

NARI ANNUAL PROGRESS REPORT 2003-2004

Report of the President

With the recent elections and change in the government, there appear to be some fundamental policy changes, which are expected to increase the emphasis on agriculture and rural development. As one of the outcomes of this Dr. Anil K. Rajvanshi, Director of the institute was invited by the Planning Commission, Government of India in June to present his work in the areas of cooking and lighting. Subsequently the Planning Commission recommended the setting up of a [National Technology Mission on Cooking and Lighting for rural areas.](#)

The new Prime Minister, Honorable Dr. Manmohan Singh had presented the Jamnalal Bajaj Award to Dr. Rajvanshi in the year 2001. Since then they have been in constant contact. Dr. Rajvanshi has been regularly sending his writings to Dr. Singh and we hope that some of it is reflected in the government's policy on rural development. Another of the well wishers of NARI since its inception, honorable Shri. Sharad Pawar, has taken charge of the ministries of agriculture, consumer affairs, food and public distribution at the center. We congratulate him on his appointment and expect to have a fruitful collaboration with the agencies under him.

From 1 January 2003 the animal husbandry division of NARI is implementing the new project sanctioned by the Australian Center for International Agricultural Research. This project entitled "Improved productivity, profitability and sustainability of sheep production in Maharashtra, India through genetically enhanced prolificacy, growth and parasite resistance" has the potential to revolutionize sheep rearing in Maharashtra and other states of India if it succeeds.

In the face of successive years of drought and to give a fillip to the state's rural economy, Tamil nadu government recently announced a program to promote a switch to less water-intensive crops like – sweet sorghum and jatropha. The government has also invited expressions of interest from corporates for processing these crops for bio-fuel. NARI has already been supplying the seeds of sweet sorghum and know-how for growing it to many agencies in Tamil nadu for last several years. This announcement by the chief minister is expected to further boost the interest in sweet sorghum.

Last four years have been drought years with the year 2003 having had only 141-mm rainfall. This year till June-end 280-mm rainfall has been received at the institute, which is more than twice that for a normal year. Thus we are expecting this to be a normal rainfall year at least in western Maharashtra. Although the drought seems to be over as of now, its effects will be felt for a long time to come.

I would like to thank all those who have given generously in response to our appeal for funds, and to remind others that we would be grateful for contributions to the Institute's fund for sustainable development, however small the amount. I would especially like to mention Mr. Rakesh Sharma, Commissioner Customs, Mumbai who has been instrumental in spreading the word around about our work and inspiring a considerable number of people to donate to our cause. Due to the efforts of well wishers like him we are hoping for more fruitful years of research in coming days.

Dr. N. Nimbkar

July 19, 2004

AGRICULTURAL RESEARCH

Our work in agricultural research continues to be focussed on two crops viz. safflower and sweet sorghum.

SAFFLOWER

Project 1 : All India Coordinated Research Project (AICRP) on Oilseeds (Safflower) : Funded by Indian Council of Agricultural Research (ICAR), New Delhi.

NARI is one of the AICRP centers of safflower research for limited irrigation since 1980. The thrust of safflower improvement at NARI is on developing high yielding and high oil producing spiny and non-spiny varieties and hybrids with inbuilt resistance to wilt (*Fusarium oxysporum*). In addition, development of suitable agro-production technology for safflower under limited irrigation conditions is also under progress.

The major findings of safflower research carried out under the AICRP during 2003-04 are as follows :

1. **Dissemination of technology of seed production of non-spiny hybrid NARI-NH-1 :** The technology of seed production of newly developed non-spiny hybrid NARI-NH-1 is being disseminated to the seed producing agencies in order to familiarize them with the technology. This would make seed production in safflower commercially feasible resulting in increased area under hybrid safflower leading to an increase in productivity of the crop in the country.
2. **Development of promising spiny and non-spiny safflower hybrids :** The spiny hybrids NARI-SH-14 and NARI-SH-15 based on a non-spiny male sterile line have been developed. The hybrid NARI-SH-14 recorded an average increase of 14% in seed and oil yield over the hybrid check DSH-129 under rainfed conditions and the hybrid NARI-SH-15 showed an increase of 12 and 14% in seed and oil yield respectively over DSH-129 under irrigated conditions in the initial hybrid trial of the coordinated program carried out during winter 2002-03. In addition, in the initial hybrid trial the non-spiny hybrid NARI-NH-17 exhibited an increase of 15% in seed yield and 13% in oil yield over the non-spiny hybrid check NARI-NH-1 under irrigation. All the three hybrids were promoted to advance varietal and hybrid trial-I for evaluation during 2003-04.
3. **Development of high yielding and high oil containing safflower cultivars :** The high oil containing safflower variety NARI-38 which was evaluated in the state multilocation trial during winter 2003-04 recorded seed yield at par with the check Phule Kusuma – a newly developed cultivar released in 2003. NARI-38 contains > 36% oil in its seeds. The other high oil containing cultivars viz. NARI-33, NARI-34, NARI-35, NARI-36 and NARI-37 developed at the center have been evaluated in the initial varietal and hybrid trials of coordinated program carried out during winter 2003-04.
4. **Breeding for wilt resistance in safflower :** Safflower wilt is one of the major diseases affecting irrigated safflower and is considered to be a major hindrance to cultivating safflower in the wilt-prone areas. Therefore, to overcome the wilt problem, a breeding program to transfer wilt resistance from a stable source identified in the AICRP system into a high yielding but wilt-susceptible cultivar Nira has been initiated at the institute by adopting the backcross method of breeding. During 2003-04, 170 individual plant progenies of BC₄F₃ generation were evaluated for wilt resistance which resulted in identification of 53 progenies exhibiting < 10% wilting in them as compared to more than 93% wilting recorded in the wilt-susceptible cultivar Nira.
5. **Polyembryony in safflower :** The studies on polyembryony in safflower revealed the recurrent nature of its occurrence. This indicated its possible use in crop improvement in safflower.

