

Nimbkar Agricultural Research Institute (NARI), Phaltan

ANNUAL RESEARCH REPORT 2004-2005

Report of the President

I would like to thank all the private donors and the funding agencies for their support during the past year. This support has made possible our efforts over last nearly forty years, and we hope will continue to do so. I would specially like to thank Housing Development Finance Corporation (HDFC) and Nimbkar Seeds Pvt. Ltd. (NSPL) for giving generous donations to the center for sustainable living and animal husbandry division building fund, respectively.

Our work has started attracting the attention of researchers and students from all over the world. Consequently during the past one year we have had 10 interns from various parts of the world working with us on different projects. This has been very helpful in several of our programs. We are especially thankful to the University of Florida International Center for making available to us an intern via generous funding from the Coca-Cola foundation.

NARI was one of the winners of the prestigious Energy Globe Award-2004 also called the Oscar of Energy in the AIR category. This award (out of 700 applications from world over) was given for its Motor-Assisted Pedal Rickshaw (MAPRA). I would like to congratulate Dr. Rajvanshi and his staff for this award. Dr. Rajvanshi was also honored by being invited to give a distinguished lecture to the College of Engineering, at his alma mater University of Florida, Gainesville, U.S.A.

Last year we were lucky to get about 33% more rainfall than normal and hope for a normal monsoon this year, though it has been 15 days late to arrive. Thus the water situation last year was quite good, but the power situation is really dismal. The newly elected Maharashtra government made matters worse by offering free power to the farmers. Now they have back tracked by removing this facility. However, in spite of the trifurcation of Maharashtra State Electricity Board, the scenario is very bleak. In their last meeting Maharashtra Electricity Regulatory Commission (MERC) adopted the plan for establishing microuilities in rural Maharashtra on the suggestion of Dr. Anil K. Rajvanshi, our Director, who is on the advisory committee of MERC. We hope that this strategy will help alleviate the power shortage in rural areas to some extent.

Next few years are going to be very critical for agribusiness and very few politicians appear to be aware of this fact. If some concrete decisions, which may be unpalatable in the short term, are not taken there is a danger of the collapse of economy in Maharashtra and even the whole country. We sincerely hope that this does not happen. In this connection our research on renewable energy, bio-fuel crops like sweet sorghum, non-spiny safflower and better breed of sheep, which will increase the remuneration to the farmers, offers hope and useful solutions for the state of Maharashtra.

Dr. N. Nimbkar

June 25, 2005

AGRICULTURAL RESEARCH

Our work on 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 area of safflower improvement at NARI is development of 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 2004-05 are as follows :

1. **Dissemination of technology of seed production of non-spiny hybrid NARI-NH-1** : In order to disseminate the technology of hybrid seed production in safflower, the seeds of parental lines of newly developed non-spiny hybrid NARI-NH-1 and the technical bulletin giving information on seed production were supplied to both public and private seed producing agencies in the country. The agencies involved in seed production of NARI-NH-1 during rabi 2004-05 were National Seeds Corporation, Pune; State Farms Corporation of India, Raichur; Mahabeej, Akola; Nimbkar Seeds Pvt. Ltd., Phaltan; Krishidhan Seeds, Jalna etc., Seed production was taken up on about 56 hectares during rabi 2004-05.
2. **Development of promising spiny and non-spiny 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 15% in seed and oil yield over the hybrid check DSH-129 under rainfed conditions and the hybrid NARI-SH-15 showed an increase of 13% and 14% in seed and oil yield respectively over DSH-129 under irrigated conditions in two years of multilocation evaluations in AICRP programme, carried out during rabi 2002-2003 and 2003-2004. In addition a non-spiny hybrid NARI-NH-17 exhibited an average increase of 8% in seed yield over the non-spiny hybrid check NARI-NH-1 under irrigation in two years of AICRP evaluations. All the three hybrids were promoted to Advanced varietal and hybrid trial-II for third year of AICRP evaluations during 2004-05.
3. **Development of high yielding and high oil-containing safflower cultivars** : The high oil containing safflower variety NARI-36 which was evaluated in Initial varietal and hybrid trial during winter 2003-04 recorded an average increase of 10% in oil yield over the national check A-1. NARI-36 also showed immune reaction to wilt under wilt-sick plot screening carried out at the Directorate of Oilseeds Research, Hyderabad. This variety contains more than 35% oil in the seed and has been promoted to Advanced varietal and hybrid trial-1 for evaluation during 2004-05.
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 bottleneck to producing safflower in the wilt-affected areas. Therefore, in order to overcome the wilt problem, a breeding programme 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 rabi 2004-05, 224 individual plant progenies of BC₄F₄ were evaluated for wilt resistance. Most of the lines evaluated in the trial showed very high resistance to *Fusarium oxysporum*.

