During the mid term review of the Indo-UK Project on Fodder Production, the UK Coordinator (Professor R.J. Haggar) felt a need for the professional training of IGFRI scientists at the International Centre for Development Oriented Research in Agriculture (ICRA), Wageningen, The Netherlands. ICRA provides training in managing multinational and interdisciplinary teams, and inter-institutional linkages. Professor Haggar supported IGFRI applicant for 1997 ICRA Programme followed by the visit of IGFRI delegation to ICRA in July, 1996. This led to the participation of Dr. S.K. Sharma in 1997 ICRA Programme. IGFRI explored the possibility of further training of its scientists at ICRA and the tripartite collaboration among IGFRI, ICRA and DFID through Professor Haggar and J. Farrington resulting into their visit to India in November, 1997 along with Dr. JRV Daane, Director, ICRA.

**Achievements**

The visit was fruitful in more ways than one. Some of the achievements are: (i) ICRA selected Dr. S.K. Soam for its 1998 programme (ii) The Indo-UK Project funded another IGFRI Scientist, Dr. R.B. Yadava (iii) IGFRI and ICRA agreed to conduct the joint field study entitled 'A comparative system analysis of causes and effects of free range grazing and alternative

feed supply and grazing regimes in the Bundelkhand Region (iv) Opportunities for IGFRI research in India (at IGFRI) as part of ICRA Programme (v) Dr. Sharma was identified as the Co-ordinator for IGFRI-ICRA collaboration (vi) ICRA team of six members including the Indian participants, Drs Soam and P. Ranjitha is completing three months field study from 11 April to 10 July, 1998 (vii) Dr. Ranjitha joined ICRA team only for the period of the field study in India (viii) Dr. Yadava is participating in another field study at Kenya.

**Future Prospects**

ICRA is ready to accept two IGFRI scientists in 1999 with funding from the Indo-UK Project and ICRA. One participant will go to a third country for field study. Another participant will join the Indian Field Study probably at KIRIBCO Indo-British Project (KIRBP) at Dahod which will focus on meeting the fodder requirements of small and marginal farmers under rainfed conditions. Considering the findings of the Dahod field study, IGFRI and KIRBP will prepare an on farm research project for taking relevant on the shelf technologies to the farmers fields and conduct research to fill the gaps where appropriate technologies do not exist. Negotiations are on to have ICRA field study at the IGFRI Regional Research Station, Dharwad.
IGFRI-ICRA JOINT FIELD STUDY

IGFRI is hosting a joint field study with the International Centre for development oriented Research in Agriculture (ICRA), The Netherlands from 13 April to 10 July, as a part of 1998 ICRA Programme. The programme started in Wageningen (The Netherlands) on 12 January, 1998. The topic of the field study is A comparative systems analysis of causes and effects of free range grazing and alternative feed supply and grazing regimes in Bundelkhand Region: Opportunities for IGFRI research.

Goal

The goal of the field study is to contribute for improving the livelihood of livestock farmers in the Bundelkhand Region by promoting technologies for the development of natural grassland through the promotion of institutional support that uses an interdisciplinary, systemic and participatory approach to identify and meet the needs of farmers.

Objectives

The objectives of the field study are to:

- make a comparative analysis of the free range grazing (FRG) and managed feeding regimes (MFR)
- determine the reasons for the persistence of FRG
- identify the constraints and opportunities for conversion of FRG to MFR
- assess the existing technologies that may be useful in an MFR
- identify the zones where such technologies have better chances of success and
- suggest relevant research areas to IGFRI to fill the gaps between the problems and existing technologies.