6. ***Apomixis in safflower*** : The studies carried out on crosses involving suspected apomictic plants in their F₁ and F₂ generations indicated the development of both apomictic and sexual seeds in safflower. The apomictic nature of seeds was recognized from the fact that plants originating from them had characteristics similar to mother plants in F₁ and subsequently there was no segregation in F₂ generation, which originated from these plants.
- About 221 advance generation entries having oil content of about 35-40% were evaluated during 2003-04. Twenty four entries out of them were found to give higher seed yield than the best check.

Project 2 : Identification of early plant growth male sterility marker in existing GMS systems and search for cytoplasmic-genic male sterility in safflower : Funded by Indian Council of Agricultural Research (ICAR), New Delhi.

The investigations carried out under the scheme during 2003-04 are described below :

1. ***Identification of male sterility maintainer gene for the sterile cytoplasm in safflower*** : NARI has identified the cytoplasm causing male sterility in safflower. The gene imparting fertility to the sterile cytoplasm has also been identified. During 2003-04, about 1433 crosses made between individual male sterile plants and their fertile-sib counterparts were evaluated for identification of crosses giving 100% male sterility in them. The screening of crosses resulted in identification of three crosses exhibiting 100% male sterility in them. These crosses were the same ones which had shown 100% male sterility during 2002-03. However, the crosses, made between male sterile lines showing 100% male sterility and their corresponding maintainer plants, when grown under summer conditions did not show 100% male sterility in them. This indicated the possibility of thermosensitive nature of male sterility maintenance in safflower.
2. ***Identification of male sterility maintainer and restorer genes for induced cytoplasmic male sterility in safflower*** : The male sterility induced in safflower through chemical mutagenic agent streptomycin has been observed to be cytoplasmic in nature, as a few crosses made between male sterile plants and their sib-fertile counterparts and also a cross with a genotype from germplasm lines, showed complete fertility in them. Efforts are in progress to identify the maintainer gene for the chemically induced male sterile cytoplasm in safflower.

Project 3 : Biometrical investigations of flower yield and its components and their maximization in safflower : Funded by Indian Council of Agricultural Research (ICAR), New Delhi.

The progress made under the scheme during 2003-04 is described below :

1. ***Evaluation of spiny and non-spiny genotypes for flower yield and other physiological traits*** : Wide variability among the entries evaluated for flower yield and different physiological traits was observed. The components of variability indicated that the traits such as flower yield/plant, seed yield/plant, number of primary branches/plant, number of capitula/plant, capitulum diameter, number of seeds/capitulum and number of flowers/capitulum which showed high GCV, PCV and heritability coupled with high genetic advance as percent of mean, may be considered for selection to bring desired genetic improvement in the crop.
2. ***Correlation studies between flower yield and its component traits*** : The correlation studies between flower yield and its components in spiny and non-spiny genotypes showed that number of primary branches per plant, number of flowers per capitulum and seed yield per plant recorded significantly positive association with flower yield in safflower.