5. **Identification of thermosensitive male sterility in safflower** : In the course of cytoplasmic male sterility development in safflower it was observed that some of the crosses as well as their respective pollinator parents showed > 75% male sterility in them during winter 2003-04. Even the fertile plants appearing in them were only partially fertile producing only one or two seeds per capitulum. To examine the thermosensitive nature of the male sterility in them, the leftover seed of the said crosses was planted along with that of their pollinator parents in summer 2004. The summer evaluations of the crosses and respective parents during flowering of the crop revealed that the plants in both were mostly fertile. A few entries showed < 3% male sterility in them. The seeds obtained from individual plants of both crosses and parents were further evaluated for thermosensitive nature of male sterility in them in winter 2004-05. Out of the 116 individual selections raised during winter 2004-05, five showed complete male sterility in them, however the remaining selections showed segregation for male sterility. The individual selections exhibiting thermosensitive male sterility are being evaluated during summer 2005 to confirm the thermosensitive nature of male sterility in them. The summer evaluations seem to indicate restoration of fertility in them. This reconfirms the thermosensitive nature of male sterility in safflower in the present case.
6. **Induction of cytoplasmic male sterility through mutagenesis with streptomycin in safflower** : The chemical mutagen streptomycin used to induce cytoplasmic male sterility resulted in induction of male sterility in safflower. The efforts to identify fertile genotypes acting as a restorer and a sterility maintainer to the sterile cytoplasm have resulted in identification of 18 crosses showing complete fertility. However only two crosses showed complete maintenance of male sterility in them. The male sterile plants of these crosses have been maintained individually with the help of fertile plants of the respective pollinator parents and will be planted for confirmation of male sterility maintenance ability of the pollinator parents during winter 2005-2006.
7. **Evaluation of advanced generation selections** : About 131 advanced generation entries having 35-40% oil content were evaluated during 2004-05. The analysis of the trial is under progress.

Project 2 : Biometrical investigations of flower yield and its components and their maximization in safflower : Funded by Indian Council of Agricultural Research (ICAR), New Delhi. **Project Duration** : October 1, 2001 to March 31, 2005

The progress made under the scheme during 2004-05 is described below :

1. **Evaluation of spiny and non-spiny genotypes for flower yield and other physiological traits** : Wide variability was observed among the 26 entries evaluated for flower yield and different physiological traits. The components of variability studied indicated that the traits such as flower yield/plant, seed yield/plant, number of seeds/capitulum and number of flowers/capitulum which exhibited high GCV, PCV and heritability coupled with high genetic advance as percent of mean, may be considered for selection to bring about 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 capitulum diameter, number of seeds/capitulum and number of flowers/capitulum recorded significantly positive association with flower yield in safflower.
3. **Variability for flower yield and physiological traits in F₁ and F₂ generations** : Forty five hybrids along with their parents and their F₂s were evaluated to examine variability for flower yield and its components. The results suggested the presence of considerable extent of diversity in the F₁ and F₂ generations. The variability parameters viz. GCV, PCV, heritability and genetic advance as percent of mean were observed to be high for flower yield/plant, seed yield/plant, 100-seed weight and oil yield/plant in both F₁s and F₂s except 100-seed

weight in F_2 generation, 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 and F_2 generations** : 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/plant, number of capitula/plant, number of flowers/capitulum, petal length, anther length, stigma length, seed yield/plant and oil yield/plant. In F_2 generation, the flower yield/plant was significantly and positively associated with number of capitula/ plant, seed yield/plant and oil yield/plant.
5. **Inheritance of flower yield and its components** : The inheritance study of flower yield and its components in F_1 and F_2 generations indicated that both additive and non-additive gene actions are responsible for the inheritance of different traits except for petal area in both F_1 s and F_2 s and number of primary branches/plant only in F_2 s where only additive gene action is predominant. These results suggested that hybrid vigour can be exploited for flower and seed yield either by using genetic male sterility system existing in the crop or resorting to biparental mating in the crosses exhibiting dominant X recessive gene action. Biparental mating will be followed by individual plant selections to identify the most promising one 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 the presence of very high heterosis for flower yield/ plant (123%), number of capitula/plant (93%), seed yield/plant (90%), number of flowers/capitulum (70%), number of seeds/capitulum (46%) and 100-seed weight (30%). Promising crosses for different traits of economic importance 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 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 at a plant spacing of either 45 X 10 cm or 45 X 20 cm with 100% recommended dose of fertilizers.

