

## NARI ANNUAL REPORT 2002-2003

### Report of the President

This past year has been quite eventful for the institute. NARI was given the prestigious 2001-2002 [FICCI award](#) in recognition of its institutional initiative in ‘Rural Development’. It was received on behalf of the institute by its director Dr. Anil K. Rajvanshi on December 13, 2002 by the hands of the honorable Prime Minister of India Shri. Atal Behari Vajpayee in New Delhi. This award also held a special significance it being the platinum jubilee year of FICCI. I would like to take this opportunity to thank the innumerable persons who have worked at this institute for last more than 35 years. Their contribution in various projects carried out at NARI has been responsible for the recognition received in recent times.

Dr. [Anil K. Rajvanshi](#), NARI’s director has recently been appointed to the Core Advisory Group (CAG) constituted to advise the office of the Chief Scientific Advisor to the Government of India – Dr. R. Chidambaram. Dr. Rajvanshi is one of the 13 members of this advisory committee constituted under the chairmanship of Dr. Panjab Singh. We congratulate Dr. Rajvanshi for this appointment, and wish him success in giving a meaningful direction to the work of rural development being carried out in India, in the coming days.

Dr. Rajvanshi was also honored by his alma mater – University of Florida, U.S.A. when he was invited to deliver the inaugural lecture of Charles V. and Bertha P. Perrill lecture series on sustainable development last July.

Dr. Vrijendra Singh, who has been carrying out breeding of safflower and sweet sorghum at NARI was one of the seven HARDF (Hexamar Agricultural Research and Development Foundation, Mumbai) awardees for 2001-2002. He was given this award for his valuable contributions in safflower breeding, especially the outstanding research in variety improvement of safflower. We are proud of his achievements and heartily congratulate him.

The battle NARI has been waging for last 5-6 years in order to save its land from being acquired by the Government of Maharashtra for the purposes of rehabilitating people affected by Krishna Valley Irrigation Projects finally appears to be over. I would like to thank all the people at all levels that have helped us tide over this crisis and especially the persons who offered their land as an alternative in lieu of NARI’s land.

NARI has recently undertaken a project on “Introduction, evaluation and distribution on plant material of grape varieties suitable for export”. This project sponsored by APEDA is being carried out in collaboration with National Research Centre for Grapes (NRCCG), Pune. The main aim of the project will be to standardize the technology protocol for the production of export quality grapes and to make them available during November-December/March-April. After multiplying the material of desirable varieties NARI will supply it to the horticultural department and interested growers in the region. This is the first time NARI has been involved in a research project on fruit trees and we hope it is able to give local farmers a new option for increased income from their farms.

2003-2004 promises to be another good year for research and development and we look forward to solving more problems and meeting more of the needs of the local community. Much of our work, of course is made possible only because of the assistance of many people too numerous to acknowledge, and all the various government agencies which generously fund our projects.

Dr. N. Nimbkar  
July 14, 2003

## Agricultural Research

Our work in agricultural research has focussed on two crops; safflower and sweet sorghum.

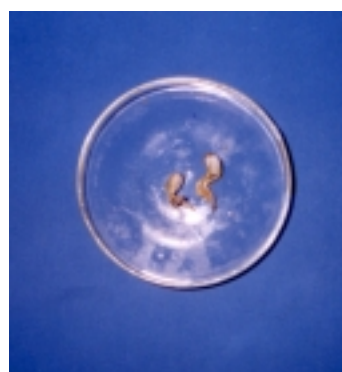
### *Safflower :*

**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 All India Coordinated Centers of safflower research for limited irrigation since 1980. The major emphasis of safflower program at the NARI center is on developing high yielding and high oil bearing spiny and non-spiny varieties and hybrids. In addition, work is also focussed on developing varieties tolerant to wilt (*Fusarium oxysporum*) under limited irrigation conditions, apart from developing suitable agro-production technology for safflower under such conditions.