3. **Variability for flower yield and physiological traits in F_1 hybrids** : Forty five hybrids along with their 10 parents were evaluated to examine variability for flower yield and its components in them. The results suggested the presence of considerable extent of diversity in F_1 hybrids and their parents. The variability components viz. GCV, PCV, heritability and genetic advance as percent of mean were observed to be high for flower yield per plant, seed yield per plant, number of primary branches per plant, number of capitula per plant, number of seeds per capitulum and number of flowers per capitulum thereby indicating the usefulness of selection in these traits for bringing about the desired improvement in the crop.
4. **Correlation studies between flower yield and floral traits in F_1 hybrids** : The correlation studies between flower yield and its components in F_1 hybrids showed that flower yield was significantly and positively associated with number of primary branches per plant, number of capitula per plant, capitulum diameter, number of flowers per capitulum, stigma length, petal area of flower and seed yield per plant.
5. **Inheritance of flower yield and its components** : The inheritance study of flower yield and its components indicated that both additive and non-additive gene actions are responsible for the inheritance of different traits and suggested the exploitation of hybrid vigour for flower and seed yield by using genetic male sterility system existing in the crop as well as resorting to biparental mating in the crosses exhibiting dominant X recessive gene action followed by individual plant selection in the crosses to enhance flower and seed yield in safflower.
6. **Heterosis for flower yield and its components in safflower** : Heterosis studies for flower yield and its components indicated very high heterosis for flower yield per plant (188%), which was followed by number of capitula per plant (173%), seed yield per plant (171%), number of primary branches per plant (81%), number of seeds per capitulum (63%) and number of flowers per capitulum (52%). Promising crosses for different traits were identified for commercial exploitation.
7. **Maximization of flower yield** : Altering of cultural practices like date of sowing, fertilizer levels and plant spacings to maximize flower yield showed that the maximum flower and seed yield from the non-spiny safflower hybrid NARI-NH-1 could be obtained by planting in the first week of October by following a plant spacing of either 45 X 10 cm, 45 X 20 cm or 45 X 30 cm with 100% recommended dose of fertilizers.

Project 4 : To study the usefulness of petal from Indian cultivars of safflower for developing value added products of edible nature : Funded by Department of Science and Technology (DST), New Delhi.

The progress of work carried out under the project during 2003-04 is given below :

1. **Nutritive and toxic element analysis of safflower flowers** : An analysis of nutritive and toxic elements in safflower flowers was carried out to assess the nutritiveness and suitability of safflower flowers of Indian cultivars for human consumption. The analysis of toxic elements in flowers of seven genotypes showed the amount of cadmium to range from 0.33 to 0.51 mg/kg and of arsenic to range from 0 to 0.66 mg/kg. The traces of lead (Pb) ranged from 1.27 to 8.31 mg/kg. The Pb content was observed to be higher in the entries 327 (7.56 mg/kg) and 684 (8.31 mg/kg) as compared to < 2.33 mg/kg recorded in rest of the entries. The presence of high Pb content in the two entries makes their flowers unsuitable for human consumption. The nutritive analysis carried out in non-spiny cultivar NARI-6 and non-spiny hybrid NARI-NH-1 indicated that flowers of both the cultivars were rich in protein (12.86 and 10.4%), total sugars (7.36 and 11.81%), calcium (558 and 708 mg/100 g), iron (55.1 and 42.5 mg/100 g), magnesium (207 and 142 mg/100 g) and potassium (3992 and 3264 mg/100 g) respectively. Thus the nutritive analysis of safflower flowers of NARI-6 and NARI-NH-1 revealed that the flowers are totally safe for human consumption and are rich in essential components needed for good health.

2. ***Evaluation of safflower colour for colouring food products*** : Safflower flower extract was evaluated for determining its suitability and acceptability as a natural colour for different food products. Safflower dye appeared to be a good colourant for different food products like icecream, sweets (Jalebi, Pedha, Burphi, Shrikhand, etc.), flavoured milk, cake and bread. Concentration of pigment required for imparting yellow colouring to different food products was also determined.



Dr. Padma S. Vankar at the Facility for Ecological and Analytical Testing (I.I.T. Kanpur) carried out crude dye extraction from dried safflower flowers of NARI-NH-1 supplied by us. Column chromatography of these extracts was carried out to know the different components of the dye. The dye was also used for dyeing cotton, silk and wool samples. The content of Carthamin

(red dye) by solvent method was found to be 1.25% while that of safflower yellow (by aqueous method) was found to be 28.5%.

3. ***Pharmacological investigations of safflower flowers in controlling hypertension in humans*** : The pharmacological investigations of safflower flowers to control hypertension are being carried out by Dr. U. M. Thatte, Associate Professor, Department of Clinical Pharmacology at BYL Nair Charitable Hospital and T. N. Medical College, Mumbai.

Extension activities in safflower at NARI :

- NARI supplies high quality seeds of spiny and non-spiny safflower varieties and hybrids for testing purposes in addition to the complete production technology of safflower.
- NARI also supplies dried safflower flowers as a herbal health tea and for other commercial utilization.
- NARI has conducted 15 frontline demonstrations in safflower on farmers' fields in district Satara during 2003-04 to demonstrate the latest technology developed in the crop for commercial adoption by the farmers.

SWEET SORGHUM

Project : Developing sorghum as an efficient biomass and bio-energy crop and providing value addition to the rain-damaged kharif grain for creating industrial demand : Funded by Indian Council of Agricultural Research (ICAR), New Delhi under National Agricultural Technology Project (NATP).