Project 3 : 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.
Project Duration : October 1, 2001 to February 28, 2005 (with extension)

The progress made under the project during 2004-05 is given below :

1. **Evaluation of safflower genotypes for flower and seed yield** : Advanced generation selections and cultivars released for commercial production in the country was evaluated for flower and seed yield in five trials. Fifteen advanced generation selections out of 41 evaluated in trial 1 recorded significantly higher flower yield than the highest flower yielding check Bhima. By considering both flower and seed yield, entry D-149-4-2-2 was observed to be the most promising one as it recorded 63% increase in flower yield over the best check Bhima in addition to giving seed yield at par with it. In trial 2, out of the 39 entries screened, eight showed significantly higher flower yield than the best check A-1. The entry D-150-21-2-3 was observed to be the most promising one as it recorded significantly higher seed yield than the best check A-1 besides giving an increase of 36% in flower yield. In trial 3, three entries out of the 38 evaluated exhibited significantly higher flower yield than the best check A-1 of which entry D-150-8-2-14 was observed to be the most promising one as it recorded the maximum increase of 25% in seed yield and 30% in flower yield over the best check A-1. In trial four, eight entries out of the 37 evaluated showed significantly higher flower yield than the best check A-1. Of these, entry D-151-24-3 was found to be the most promising one as it

recorded the maximum heterosis of 28% for seed yield and 62% for flower yield over the best check A-1. In trial 5, out of the 17 released cultivars evaluated, the entry PBNS 12 showed the maximum seed yield of 2714 kg/ha and flower yield of 191 kg/ha which was followed by the entry NARI-2 giving seed yield of 2137 kg/ha and flower yield of 144 kg/ha.

2. **Assessment and acceptance of petal dye as food colour** : Yellow pigment in safflower petal is water soluble in nature. The amount of yellow pigment in non-spiny safflower variety NARI-6 was estimated to be 33 to 35% of its flower weight. To extract the optimum amount of pigment from flowers, a simple and user-friendly procedure was standardized so that it could be easily used by a common man, which is an important step to commercialize safflower flowers. This requires the flowers to be ground to powder. The safflower powder is added to water in the ratio of 1:80 or 1:100 (w/w) and the solution is boiled for 20 minutes followed by filtration. The filtrate is heated long enough to make the final pigment concentration of liquid to 4.5%. This dye was used to colour different food products like jilebi, ice cream, shrikhand, cake, burfi, pedha, scented milk, soft drink and bread. The suitability and acceptability of safflower dye was judged in comparison to synthetic dyes. The quantity of colour required for each product was determined. The suitability and acceptability of safflower dye for food colouring was found to be excellent.
3. **Pharmacological investigations of safflower tea** : A clinical trial to study efficacy and safety of safflower tea - a herbal formulation, when given as an add-on therapy in patients suffering from mild hypertension was carried out by Dr. U. M. Thatte, Associate Professor, Department of Clinical Pharmacology at BYL Nair Charitable Hospital and T. N. Medical College, Mumbai. The study concluded that the addition of safflower tea to the ongoing antihypertensive monotherapy, successfully reduces the blood pressure in patients of mild hypertension. It was observed that in safflower-treated group, the percentage decrease in blood pressure was more between day 0 and day 15 as compared to that between day 15 and day 30. This may be attributed to one or more of the three reasons as follows :
 - The compliance of the patient might have decreased from day 15 onwards due to cumbersome method of tea preparation. The “ready to dip sachets” can be an alternative.
 - Patients might have developed tolerance. In this case, the dose of safflower may need to increase after day 15.
 - The safflower may have lost its potency after day 15. It is therefore recommended to conduct stability testing after regular time intervals.

Project 4 : To study origin of seeds with twin embryos and of fused multiple seeds, their inheritance and relationships with possible existence of polyembryony and/or apomixis in safflower : Funded by Indian Council of Agricultural Research, New Delhi.



Project Duration : January 1, 2005 to December 31, 2007

This project has been started from January 2005. Efforts are in progress to confirm the existence of polyembryony and apomixis in safflower. A part of the project aims at enhancing the research facilities at NARI. Thus NARI has acquired state of the art Nikon 80i microscope attached with eip fluorescence, phase contrast and digital imaging system for cytological studies.

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 cultivation.

- NARI also supplies safflower flowers as a herbal health tea and for other commercial utilization.
- NARI has conducted 20 frontline demonstrations in safflower on farmers' fields in districts Satara and Pune during 2004-05 to demonstrate the latest technology developed in the crop for commercial adoption by the farmers.

SWEET SORGHUM

Project 5 : 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
Project Duration : April 1, 2000 to April 30, 2005 (with extension).

Thrust of research activities on sweet sorghum at NARI :