Team

The interdisciplinary and multicultural team is comprised of the following six members:

<table>
<thead>
<tr>
<th>Name</th>
<th>Discipline</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gomez Norma</td>
<td>Socio-economics</td>
<td>Philippines</td>
</tr>
<tr>
<td>Kombiok James</td>
<td>Agronomy</td>
<td>Ghana</td>
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<td>Mshana Yahya</td>
<td>Animal Nutrition</td>
<td>Tanzania</td>
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<tr>
<td>Pushkar Ranjitha</td>
<td>Ag Economics</td>
<td>India</td>
</tr>
<tr>
<td>Soam Sudhir Kumar</td>
<td>Economic Botany</td>
<td>India</td>
</tr>
<tr>
<td>Williams Stephen</td>
<td>Plant Sciences</td>
<td>Belize</td>
</tr>
</tbody>
</table>

Methodology

The team is applying development oriented research in agriculture (DORA) methods to meet the needs of the farmers and the society through a process that:

- is carried out by interdisciplinary teams
- involves participation of stakeholders
- takes system approaches to promote agricultural systems that balance
  - economic competitiveness
  - social equity, and
  - environmental sustainability

The team prepared for the field study at Wageningen based on the secondary data and made a zonation of the Bundelkhand Region using criteria that influence the grazing systems. After arriving at IGFRI the team conducted a reconnaissance survey to get acquainted with the ground realities and provisionally selected sites for conducting in-depth studies. The team interacted with different stakeholders like farmers, officials and village level functionaries from relevant government departments, NGOs and researchers to obtain their perceptions regarding the problem. The team used participatory rural appraisal (PRA) methods to collect information from the selected sites and prioritize problems with particular reference to FRG.

The Mid-Term Workshop was conducted on the 23 May, 1998. A cross section of stakeholders participated in the workshop. The workshop aimed at:

- providing an opportunity to the stakeholders to share their perspectives on FRG
- obtaining feedback on the ICRA teams perspective on FRG
- identifying constraints, opportunities and technology requirements for improving both, livestock feeding and grazing resource management.

The technological options available to solve the problems faced by the farmers were identified through a review of research reports and discussions with various stakeholders. The options were screened for three criteria viz., equity, sustainability and economic competitiveness. The results will be presented in a final Workshop to be held on 4 July, 1998.

(S.K. Sharma, S.K. Soam & P. Ranjitha)
Flowering Phenology and Pure Germinating Seed (PGS) Yield in Gamba grass

Gamba grass (Andropogon gayanus Kunth) is a native of tropical Africa and introduced as a fodder grass in many countries. It is favoured due to its persistence in regions with a pronounced dry season. Flowering phenology and pure germinating seed (PGS) yield of this grass was examined during 1995, 96 and 97 as it varies from place to place depending upon the site i.e. latitude and altitude. Floral initiation takes place in the first or second week of November, in response to short days and at the advent of favourable day temperature i.e. below 30°C. Monsoon initiated growth starts during end of June or early July. The sward height exceeds three metres after inflorescence exserction during end of November. Tiller density varies 200-300/m² with about 1000 inflorescences/m², having cent per cent tiller fertility. Each inflorescence possesses two racemes with about 20 seeds/head. One thousand seed weight is 2.5 g giving an estimated potential seed yield of 618, 817 and 755 kg/ha against 26, 15 and nil per cent PGS during 1995, 96 and 97 respectively. Low night temperature (below 10°C) during anthesis and grain formation towards end of November and first half of December appears to have adversely affected seed setting since low night temperature below 10°C, impedes seed setting in tropical grasses. Unusual weather conditions during anthesis and grain formation in 1997 e.g. extended rainfall during autumn and winter, early drop in night temperature, less sunshine and higher humidity did not allow seed setting, resulting into nil PGS yield, though seed (empty spikelet) production was 755 kg/ha.

Unlike native grasses of the region producing seed during September-October, gamba grass yields seed during winter, after more than 5 months of vegetative growth, when night temperatures are below 10°C and unfavourable for seed setting, suggesting that prospects of pure seed yield of this species are poor under Central/Northern Indian conditions. Due to longer vegetative growth, the spikelet yield was higher, but majority of spikelets could not be filled due to sudden drop in night temperature. The tiller height recorded up to 3.6 metres is much higher compared to two metres in African or South American regions (lat. 3.1, Alt. 990 m) where it flowers repeatedly 3-4 times in a year with more than 60% seed purity.