Thrust of research activities on sweet sorghum at NARI :

1. To develop photo-thermoinsensitive cultivars and hybrids suitable for grain, fodder and sugar production.
2. To develop round the year seed production technology for sweet sorghum hybrid 'Madhura' to meet the great demand for its seed.

3. To disseminate the agroproduction technology for sweet sorghum cultivation to the farmers.
4. To develop technology for economical, good quality syrup production from sweet sorghum and popularise it among rural communities to encourage them to set up their own units.
5. To carry out training programs for the progressive farmers to make them aware of multi-purpose sweet sorghum crop.

Significant achievements of sweet sorghum research activities at NARI :

1. NARI has identified a number of promising sweet sorghum hybrids for grain, fodder and sugar yields. Among them NARI-SSH-43 has shown good overall performance in multilocation trials under NATP project and development of its seed production technology is in progress.
2. An attempt is being made to formulate a breeding strategy to develop photo-thermoinsensitive cultivars and hybrids. An experiment was conducted to screen the potential CMS lines to be included in the hybrid development program.
3. It has been observed that there is a great demand for the seed of “Madhura”, the sweet sorghum hybrid developed at the institute, so an experiment is underway to carry out the seed production in different seasons of the year to meet the seed requirement round the year.
4. NARI supplied more than 1800 kg seed of sweet sorghum hybrid “Madhura” during 2003-2004. Most of the quantity was supplied to a company, which provides technology, equipment and services to a majority of alcohol industries in the country. Seed was also supplied to many sugar industries, distilleries etc. We also expect to export “Madhura” seed to Zambia as the Zambian government is keen on taking trials on sweet sorghum as an alternative to sugarcane or molasses for ethanol production.
5. NARI has produced about 3000 kg of seed of sweet sorghum hybrid “Madhura” during 2003-2004 against a demand of more than 30 tones from farmers and other interested agencies in the country. An attempt will be made to fulfill at least part of the demand during 2004-05 by carrying out large scale seed production program. NARI initiated for the first time in India the research on ethanol production from sweet sorghum in the early eighties and now after 20 years since then this program is being taken up all over India. Sweet sorghum has emerged as one of the most attractive crops in India as an alternative to sugarcane for ethanol production.
6. NARI has test marketed about 85 liters of sweet sorghum syrup “Madhura” during 2003-2004. NARI is trying to make the existing uneconomical “gurhal” units producing jaggery from sugarcane juice more economical by carrying out syrup making in off season by using sweet sorghum as an alternative feedstock.
7. NARI has also attempted to popularise sweet sorghum cultivation among the farmers by distributing relevant literature, encouraging field visits, and demonstrating the syrup technology to the farmers.

GRAPES

Project : Introduction, evaluation and distribution of plant material of grape varieties suitable for export : Funded by Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi.

The rootstocks planted were fertilized and irrigated regularly. Weeding and pesticide application was carried out as and when required. During monsoon 2003 a soybean crop was sown in between the grape rows.

A trellis structure was fabricated in the institute and erected in the field to train the grape vines on it as per the specifications provided by NRCG. Similarly a drip system has also been installed.

For two varieties viz. Red Globe and Crimson seedless the grafting on the Dogridge rootstock has been nearly completed. For the third variety 'Italia' it still needs to be done on about 100 rootstock plants.

STYLO

Ten elite stylo cultivars were procured from Dr. C. R. Ramesh, Principal Scientist and head, IGFRI Regional Research Station, Dharwad. It included five cultivars each of Stylosanthes seabrana and S. scabra. S. scabra showed relatively poor growth and was harvested in the third week of February 2004 after 19.5 months of growth. S. seabrana appeared much more promising and we were able to harvest it initially 3.5 months after sowing and again recently (in the first week of January 2004) – 12.5 months after the first cutting. No fertilizer application was carried out in this trial and on an average one irrigation per month was applied.

According to preliminary assessment of this trial, it appears possible to get 35 T fresh biomass per hectare per annum which @ 65% moisture translates to 12 T dry biomass ha⁻¹ annum⁻¹. This should easily support a flock of 20-25 sheep or goats giving a gross annual income of Rs. 20,000 to 25,000.

The main advantages of this system are that no outside fertilizer addition is required as stylo fixes its own nitrogen and if grazing is carried out, urine and faeces will be added to the soil automatically. Secondly, due to the high protein content of stylo fodder no concentrates need to be given to the animals. It is possible to collect about 8 tons of seed from the crop per hectare per annum and a good demand for the seed is anticipated at least in the near future. This will be an additional source of income.