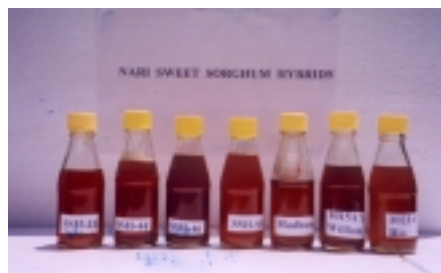
1. To develop photo-thermoinsensitive cultivars and hybrids suitable for grain, fodder and sugar production.
2. To develop and improve the present CMS lines and pollinators suitably to exploit the potential of sweet sorghum hybrids in terms of sugar and biomass production.
3. To develop round the year seed production technology for sweet sorghum hybrid 'Madhura' to meet the great demand for its seed.
4. To disseminate the agroproduction technology for sweet sorghum cultivation to the farmers.
5. 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.
6. To carry out training programmes 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 NARI-SSH-43 a promising sweet sorghum hybrid under multilocation trials under NATP project. A new sweet sorghum hybrid NARI-SSH-54 giving high yield of good quality grain, fodder and sugar has also been identified. Seed production technology of these hybrids is being developed.
2. An attempt to develop and improve potential CMS lines in sweet sorghum through breeding is under progress. NARI has improved the grain-based, notified CMS line 296A by conferring resistance to diseases such as grain mould and downy mildew to it. Also the line now possesses staygreen nature, earliness in flowering, greater plant height and a different phylotaxy than original 296A and is thus more suitable for hybrid development in sweet sorghum.
3. NARI has produced and supplied approximately 3 tonnes seed of sweet sorghum hybrid "Madhura" during 2004-05 as against a demand of more than 30 tonnes from farmers and industries. The seed was supplied to many sugar factories, distilleries and small farmers in India and abroad for growing sweet sorghum as an alternative to sugarcane for ethanol production. 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 programme is being taken up all over India. Sweet sorghum has emerged as one of the most attractive

new crops in India with a bright future and as an alternative to sugarcane for ethanol production.

4. NARI has tested the marketability of "Madhura" - a sweet sorghum syrup by participating in agro exhibitions held at different places in Maharashtra. The syrup has received a favourable response.
5. NARI has published literature in the form of leaflets on agroproduction and syrup production of sweet sorghum and distributed them to the farmers with a view to popularise sweet sorghum cultivation in India. Also farmers' field visits to NARI were encouraged and syrup production technology was demonstrated to them.



GRAPES

Project 6 : 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.

Presently about 700 grafted plants of three varieties – Crimson seedless, Red globe and Italia are in the field. They are being fertilized as per schedule. Weeding, disease and pest control and irrigation are being carried out as required.

Training and pruning is being done so that first harvest of fruits can take place in November-December 2005.

Project staff : N. Nimbkar, Ph.D.; Dr. D. R. Bapat, Ph.D. (Consultant); V. Singh, Ph.D.; M. B. Deshpande, M.Sc.; S. V. Choudhari, B.Sc.; S. R. Deshmukh, M.Sc.; N. M. Kolekar, M.Sc.; J. H. Akade, M.Sc.; A. T. Ranaware, B.Sc.; R. K. Andhalkar, J. R. Kashid, M. G. Shirke, N. T. Madkar

RENEWABLE ENERGY RESEARCH

Project 1 : Solar catalyzed chemo-oxidation of distillery waste : Funded by Ministry of Non-conventional Energy Sources (MNES), New Delhi.

The project was completed and the final report was submitted to MNES in May 2004. Subsequently a detailed discussion took place with Jubilant Organosys regarding the use of this technology for cleaning the distillery effluent in their Nira plant. Negotiations are on to transfer this technology to them for full scale testing.

Project 2 : Development of ethanol stoves for rural areas : Funded by Ministry of Non-conventional Energy Sources (MNES), New Delhi.

Project Duration : February 1, 2004 to January 31, 2006

Ten ethanol stoves designed by us have been fabricated. The stoves run on a concentration of 50% (w/w) ethanol/water and above. The stoves have undergone thorough testing in the lab and their characteristics are as follows :

1. Dimensions of stove	42.5 cm (L) X 20 cm (W) X 22.7 cm (H)
2. Weight of stove	4.3 Kg
3. Fuel tank capacity	2.6 l
4. Material of stove	Stainless steel
5. Capacity of stove (for 50% w/w mixture)	2.55 kW for maximum capacity (max) 0.73 kW for minimum capacity (min)
6. Fuel consumption	0.31 Kg/hr (max) 0.09 Kg/hr (min)
7. Efficiency of stove (for 50% w/w mixture)	52% (max) 47% (min)
8. Water boiling time (1 liter of water) (50% w/w mixture)	6.5 minutes (max) 24.5 minutes (min)
9. Carbon monoxide emissions	< 5 ppm

Preliminary testing of this stove was done by a dozen female farm labourers. They cooked their regular food on this stove. Their comments were :

- It is very easy to light and run this stove.
- There is no smell and smoke and hence this stove is much better than the woodstove. The eyes don't burn and it gives no headaches.
- Some women who normally cook on a pressurized kerosene stove said that this is much better than the kerosene stove because it is completely silent and no kerosene smell comes out after extinguishing it. Some of them also felt that it is much safer than kerosene stove since it requires much less pumping.
- Some women thought that it is just like the LPG stove since it has flame control.
- Some said that they will buy it if it is priced at less than Rs. 800.



Efforts are on to thoroughly test the 10 stoves in the field.

Project 3 : Lantern for tsunami-affected areas : Internal funding.