From the Director’s Desk

Dear Readers,

Ever since I took over charge of Director IGFRI, I have been striving hard to push ahead the ongoing research programmes of the Institute and also to look into strengthening and upkeep of the infrastructural facilities. The SRC was held in May 1998 and a thorough exercise has been done to review the current activities and also to develop a compatible team of scientists to manage the research projects. The technical programme for the year 1998-99 was also given a critical look and was discussed and finalized.

A team headed by a senior level functionary and comprising of subject matter specialists was constituted to review the field and laboratory trials and to suggest improvements. To put this activity on a regular and systematic footing it was recommended by the RAC to have a regular set up for research planning, information and monitoring. This is being implemented now.

All the national and international collaborative research programmes were also looked into and all of them are moving ahead on the expected line. The other research programmes with external funding and also Institutes outreach programmes are also running as per schedule. A major improvement in the library facilities was effected by addition of a well-furnished reading room.

Much attention was required on the upkeep of the residential campus and Central Research Farm. A cleanliness drive was initiated and particularly the lighting facilities are greatly improved now. The campus roadside was also developed and it now gives a well managed green look all around.

Hopefully, all these activities and facilities will create a better working and social environments for the scientists and the Institute will march ahead.

(P.S. TOMER)
Profile of a Division

FARM MACHINERY AND POST HARVEST TECHNOLOGY

A unit of Agricultural Engineering started functioning in the year 1967 under the leadership of Dr. Jai Singh with the aim of procurement and maintenance of various farm tools and development of Institute Research Farm. The unit was upgraded in the year 1971 to the level of a section of Agricultural Engineering having two distinct but closely inter-related units namely research unit and service unit (Farm Operation and Management Unit). To meet the specific requirements of farm tools/ implements and machinery, irrigation and drainage systems for fodder and forage production, soil and moisture conservation techniques for increasing production and productivity of rangelands, conservation, processing and storage of herbage and their seeds, the section of Agricultural Engineering was, further, upgraded to the level of Agricultural Engineering Division during year 1977 subsequently redesignated as Farm Machinery and Post Harvest Technology (FM&PHT) Division with the following major objectives. This division is presently headed by Dr. P.D. Gupta with a strength of 11 scientists.

UNITS
- Farm Machinery and Power
- Post Harvest Technology and Processing
- Soil and Water Conservation Engineering
- Agricultural Engineering Workshop

MANDATE
- Design, development and evaluation of farm machinery and implements for forage crops.
- Design, development and evaluation of post harvest processes, techniques for efficient utilization, conservation and value enrichment of forage produce.
- Development and evaluation of soil and moisture conservation techniques and structures for increasing production and productivity of rangelands.
- Development of structures and processes for utilization of non-conventional energy sources.

SPECTRUM OF ACTIVITIES

To meet the specific requirements of farm tools and machinery for higher production of fodder and its effective utilization through processing and enrichment techniques, scientists of the division are engaged in research programme related to following thrust areas:
- Evaluation of tillage implements for higher forage productivity.
- Design and development of forage harvesting machines.
- To evolve processes and techniques for fodder conservation and utilization through pelleting, baling and densification.
- Evaluation of different soil and water conservation measures to increase productivity of forage crops.
- Transfer of technology to the farming community engaged in forage crop production.

The division has a Prototype Feasibility Test Centre of All India Coordinated Research Project on Farm implements and Machinery, coordinated from CIAE, Bhopal.

Agricultural engineering workshop caters to repair and maintenance work of tractors, pumps and farm machinery.