Project staff : N. Nimbkar, Ph.D., V. Singh, Ph.D., M. B. Deshpande, M.Sc., S. V. Choudhari, B.Sc., S. R. Deshmukh, M.Sc., N. M. Kolekar, M.Sc., S. P. Patil, M.Sc., Y. N. Bhongale, M.Sc., J. H. Akade, M.Sc., A. T. Ranaware, B.Sc., R. K. Andhalkar, J. R. Kashid, M. G. Shirke, N. T. Madkar, R. M. Ahirekar

RENEWABLE ENERGY RESEARCH

Project 1 : Design and development of motor-assisted hand-driven cycle rickshaw and a completely motorized rickshaw for handicapped persons : Funded internally.

A step has been taken in the direction of commercializing Motor-Assisted NARI Handicapped Rickshaw (MANHARA). A transfer of technology agreement was signed for its manufacture and sales with Adroit Systems, Pune and the engineering drawings were transferred to them. The manufacturing is expected to commence soon.

Project 2 : Road Testing of motor assisted pedal rickshaw (MAPRA) : Funded internally.



Extensive testing of MAPRA has been carried out to test the component failure profile and its road worthiness on poor roads. Thus MAPRA was modified based upon these tests so that it has four back wheels instead of two. This allowed better load bearing and less breakage of spokes and wear and tear. At the same time the feedback from the road testing allowed development of a better and more powerful motor. Hence a new PMDC motor with better torque and power characteristics has been developed and used in MAPRA.

The modified MAPRA has logged more than 4000 kms in trial runs and has proved that it can be safely run on very rough roads.

Project 3 : Solar-catalyzed chemo-oxidation of distillery waste : Funded by Ministry of Non-conventional Energy Sources (MNES), New Delhi.

The project was completed at the end of December 2003 and the final project report was submitted to MNES. An effective treatment system for anaerobically digested distillery wastewater (ADW) was developed and a pilot plant based on it was set up and tested in this project.

The process involved two steps viz. pretreatment where ADW was diluted with tap water or treated effluent and then treated with coagulants in presence of aeration. After about 90 minutes of aeration the effluent was allowed to settle overnight. This was followed by the second step of solar detoxification where supernatant of pretreated ADW was mixed with 1% MgO and then detoxified in presence of solar radiation. The treated effluent obtained after the 3-day treatment resulted in about 95-98% reduction in COD and increase in transmittance upto 90%. For distilleries producing about five lakh liters of ADW daily the treatment cost is expected to be Rs. 0.42 per liter of ADW. Treated effluent was found to be suitable for agricultural purposes, but its long-term effects need to be studied.

Project 4 : Development of ethanol stoves for rural areas : Funded by Ministry of Non-conventional Energy Sources (MNES), New Delhi.

This two year project with MNES funding commenced from February 1, 2004. The objective of the project is to develop stoves with and without wick to run on ethanol-water mixture, suggesting best material for wicks (metallic or ceramic wool), preparing co-emissions report and finally coming out with an optimized design of stove. Ten such stoves will also be tested under actual field conditions.

Though not a part of this project, development of a stove running on non-edible oils has also been done. Thus a 2.5 kW (thermal) wick stove running on karanja oil has been developed which produces a completely blue flame. The complete combustion was achieved by a judicious mix of air/fuel ratio together with the development of a high temperature wick. The wick is a combination of ceramic wool and stainless steel mesh of suitable size and density. Efforts are on to develop an oil control

mechanism so that the flame could be regulated. An offshoot of this stove development will be development of a mantle lamp to be used in remote tribal areas where only non-edible oils are available.

The same methodology and wick design has been used in ethanol stove design. Thus a suitable 2.5-3 kW (thermal) wick stove running on 50% (w/w) ethanol water mixture has been designed and tested and provides a complete combustion of the fuel. The efficiency of the stove is 40-45%. Efforts are on to make this stove run on higher ethanol/water mixtures.

Project staff : A. K. Rajvanshi, Ph.D., S. C. Chilekar, B.Tech. (Consultant), S. C. Parulekar, M.Tech. S. B. Songire, M.Sc. (Trainee), Y. H. Shaikh, B.Tech., N. T. Kumbhar, B.Tech. A. D. Bhopale, B.Tech., S. M. Patil, A. M. Pawar, D. B. Gadhawe, A. A. Thorat, B.Tech., M. G. Dhandare, B.Tech.

ANIMAL HUSBANDRY RESEARCH

From 1 January 2003, the animal husbandry division (AHD) is implementing the new project sanctioned by the Australian Center for International Agricultural Research (ACIAR) No. AS1/2002/038 entitled "Improved productivity, profitability and sustainability of sheep production in Maharashtra, India through genetically enhanced prolificacy, growth and parasite resistance". This project is built on the results of the previous ACIAR-funded project. This is a unique project aimed at improving the prolificacy efficiency of the local Deccani sheep, which usually have a single lamb at each lambing. The approach is to introduce a single gene of major effect on fecundity (the *FecB* or Booroola gene) through crossbreeding with the Garole breed and using a DNA test to identify lambs carrying the gene. The uniqueness of the project also lies in the close involvement of 23 local sheep owners' flocks where the fecundity gene has been introduced. Females born in their flocks and carrying one copy will mature and start to lamb by the end of this year. This will be a test of whether twin lambs are more profitable to flock owners than singles. This project has the potential to revolutionize sheep rearing in Maharashtra and potentially other states of India if it succeeds.