There seems to be a great deal of interest in NARI's Noorie lanterns in the tsunami-affected areas. Consequently, there have been a large number of inquiries for these lanterns and a small lot has been sent to the affected areas through the Bangalore Rotary Club. Based on the feedback they may order substantial numbers. Some lanterns have also been given to the tribal areas of Maharashtra and have been exported to Europe.

Project 4 : Development of an electric controller for MAPRA : Internal funding.

A Dutch graduate student from Twente University has joined NARI on a 2-month internship program. He is developing an electronic controller, which senses the load on the MAPRA and can switch the motor on/off. The controller has been fabricated and is undergoing testing. It is hoped that with the use of a low cost controller the motor and battery life of MAPRAs can be substantially extended.

Project staff : A. K. Rajvanshi, Ph.D., S. C. Chilekar, B.Tech. (Consultant), S. B. Songire, M.Sc. (Trainee), Y. H. Shaikh, B.Tech. (Trainee), N. T. Kumbhar, B.Tech. (Trainee), A. D. Bhopale, B.Tech. (Trainee), S. M. Patil, A. M. Pawar, D. B. Gadhave, Sander Groeneveld, M.Tech (Intern from The Netherlands).

ANIMAL HUSBANDRY RESEARCH

Ongoing project :

The Animal Husbandry Division's (AHD) project "Improved productivity, profitability and sustainability of sheep production in Maharashtra, India through genetically enhanced prolificacy, growth and parasitic resistance" which is sponsored by the Australian Centre for International Agricultural Research (ACIAR) is in its last phase.

This project has two major objectives.

1. Production of rams that are homozygous for the FecB gene (The gene for prolificacy).
2. Introduction of these rams into shepherds' flocks with a view to recording the performance of these rams, their daughters and their progeny.

During 2004 NARI worked in 25 shepherds' flocks. In six of these flocks ewes were synchronized and bred with NARI rams using artificial insemination. In the remaining flocks 21 rams were introduced for natural mating. In both cases shepherds' own rams were withdrawn for a period of 45 days and kept at the Institute. Out of a total 414 lambs born in shepherds' flocks, 214 were carrying at least one copy of the FecB gene.

In addition to the above we introduced into shepherds' flocks, 38 ewes from our flock carrying the FecB gene and 40 ewes having no copy of the gene. The objective was to compare the lamb production performance of the two genotypes in the same environment.

Impact on the shepherd community :

Most shepherds are traditional and are not always amenable to changing their sheep rearing practices. The AHD's research work is unique in that a part of it is being carried out in shepherds' flocks. The services which AHD provides to the shepherds and which are valued greatly by them are as follows. These are listed in the order of their importance as assessed by shepherds.

- NARI looks after health care in the shepherds' flocks by regular vaccination, treatment of illnesses and wounds. AHD regularly checks the worm burden of the shepherds' flocks and their animals are dewormed when worm burden increases.
- NARI insures all the sheep belonging to the shepherds and ensures that all claims are settled. The National Insurance Company has been extremely helpful in helping us carry out this activity.
- Once in two months shepherds' flocks are weighed and records maintained of lambs born, their sales and mortality. This helps the shepherds in monitoring the profitability of their venture.
- Shepherds are realizing the importance of a ewe having twins and its impact on the profitability of sheep rearing. The shepherds are retaining in their flocks the ewes that are carrying the FecB gene in order to increase the profitability of their enterprise.

The second coordination meeting of the project was held from 20-23 July 2004 at NARI. This was the first time the whole meeting including the scientific presentations was held at Phaltan. It was attended by the Indian and Australian collaborators of the project. Dr. Steve Walkden-Brown from the University of New England, Dr. James Kijas from CSIRO, Brisbane, and Dr. Vidya Gupta, Dr. Mohini Sainani and Ms. Varsha Pardeshi from the National Chemical Laboratory, Pune.

NARI Sheep breeding program:

The main objectives of this breeding program were to produce ewes and rams carrying one or two copies of the FecB gene. NARI has developed two strains of sheep. A fecund Deccani strain

having only Garole genes in addition to Deccani genes and a fecund composite strain having Garole, Bannur and Awassi genes in a Deccani background.

In all the NARI programs sheep are inseminated artificially on natural oestrus using fresh diluted semen.

The present flock strength of NARI is approximately 700 ewes, 80 rams and 250 lambs of various genotypes. AHD also maintains a small flock of pure Garole sheep.

Staff of AHD : B. V. Nimbkar, M.Sc. (Acting Director); C. Nimbkar, M.Sc. (Hon. Director); P. M. Ghalsasi, B.V.Sc.; P. P. Ghalsasi, B.Sc.; M. H. Nalawade, B.Sc.; A. H. Magar, B. A.; K. M. Chavan, H.S.C., LSS; R. T. Khanvilkar, H.S.C., LSS; D. D. Mulik, S.S.C.