RESEARCH ACHIEVEMENTS

Farm Machinery and Powers
- Developed a IGFRI country plough seeding attachment having a field capacity of 0.04 ha/h with 65% field efficiency.
- Developed a IGFRI two row bullock drawn multi-crop seed drill for sowing of wheat, sorghum, peas, urd, moong, gram, safflower, linseed, oat, maize etc. It is useful for both dryland agriculture and irrigated areas. Trials on farmers field have shown 17-20% increase in yield of wheat over traditional methods of sowing.
- IGFRI Bullock and tractor drawn channel-cum-bund formers were developed for preparation of bund and channel. The effective field capacities are 0.8 ha/h and 2 ha/h with 70% and 80% field efficiency respectively.
- Designed and developed a weeder-mulcher for intercultural operations. A comparative study with respect to local spade has shown that it is better than local spade by 18%.
Division has developed a pod-plucker for harvesting of seed pods, twigs from a tree height up to 6.6 m. In case of subabool pod plucking, it has the capacity of 9 kg/day.

Developed a IGFRI pitter-disc harrow for in-situ moisture conservation in degraded lands. Its effective width of operation is 1.57 m. at feed capacity of 0.5 ha/h along with 70% field efficiency.

Developed a rotary grass mower for harvesting of forage crops. It utilizes the rotary action of knife as the cutting force. It is operated by a 45 hp tractor and blades/knives rotate at 750 rpm with an effective field capacity of 0.3 ha/h.

Designed and developed a rotary disc mower for harvesting of berseem, lucerne, oats etc. During operation discs rotate horizontally in opposite direction and crop is cut by revolving blades fitted on the discs. It is operated by 35 hp tractor using V-belt and chain drive power transmission mechanism. Effective cutting width of machine is 1.30 m. at an effective field capacity of 0.25 ha/h.

A flail type forage harvester has been developed for harvesting of all types of green material for silage making and fresh feeding. It has three fold function i.e. cutting, chopping and loading in accompanying trolley. The tractor operated forage harvester has an effective field capacity of 0.2 ha/h with 100 cm effective width of cut.

Division has developed a power operated feed pelleting machine to produce feed pellets from roughage mixed with leguminous fodder and concentrate as per the requirement. The capacity of the machine ranges from 60-80 kg/h and operating cost varies from Rs. 0.18-0.21/kg depending upon the size of pellet. Same machine can also be used for making seed pellets by changing its die.

For artificial drying of green forage, a hay drier has been developed. It consists of an inverted V-shaped wooden structure over which green fodder @ 1 t/day is spread for a period of 7 days. Air is blown through the structure to dry the forage below 20% moisture. About 2-3 tonnes of hay is produced in a batch of 7 days.

Division has also developed a tyre type seed pelleting machine for making seed pellets from a mixture of finely ground pelleting material and grass seed with different combinations.

<table>
<thead>
<tr>
<th>Pelleting material</th>
<th>Pelleting material to seed ratio for</th>
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<tbody>
<tr>
<td>Clay soil + FYM ; 3:1</td>
<td>Aerial seeding ; 4:1</td>
</tr>
<tr>
<td>Clay soil + SSP ; 99:1</td>
<td>Mechanical seeding ; 24 :1</td>
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</table>

Designed and developed a high density forage baling machine. It could bale upto a density of 350-400 kg/m³. The capacity of the machine is 600-800 kg/h. The cost of baling ranges from Rs. 60-80 per tonne. This type of baling press is very useful in high fodder producing areas of the country. It can reduce the cost of storage and transportation significantly.