The key outputs of the work carried out during the past year under the project are as follows :

- A. **Production of appropriate genotypes for testing in shepherds' flocks :** A breeding program is established at the AHD to produce ewes and rams carrying one or two copies of the fecundity gene *FecB* and to reduce the proportion of Garole genes in the *FecB* carrier and non-carrier progeny. There are two strains being developed – a fecund Deccani strain without contribution from breeds other than the Garole and a fecund composite with Deccani, Garole, Awassi and Bannur genes. Details of AHD's flock are in Table 1 below.

Table 1. Flock strength at AHD (14 June 2004)

Sr. No.	Description	Adults	Lambs	Total
1.	Homozygous (BB) ewes	6	8	14
2.	Homozygous (BB) rams	3	13	16
3.	Heterozygous ewes	177	79	256
4.	Heterozygous rams	43	26	69
5.	Pure Garole ewes	69	35	104
6.	Pure Garole rams	13	18	31

- B. Testing of improved sheep genotypes in shepherds' flocks and development of appropriate management technologies :** The AHD's main achievement towards this aim has been gaining the confidence of shepherds who are usually very conservative. They have allowed us to use their flocks for experimental purposes. The AHD is working with 23 flocks and renders services such as free veterinary treatment when needed and insuring their animals in return for carrying out research in their flocks. Details of participating shepherd flocks are in Table 2 below.

Table 2 : Information on shepherds' flocks participating in the project (14 June 2004)

Number of flocks	23
Total number of ewes	1010
AHD's pregnant ewes introduced in the flocks (38 B+ and 40 ++)	78
Shepherds' ewes synchronized and artificially inseminated	198
AHD's rams introduced in the flocks	21
Number of lambs born in shepherds' flocks that were genotyped	148
Number of lambs carrying one copy of the gene (B+)	73
Number of lambs not carrying the gene (++)	75
Number of B+ lambs purchased by AHD from shepherds	6
Number of B+ lambs alive in shepherds' flocks	22
Number of B+ lambs sold by shepherds (mostly males)	31
Number of B+ lambs died in shepherds' flocks	14

Research activities being carried out with local flocks are :

1. Epidemiology of gastrointestinal nematode infections in the semi-arid areas has been studied extensively by measuring faecal worm egg counts of animals in shepherds' flocks bi-monthly from mid-2003.
2. Rams carrying one copy of the *FecB* gene were introduced into shepherds' flocks after withdrawing their rams for a stipulated time period. In some shepherd flocks, ewes were oestrus synchronized and inseminated with semen from rams homozygous for the fecundity gene. All lambs produced from these inseminations will carry at least one copy of the fecundity gene.
3. Some ewes carrying one copy of the *FecB* gene, belonging to the AHD were sent to shepherds' flocks for testing their performance under shepherd flock conditions.
4. Participating shepherds' flocks were regularly monitored for all aspects of productivity and profitability in order to compare prolific ewes with non-prolific ones. Weights of all animals were regularly measured along with economic data regarding mortality and sales of animals.

This was however the fourth subsequent year of severe drought and the shepherds faced many unusual constraints and had to migrate to distant pastures.

Results of the above studies are being collated and analyzed.

Key outputs listed in last year's report were confirmed and are once again listed.

1. The genetic basis of fertility in the Garole was shown, by the project in collaboration with AgResearch, New Zealand, to be the single gene called the *FecB* or Booroola. The Garole breed is the most likely source of the Booroola mutation and is probably the 'Bengal sheep' that the late H.N. Turner hypothesized to be the origin of the prolificacy of the Booroola Merino.

2. The *FecB* gene from the Garole can be introduced into another non-prolific breed by crossbreeding to improve prolificacy.
3. Project results indicate that a desirable proportion of Garole genes in a composite meat breed for Maharashtra would be < 25%.
4. Protocols for sheep DNA isolation from WBC pellet and FTA paper and the direct DNA test to detect the *FecB* mutation were established during the project at the National Chemical Laboratory. Sheep can now be genotyped quickly (300 sheep in 10 days) and accurately from blood samples collected on FTA paper.
5. Garole crosses have superior genetic resistance to worms (gastrointestinal nematodes) compared to the Deccani with the Bannur being intermediate.
6. A successful participatory research study carried out in four shepherds' flocks over 18 months showed that gastro-intestinal nematode infection is not a major constraint to Deccani sheep production.