I. LIST OF PUBLICATIONS (ALPHABETICAL ORDER) :

1. A booklet in Marathi "A new approach to increasing profits from sheep rearing" (Mendhi palanatla phayda vadhavayacha ek nava marg) was published in January 2005. It was prepared to give information about the discovery and introduction of FecB gene in Deccani sheep and achievements of ACIAR-funded projects 1994/22 and 2002/38. This booklet has been distributed among shepherds and others interested in improving sheep production.
2. A Marathi booklet on "Importance of colostrum in kid and lamb rearing" (Pillanchya sangopanat chikache mahatwa) was published in February 2005.
3. Nimbkar, N., Vrijendra Singh, M. B. Deshpande, and S. R. Deshmukh. 2004. "Non-spiny safflower". (Binkateri kardai). Marathi daily Sakal (Pragati). P. 4, dated September 29, 2004.
4. Nimbkar, N. and Jitendra Akade. 2004. "Sweet-stalk sorghum for alcohol production". (Madyarknimitisathi goad dhatachi jwari). Marathi daily Sakal (Pragati). P. 1, dated December 1, 2004.
5. Nimbkar, N., Vrijendra Singh and Jitendra Akade. Final Report of Project on "Developing sorghum as an efficient biomass and bioenergy crop and providing value addition to the rain damaged kharif grain for creating industrial demand". Submitted to NRCS and CRIDA (Govt. of India), Hyderabad. February 2005. pp. 84.
6. Rajvanshi, A. K., "Nature of Human Thought", A book published by NARI, August 2004. pp. 104.
7. Rajvanshi, A. K., S. M. Patil and Y. H. Shaikh, "Development of stove running on low ethanol concentration". <http://nariphaltan.virtualave.net/ethstove.pdf>, November 2004.
8. Rajvanshi, A. K., "Rocket science for rural development", <http://nariphaltan.virtualave.net/rocketscience.pdf>, January 2005.
9. Rajvanshi, A. K., "Less possessions more happiness", Editorial article in Times of India, January 14, 2005.
10. Rajvanshi, A. K., "Technologies for disaster management", Editorial article in Project Monitor, Vol. 4, No. 19, January 17, 2005.
11. Rajvanshi, A. K., "Of human thought and bondage", Editorial article in Times of India, February 9, 2005.
12. Rajvanshi, A. K., "Development of ethanol stove for rural areas", Annual report submitted to MNES, (Govt. of India), New Delhi, March 2005.
13. Rajvanshi, A. K., "Rediscovery of fire in 21st century", Science Dev. Net, May 7, 2005.
14. Rajvanshi, A. K., "Hi-tech at the grass roots", Editorial article in Times of India, May 11, 2005.
15. Rajvanshi, A. K., "Transcend trivial pursuit with hi-tech experience", Editorial article in Times of India, May 17, 2005.
16. Rajvanshi, A. K., "Quality life for rural folks", Editorial article in Project Monitor, May 23, 2005.
17. Rajvanshi, A. K., "Safflower Petal Collector", Paper presented at VI International Safflower Conference held in Istanbul, Turkey from June 6-10, 2005.

18. Singh, Vrijendra, M. B. Deshpande, S. V. Choudhary, and N. Nimbkar. 2004. Correlation and path coefficient analysis in safflower (*Carthamus tinctorius* L.). Sesame and Safflower Newsletter. 19 : 77-81.
19. Singh, Vrijendra. "Identification of early plant growth male sterility marker in existing GMS systems and search for cytoplasmic genetic source of male sterility in safflower". Final report of adhoc project submitted to ICAR (Govt. of India), New Delhi. March 2005. pp. 61.
20. Singh, Vrijendra, M. B. Deshpande and N. Nimbkar. 2005. Polyembryony in safflower and its role in crop improvement. Paper presented at VI International Safflower Conference held in Istanbul, Turkey, from June 6-10, 2005.
21. Singh, Vrijendra, M. B. Deshpande and N. Nimbkar. 2005. Nutritive value of safflower flowers and development of value-added products from them. Paper presented at VI International Safflower Conference held in Istanbul, Turkey from June 6-10, 2005.
22. Singh, Vrijendra, N. M. Kolekar and N. Nimbkar. 2005. Breeding strategy for improvement of flower and seed yield in safflower. Paper presented at VI International Safflower Conference held in Istanbul, Turkey from June 6-10, 2005.