Developed technologies related to soil and water conservation under different forage production and grazing systems.
Nitrogen economy in Setaria grass through intercropping of pasture legumes

Field experiments were conducted to evaluate the performance of five pasture legumes (*Sesbania sesban*, *Desmenthus virgatus*, *Stylosanthes scabra*, *Clitoria ternatea* and *Desmodium tortuosum*, used as intercrop components) with respect to nitrogen economy and seed production of *Setaria sphacelata* - a grass based management system which was maintained under rainfed condition from 1993 to 1995 at Research Farm, IGFRI, Jhansi. The average fertiliser nitrogen equivalence (NE) values over the 3 years were found to be *S. scabra* (46.9 kg N/ha), *C. ternatea* (39.8 kg N/ha), *D. virgatus* (29.0 kg N/ha), *S. sesban* (20.0 kg N/ha) and *D. tortuosum* (17.0 kg N/ha). The intercrops of *C. ternatea* and *S. sesban* increased the seed yield of *S. sphacelata* by 52 and 43%, respectively over monoculture of the latter. Overall, *C. ternatea* gave significant association as an intercrop in *S. sphacelata* grass.

Forage Seed Production

Continuous and concerted efforts are being made to produce quality seed of various fodder crops (including grasses) at IGFRI, Jhansi. Consequently, 10, 040 kg of breeder seed of various cultivated fodder crops was produced under National Seeds Project (Crops) during 1997-98. The crop/variety-wise break-up of seed produced is:

Cowpea EC 42160 520.0 kg; Bundel Guar 1 - 80.0 kg, Bundel Guar 2 - 50.0 kg; Berseem - 300.0 kg; M.P. Chari - 275.0 kg and Sem 15.0 kg; Oat kent - 2.5 t; JHO 822 - 6.0 t and JHO 851 - 300.0 kg.

Similarly, 1073.0 kg TFL seed of grasses (*Pennisetum pedicellatum* - 880.0 kg and *Cenchrus*, *Chrysopogon* etc. - 193.0 kg) was also produced during the year 1997-98.

IGFRI 1019-1 (Bundel Guar-3) - A Multipurpose Superior Guar Variety

A new variety of forage cum seed type Guar IGFRI 1019-1 has been developed. The variety has been identified for consideration by Central Sub Committee on crop standards notification and release of varieties of Agricultural Crops. The variety has proven its superiority by a margin of 10.9% grain yield, 12.27% gum, 15.62% seed protein yield, 12.1% green fodder, 12% dry matter, 13% crude protein and digestibility at par as compared to standard checks of both fodder and seed types.

Regeneration of Plantlets in Lucerne Tissue Culture

Nodal segments, petioles and cotyledons of several genotypes were used as explants for callus induction and plant regeneration. Callus was induced on SH medium with different auxin and cytokinin concentrations. The calli was subcultured at 20 days intervals. After several subcultures, the plantlets were regenerated and rooted on SH or MS media with or without growth regulators and adjuvants. The plantlets exhibited well developed shoot and root systems. These *in vitro* regenerated plants were successfully transferred from cultured conditions to the pots for hardening.

(Sanjay Gupta, M.G. Gupta, B. Venkatesh Bhat & Vishnu Bhat)
Isozyme Polymorphism in Somaclones of Marvel Grass (*Dichanthium annulatum*)

The somaclones of *marvel grass* (*T₀*) and their progenies (*T₁*) were analysed for three isozymes viz., Esterase, Phosphoglucomutase (*PGM*) and Glucose-6-Phosphatedehydrogenase (*G₆PDH*) for characterizing stable and heritable somaclonal variations. Esterase isozymes exhibited variation among somaclones (*T₀*) compared to their mother plant. They were more polymorphic and differentiating than *PGM* and *G₆PDH* isozymes. One of the somaclones (*T₀*) differed from its progeny (*T₁*) *PGM* and *G₆PDH* isozymes indicating the presence of sexuality. Auxin-induced-parthenocarpy studies further confirmed the presence of facultative apomixis in this somaclone. Zymograms of nine somaclones (*T₀*) and their respective progeny (*T₁*) were similar, thus implicating stable heritable variations.