I. LIST OF PUBLICATIONS (ALPHABETICAL ORDER) :

1. Hegde, D. M., Singh, Vrijendra and Nimbkar, N. 2003. Safflower. P. 73-92. In : Hybrid Seed Production in Field Crops (Principles and Practices) (Singhal, N. C. ed.). Kalyani Publishers, New Delhi (India).
2. Nimbkar, C., Ghalsasi, P. M., Maddox, J. F., Pardeshi, V. C., Sainani, M. N., Gupta, V. and Walkden-Brown, S. W. 2003. Expression of the *FecB* gene in Garole and crossbred ewes in Maharashtra, India. In '50 years of DNA', Proceedings of the Fifteenth Conference of the Association for the Advancement of Animal Breeding and Genetics, Melbourne, Australia. pp. 111-114.
3. Nimbkar, C., Ghalsasi, P. M., Swan, A. A., Walkden-Brown S. W., and Kahn, L. P. 2003. Evaluation of growth rates and resistance to nematodes of Deccani and Bannur lambs and their crosses with Garole. *Animal Science*, 76 : 503-515.
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II. OTHER IMPORTANT ACTIVITIES:

1. On Dr. Rajvanshi’s recommendation Maharashtra Electricity Regulatory Commission (MERC) has taken up the cause of establishing microuilities in rural Maharashtra. Thus Dr. Rajvanshi’s letter to the Chairman, MERC was converted into a petition and public hearings on different aspects of rural electrification will soon commence. An order passed by MERC for allowing microuilities in rural Maharashtra will be first such order passed by any electricity regulatory commission in the country. We hope it will pave the way for large-scale rural electrification.
2. The AHD participated in initial trials of the new vaccine for lifetime control of the dreaded sheep and goat viral disease PPR. This vaccine developed by the Indian Veterinary Research Institute (IVRI) was subsequently made available to the AHD on a priority basis. Two thousand vaccine doses were purchased by the AHD to protect our valuable sheep and goat breeding stock.
3. Two computer database systems have been developed with assistance from Dataman, Pune-one for the data of the sheep-breeding program at the AHD and another one for the data of sheep belonging to local shepherds participating in the project. Both database systems are used extensively and have made data storage and retrieval systematic and effortless.
4. One MAPRA and three IMPRAs were exported for testing to Ireland and Sweden during the last year.
5. Dr. Vrijendra Singh visited safflower AICRP centers at Indore, Akola and Parbhani as a member of Monitoring team to monitor the safflower breeding programs, from January 19-21, 2004.
6. Dr. Vrijendra Singh attended “Safflower Germplasm Field Day” organized by DOR at Hyderabad on February 27, 2004.
7. NARI’s name has been mentioned in the popular travel guide “Lonely planet” under the heading volunteer work (pg.135, 2004 edition).

III. APPOINTMENTS ON BOARDS/COMMITTEES:

1. NARI has been nominated as a partner institution of the Global Village Environmental Project (GVEP). This project has been funded by the World Bank. Dr. Rajvanshi attended the partners’ meeting in New Delhi on June 5, 2003.
2. Ms. Chanda Nimbkar was appointed as a non-official Member of the Central Advisory Committee for the Development of Sheep, Goats and Rabbits, reconstituted by the Government of India, Ministry of Agriculture, Department of Animal Husbandry & Dairying for a period of three years from February 2004.
3. Shri. B. V. Nimbkar and Dr. N. Nimbkar were appointed as the members of the Advisory Board of the Baramati Agricultural Development Trust’s College of Agriculture, Baramati. March 2004.