II. OTHER IMPORTANT ACTIVITIES :

1. NARI signed an MOU with University of Florida International Center for providing a supervised internship experience to students for 3 months. These interns are funded by the Coca Cola World Citizenship Program. The first intern Adam Robinson, a Mechanical Engineering graduate student, has already started his internship.
2. Students from MIT, U.S.A., Twente University, The Netherlands and ISAB, Beauvais, France have either come or are doing their internship at NARI.
3. Dr. Anil K. Rajvanshi was invited for one day visit to United Technologies Center (UTC) headquarters in Hartford, Connecticut, U.S.A. in October 2004. UTC is one of the 50th largest company in the world. He was given a presentation on UTC activities by its senior staff. Discussions later on took place with the Director of UTC on how UTC and NARI can work together.
4. NARI's work on electric cycle rickshaw won the prestigious Energy Globe Award 2004 (3rd place) in the AIR category. NARI's work was chosen out of 700 applications from all over the world.
5. NARI supplied pads of 21 entries of different *Opuntia* species to Nandan Biomatrix, Ltd., Hyderabad for their exploitation for medicinal purposes. Probably this is the first time where a private company in India has started a program on NARI's *Opuntia* collection. More inquiries from progressive farmers in Andhra Pradesh have also been received.
6. AHD supplied 6 FecB carrier composite breeding rams to Saddle-Back Estates Pvt. Ltd. in Tiruchirapalli, Tamil Nadu State for breeding their sheep. The results are awaited.
7. Mr. M. B. Deshpande attended "Safflower Germplasm Field Day" organized by DOR at Hyderabad on February 15, 2005.

III. APPOINTMENTS ON BOARDS/COMMITTEES :

1. Ms. Chanda Nimbkar was appointed as a part-time member of the National Commission on Farmers with effect from 3 November 2004 by the Government of India, Ministry of Agriculture, Department of Agriculture and Cooperation.
2. The Director General, Indian Council of Agricultural Research (ICAR) nominated Shri. B. V. Nimbkar as a Member of the Judging Committee for the annual award under the name of "Jagjivan Ram Kisan Puraskar".

IV. CONFERENCES/SEMINARS/MEETINGS ATTENDED BY STAFF:

1. Dr. Rajvanshi attended the meeting of the Selection Committee of Jamnalal Bajaj Awards in Mumbai in July 2004, to select the 2004 awardees in Application of Science and Technology for Rural Areas.
2. Rajvanshi, A. K., "R&D for sustainable development". Invited "Distinguished lecture" given to the College of Engineering, University of Florida, Gainesville, U.S.A., September 20, 2004.

3. Rajvanshi, A. K., "Lighting up the lives of rural population". Invited talk at International Sustainable Resources Conference, University of Colorado, Boulder, U.S.A., September 29-October 2, 2004.
4. Rajvanshi, A. K., "Development of sustainable technologies". Invited lecture given in the D-lab of Dept. of Mechanical Engineering, MIT, Boston, October 6, 2004. Dr. Rajvanshi also addressed the prestigious IDEAS competition held at MIT.
5. Rajvanshi, A. K., "Technologies for rural development". Invited talk at International Renewable Energy Conference (ICORE-2005), Pune, January 2005.
6. Dr. Rajvanshi attended the Maharashtra Electricity Regulatory Commission (MERC) advisory meeting in Mumbai, February 2005.
7. Rajvanshi, A. K., "Technologies for cooking and lighting for rural areas". Invited talk given at National Collegiate Inventors and Innovators Alliance (NCIIA) conference in San Diego, U.S.A., March 16-19, 2005.
8. Rajvanshi, A. K., "R&D for sustainable development". Invited talk given at the Department of Mechanical Engineering, I.I.T. Kanpur, April 15, 2005.
9. Rajvanshi, A. K., "Nation building, youth and happiness". Invited talk given to the students of I.I.T. Kanpur, April 16, 2005.
10. Rajvanshi, A. K., "Sustainable development – A Gandhian approach". An invited talk given at the seminar entitled 'Relevance of Gandhi in 21st Century', organized by North Eastern Hill University (NEHU), Shillong, April 28-30, 2005.
11. Shri. B. V. Nimbkar and Dr. N. Nimbkar attended the scientific advisory committee meeting of the Krishi Vigyan Kendra, Shardanagar, Baramati on May 6, 2004.
12. Dr. N. Nimbkar attended the meeting on sweet sorghum utilization at CRIDA, Hyderabad on August 28, 2004 and gave a presentation on hybrid seed production of Madhura.
13. Dr. N. Nimbkar and Dr. A. K. Rajvanshi attended a seminar on 'Manufacture of ethyl alcohol from grains in Maharashtra' organized by MITCON, Pune on June 15, 2005.
14. Dr. P. M. Ghalsasi attended the National Symposium on 'Control of economically important viral diseases of animals' organised under the aegis of DAHD, Ministry of Agriculture, Government of India, New Delhi, April 16-17, 2004 at Izatnagar, U.P. The focus of the symposium was on the control and eradication of the disease Sheep pox, PPR, Swine fever, Blue tongue and Goat pox.
15. Ms. Padmaja Ghalsasi attended the workshop on 'Basic techniques in animal tissue culture' jointly conducted by National Centre for Cell Sciences, Pune and Vidya Pratishthan's School of Biotechnology, Baramati from July 26-30, 2004.
16. Shri. B. V. Nimbkar attended the two days' brainstorming session on state's livestock policy, held by the Department of Animal Husbandry, Maharashtra State, Pune at NITIE, Powai, Mumbai on October 27-28, 2004. Shri. Nimbkar gave a power point presentation on the activities of the Institute.
17. Ms. Chanda Nimbkar attended the 'Worm workshop' at CSIRO, Chiswick, Australia on October 29, 2004.
18. Shri. B. V. Nimbkar attended the meeting of the Central Advisory Committee for the Development of sheep, goats and rabbits held under the Chairmanship of Hon'ble Union Minister for Agriculture on January 19, 2005 at Krishi Bhavan, New Delhi. He was a special invitee and was asked to provide notes on agenda items. He gave a power point presentation on the activities of the Institute. He also prepared a concept paper on "Possibilities of increasing production of sheep and goats in Maharashtra". This was circulated among the members of the Central Advisory Committee.
19. Dr. Vrijendra Singh and Mr. M. B. Deshpande attended the Annual Group Meeting of Safflower and linseed held at the Directorate of Oilseeds Research, Rajendranagar, Hyderabad from August 18-20, 2004.
20. Dr. Vrijendra Singh participated in the brainstorming meeting on 'Prospects for utilization of sweet sorghum in India', held at the National Research Center for Sorghum, Rajendranagar, Hyderabad on December 29, 2004.
21. Dr. Vrijendra Singh presented the progress of CMS development in safflower at NARI, Phaltan at the brainstorming meeting held at the Directorate of Oilseeds Research, Rajendranagar, Hyderabad on January 10, 2005.