(Vishnu Bhat, B. Venkatesh Bhat, M.G. Gupta & Sanjay Gupta)

**Indo-UK Collaborative Project: Forages on Bunds**

**Background**

Field bunds are laid in most part of Central India to check run off losses. Although farmers appreciate the benefits of bunding around their fields, this resulted in the loss of cultivable area. Secondly, the bunds were sometime washed away during heavy rains. Therefore, the present Indo-UK collaborative project funded by DFID, UK was undertaken at IGFRI, Jhansi to address the problems of limited productivity and instability of these bunds. The UK partner of the project is IGER, Aberystwyth. The purpose of the project is to optimise functions of bund systems by enhancing their productivity and stability through participatory approaches.

**Joint decisions on possible utilisation of bunds on farmer's field.** The farmers and researchers jointly decided the methodology to carry out the mutually agreed utilisation of field bunds. The farmers are involved as equal partners from the beginning. They carried out required operations themselves with partial assistance from the project. The farmers are responsible to provide necessary inputs for the survival and the maintenance of the plants while the researchers are responsible for providing technical assistance to the farmers. Both farmers and researchers are supposed to record productivity data jointly and interpret the results. Similar plantations on bunds are taken up at CR Farm, IGFRI Regional Research Centre (RRC), Dharwad to create broader network for bund production systems in other parts of the country.

**Sites**

Presently the work is going on in the farmers fields at Khajraha Khurd and Ambabai, villages of Jhansi. The RRC, Dharwad has taken up plantation work at the farmer's fields in the Surashittikoppa village (Distt. Kalghatiga) in collaboration with the BAIF (NGO).

**Clients and beneficiaries**

Major clientele group for the findings of the project is small and marginal farmers under rainfed conditions. However, results of the project will also be beneficial for other types of farmers having irrigation resources at their fields as some of the farmers participating in on farm trials are having partial irrigation facilities.

**Outcome**

- Farmers realised the importance of participation in on farm trials to address their problems of limited productivity from bunds and their instability.
- Farmers agreed to share inputs required for such trials.
- Created sufficient motivation among lady farmers to prevail upon the male farmers to participate in on farm trials.
The Institute has constituted a PRA Cell under the chairmanship of Dr. S.A. Faruqui. The objective of the Cell is to orient IGFRI research towards its clients and impart training to IGFRI scientists/staff of outside agencies for the participatory approaches in research. The following activities have been identified to achieve the said objective of the Cell.

- Arrange training for IGFRI scientists at the Institute level and outside (abroad) for those who have not been exposed to PRA training and refresher courses for those who have been imparted PRA training earlier.

- Help IGFRI scientists in preparing the research projects involving the element of participation of the stakeholders.

- Arrange PRA training for outside agencies.

The following scientists have been included to give multidisciplinary character to the Cell. Drs. Maharaj Singh (Ag Extn.), D.R. Malviya (Pl Br.), A.K. Misra (Agr Sci), P. Ranjitha (Ag Eco) and S.K. Sharma (Hort.). Member Secretary.

XIX GROUP MEETING OF ALL INDIA COORDINATED RESEARCH PROJECT ON FORAGE CROPS

The group meeting of AICRP on Forage Crops held on May 5-7, 1998 at BCKV, Kalyani. The chief guest, Shri Narendra Nath De, Minister in charge Agriculture (W.B.) inaugurated the meeting. Dr. Mangala Rai, Deputy Director General (Crop Science) in his inaugural address gave a brief account of progress and achievement of the project. The Chairman Dr. M.G. Som, Vice Chancellor, BCKV, Kalyani informed that the area under fodder crops has increased from 5.5 million hectares to 6.9 million hectares. The major findings of the meeting are:

1. A variety of DRSV-2 of Bazara was identified for release.
2. Guinea grass was noted to be salt tolerant among other species.
3. Crop management and plant protection results were encouraging to intensify efforts in future.

Visits

Dr. S.A. Faruqui, Sr. Scientist (Entomology) has been deputed to undergo three months training programme in IGER, Northwyle campus under the Indo-UK project. In UK, he will take up the studies in developing ecological, low cost approaches to pest control, specially in sorghum.

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