IV. CONFERENCES/SEMINARS/MEETINGS ATTENDED BY STAFF:

1. Shri. B. V. Nimbkar attended a planning workshop for site selection for the DFID funded project “Enhancing livelihoods of poor livestock keepers through increasing use of fodder” on 14-16 April 2003 at International Crops Research Institute for Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh.
2. On 30 April and 19 August 2003 meetings of the Core Advisory Group constituted to advise the office of the Principal Scientific Advisor (PSA) to the Government of India – Dr. R. Chidambaram on Rural Technology were called to continue the earlier discussions on technologies for rural development. Dr. Rajvanshi, a member of this group attended the meetings.
3. On July 4, 2003, Dr. Rajvanshi attended the meeting of the Jannalal Bajaj Awards Committee to decide the 2003 Awardee of Jannalal Bajaj Award for use of Science and Technology in Rural Development.
4. Ms. Chanda Nimbkar attended the fifteenth Conference of the Association for the Advancement of Animal Breeding and Genetics on July 7-11, 2003 at Melbourne, Australia. She presented a paper in the conference. Her travel and accommodation expenses were covered by a student support scholarship from the conference.
5. On September 8, 2003 Dr. R. Chidambaram, PSA to government of India invited Dr. Rajvanshi to address all the scientists at the Bhabha Atomic Research Center (BARC), Mumbai. He was welcomed and honored by Dr. Chidambaram and Dr. Kakodkar, Chairman, Atomic Energy Commission. A team of interested scientists from BARC later visited NARI for further discussions.
6. Ms. Chanda Nimbkar attended the FAO/IAEA International Symposium on “Application of Gene-Based Technologies for improving Animal Production and Health in Developing Countries” on 6-10 October 2003 at Vienna, Austria. She presented a paper at the symposium. To attend this symposium financial support was given by the International Atomic Energy Agency (IAEA) for meeting accommodation and living expenses. She also received the 2003 UNEPA/Faculty of the Sciences Overseas Conference Travel Scholarship from the University of New England for travel expenses.
7. On October 8, 2003, Dr. Rajvanshi was invited to Mumbai to attend a seminar arranged by Confederation of Indian Industries (CII) on the New Electricity Act.
8. On November 3 and 24, 2003, the planning commission sub-group meeting on rural technologies was held at CAPART. Dr. Rajvanshi attended these meetings as a member of this committee.
9. Shri. B. V. Nimbkar attended the final review meeting of the Indian project outcomes of ACIAR project CS1/95/129 on the “Use of High Yielding Anthracnose Resistant Stylosanthes for Agricultural Systems” on 25-27 November 2003. An invitation was extended to him by Dr. P. S. Pathak, Director of the Indian Grassland and Fodder Research Institute (IGFRI) to report on his experiences with Stylo for goat and sheep feeding. He presented a CD prepared by the AHD about the stylo plots at NARI farms.
10. Dr. Vrijendra Singh attended workshop on “Biosafety issues related to transgenic crops” Sponsored by Ministry of Environment and Forests, Government of India and Organized by Biotech Consortium India Ltd., New Delhi at Aurangabad from 5-6 January 2004.
11. Dr. Vrijendra Singh was invited to deliver a lecture entitled “Certified hybrid seed production in safflower” in the National Training Course on “Hybrid seed production of sunflower, castor and safflower”, organized by DOR, Hyderabad on January 22, 2004.

12. Dr. P. M. Ghalsasi attended the National Seminar on Opportunities and Challenges in Nutrition and Feeding Management of Sheep, Goats and Rabbits for Sustainable Production on 10-12 February 2004 organized by the Indian Society for Sheep and Goat Production and Utilization and Central Sheep And Wool Research Institute at Avikanagar, Rajasthan.
13. Shri. B. V. Nimbkar presented a CD on the Volcani Research Institute of Israel and gave a talk to the staff at Krishi Vigyan Kendra, Baramati on 26 February 2004.
14. Ms. P. P. Ghalsasi and Ms. B. M. Pawar gave lectures on the Boer goat and activities of the AHD in the training program organized by MITCON for goat rearers on 1 March 2004 at their training center in Pune.
15. Dr. N. Nimbkar attended the Stakeholders' meeting on "Enhancing livelihoods of poor livestock keepers through increasing use of fodder" on 4 March 2004 at ICRISAT, Patancheru, Andhra Pradesh

V. Training of staff:

1. Dr. P. M. Ghalsasi attended a training course in Ultrasonography in farm animals at the Madras Veterinary College, Chennai from 3-8 November 2003. The main objective of this training was to get hands-on experience in animal ultrasonography, which will be useful in pregnancy diagnosis and to detect multiple fetuses.
2. Dr. Vrijendra Singh attended ICAR-CAS Training on "Exploiting hybrid vigour in crop plants through breeding and biotechnological approaches" conducted by Center for Plant Breeding and Genetics at Tamilnadu Agricultural University, Coimbatore from March 11-31, 2004.

VI. Important visitors:

1. In September 2003 and February 2004, 40-50 farmers from Punjab and Haryana were brought to NARI by the Krishi Vigyan Kendra, Baramati to see the research activities. They also had very interesting discussions with Dr. Rajvanshi on the issues of electricity, water etc.
2. Dr. Elisha Gootwine from the Institute of Animal Science, ARO, The Volcani Center, Israel visited from 6-12 February 2004.
3. Students of Third Year B.Sc. (Botany) class of Fergusson College visited the institute along with the faculty on 6 February 2004.
4. Twenty students and two faculty members of Jnana Prabodhini UPSC Interview Training Program visited the institute on 8 February 2004.
5. In March 2004, Dr. Jeremy Woods, Research Fellow in energy policy at the department of Environmental Science and Technology, at Imperial College, London, his colleague Mr. Gareth Brown and Prof. F. D. Yamba, Director, Center for Energy, Environment and Engineering (Z.) Ltd., Lusaka, Zambia visited NARI for discussions on sweet sorghum. They will be testing the performance of "Madhura" sweet sorghum hybrid in Zambia for ethanol production. During this visit Dr. Woods gave a presentation on "Land use and land use change and its impacts on climate change and development" to the NARI staff.

[HOME](#)