Institute, was inaugurated by Sri P.D. Sudhakar, IAS, Commissioner, Jhansi Division. The function was presided over by Dr. Bhag Mal, Director, IGFRI and was attended by various officials of development agencies, scientists of IGFRI, NRCAF and a large number of farmers, farm women and village extension workers. The participants interacted with scientists and development officers.

Bundelkhand Vikas Pradarshni

The Institute participated in this exhibition by putting up a stall to display various R & D activities from Feb. 14 to March 22, 1997. Various fodder production technologies and packages of practices were depicted through photographs, models and live demonstrations. The Institute extension literature was distributed to visitors. Our exhibition stall was awarded Ist Prize - a momento and certificate of Merit.

For any further information, you can reach us in person or through mail at:
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Telephones : (0517)440908, 444385, 444771 Fax : (0517) 440833, E-mail : igfri@x400.nicgw.nic.in