22. Dr. Vrijendra Singh, attended the Group Monitoring Meeting in the area of life sciences under Fast track Scheme for young scientists held at the University of Jammu, Jammu from February 3-5, 2005.
23. Dr. Vrijendra Singh attended the NATP meeting on sweet sorghum held at the National Research Center for Sorghum, Rajendranagar, Hyderabad on April 20, 2005.
24. Dr. Vrijendra Singh attended the VIth International Safflower Conference held at Istanbul, Turkey from June 6-10, 2005 and presented two papers.

V. TRAINING OF STAFF :

1. Ms. Padmaja Ghalsasi received training in genomic DNA isolation from sheep blood. She also learnt how to carry out the direct PCR-RELP DMA test for the FecB (Booroola) gene on July 1-2, 2004. This training was given by Ms. Varsha Pardeshi and Dr. Vidya Gupta from the National Chemical Laboratory (NCL).
After December 2005 when the ACIAR project ends, the facility for genotyping at NCL will not be available to NARI. This FecB test has now been established at Vidya Pratishthan's School of Biotechnology (VSBT), Baramati. VSBT has been cooperative in establishing this facility with advice from NCL.
2. Dr. Sanjeevani Lad received training in the 'in vitro gas production technique' which is useful for estimating the energetic value of feed. This training was given by Dr. U. Krishnamoorthy, Associate Professor, Department of Livestock Production and Management, Hebbal Veterinary College, Bangalore from January 24-28, 2005.
3. Ms. Chanda Nimbkar, Director, AHD is in the final stages of finishing her Ph.D. degree in Animal Breeding and Genetics at the University of New England in Armidale, New South Wales, Australia.
4. Mr. M. B. Deshpande attended the training programme on "DUS-Testing in Castor and Safflower" conducted by Directorate of Oilseeds Research, Rajendranagar, Hyderabad from February 16-19, 2005.

VI. IMPORTANT VISITORS :

1. Dr. Padma Kumar from 'Capitalisation of Livestock Programme Experiences, India' (CALP), visited AHD on April 13, 2004 to discuss their programs in India. CALPI is an agency of the Government of Switzerland : Development for Cooperation.
2. Ms. Hima Bindu Vanimisetti, Ph.D. (Genetics) student at Department of Animal and Poultry Sciences, Virginia Tech University, USA visited AHD for two months (June-July 2004) to gain some work experience. She analyzed the data of pure and crossbred Boer goats and estimated their breeding values for production traits. She also analyzed the data on effects of differential nutrition during mating and lactation on reproductive performance, lamb growth and survival in Garole ewes.
3. Ms. Neeraja Rajkumar, Joint Secretary, Ministry of Agriculture, Govt. of India visited the AHD on August 31, 2004 to see the research and development work at NARI in sheep and goats. She was taken to see the shepherds' flocks that contained prolific ewes and she was given a presentation on our activities.
4. Mr. Bijay Kumar, IAS, Commissioner, Animal Husbandry, Maharashtra State visited the AHD on September 17, 2004. He was shown work of the AHD in sheep and goat development. He was given a presentation on the activities of the Institute. He was also taken to see the shepherds' flocks, which have prolific ewes.
5. Mr. Satheesh Namasivayam, Senior Program officer from Lemelson Foundation, U.S.A. visited NARI on December 23, 2004. He held detailed discussions on collaboration between NARI and other organizations in India funded by Lemelson.

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