The highlights of safflower research carried out in the AICRP during 2002-2003 are as follows :

1. **Popularisation of newly developed non-spiny safflower variety NARI-6 and non-spiny hybrid NARI-NH-1 :** The non-spiny variety NARI-6 and non-spiny hybrid NARI-NH-1 released by the Institute in the year 2000 and 2001 respectively for commercial production are being popularised in all safflower growing areas of the country. These cultivars are gaining popularity among the farmers due to their non-spiny nature and high yielding ability.
2. **Popularisation of safflower flowers as herbal health tea :** NARI is vigorously popularising safflower flowers as herbal health tea. In order to widen the use of safflower flowers, a tablet has been made from them. The development of a tablet from safflower flowers has made their use convenient and widespread.
3. **Identification of polyembryony in safflower :** A genotype producing polyembryonic seeds at a high frequency has been identified. As many as 30% of the twin plants originating from the polyembryonic seeds have been found to be male sterile. The male sterile plants did not produce seeds under open pollination conditions and thus were assumed to be haploid. These haploids may play an important role in varietal improvement in safflower. Varietal development from haploids has expected to reduce the time taken for cultivar development from 10-12 years in conventional method of breeding to 3 to 4 years.



4. **Possible detection of apomixis in safflower :** The genotypes exhibiting polyembryony are under investigation for their possible origin through the mechanism of apomixis.
5. About 213 advanced generation entries having oil content of about 40% were evaluated during 2002-03. Out of them 31 entries were found to give higher seed yield than the best check.
6. Three, non-spiny genetic male sterile-based spiny hybrids giving high seed yield are in pipeline.

7. **Breeding for wilt resistance in safflower** : Safflower wilt is one of the major diseases affecting irrigated safflower and is considered to be the major bottleneck in popularizing safflower in irrigated areas. Therefore, to overcome the wilt problem under irrigated conditions, a breeding program to transfer wilt resistance from a stable source of wilt resistance 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 2002-2003 BC<sub>4</sub>F<sub>2</sub>s and BC<sub>5</sub>F<sub>1</sub>s of eight backcrosses were screened for their reaction to Fusarium wilt. The wilt tolerant plants having characteristics similar to recurrent parent Nira were selected for generation advancement and further evaluation for yielding ability and wilt tolerance to identify the most promising genotype for commercial release in safflower growing areas of the country.

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

The investigations attempted under the scheme during 2002-2003 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 2002-2003, about 500 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 the crosses resulted in identification of three crosses exhibiting 100% male sterility in them. Thus with the identification of male sterility maintainer gene, the system of cytoplasmic-genetic male sterility in safflower has been completed.
- (2) **Identification of male sterility maintainer and restorer genes for induced cytoplasmic male sterility in safflower** : The male sterility induced through chemical mutagenic agent streptomycin in safflower has been found to be cytoplasmic in nature as few crosses made between male sterile plants and their sib fertile counterparts showed complete fertility in them. Efforts are underway 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 2002-2003 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 traits was observed, thereby indicating the scope for further improvement for different traits in safflower.
2. **Correlation studies between flower yield and physiological traits** : The correlation studies between physiological traits and flower yield/plant indicated that physiological traits i.e. plant height, number of primary branches/plant and capitulum diameter exhibited positive and significant association with flower yield in safflower.
3. **Correlation studies between flower yield and floral traits** : The correlation studies between floral traits and flower yield/plant showed that only number of flowers per capitulum exhibited significantly positive association with flower yield in safflower. The other floral traits like petal length, anther length and stigma length did show positive association with flower yield but the association was observed to be of low magnitude.
4. **Maximization of flower yield** : The 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 by following a plant spacing of either 45 X 10 cm or 45 X 20 cm with 150% 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 the work carried out under the project during 2002-2003 is given below :

1. **Evaluation of safflower genotypes for flower and seed yield :** Evaluation of advanced generation selections and cultivars released for commercial production in the country was done in three trials for flower and seed yield. The evaluation revealed that three advanced generation selections out of 33 evaluated in trial 1, 14 entries out of 43 in trial 2 and one entry Sharda in trial 3 recorded significantly superior seed yield than the respective best checks.
2. **Development of safflower tea :** In order to develop a suitable tea from safflower flowers, initially the quantity of safflower petal required to make suitable tea was determined by making decoctions of different quantities of safflower flower powder. After determining the quantity of safflower flower powder to make a good tea, different aromatic herbs were added along with the predetermined safflower flower quantity to enhance the overall quality of safflower tea for mass acceptability. The testing of safflower flower powder in different proportions and combinations with aromatic herbs resulted in identification of a combination of safflower powder (0.3 g) + lemongrass (0.1 g) + cardamom (0.08 g) giving an excellent taste, aroma and overall acceptability of tea. It is planned to test this tea on large scale locally to know the consumer opinion about the product.
3. **Nutritive and toxic element analysis of safflower flowers :** The flowers of non-spiny safflower hybrid NARI-NH-1 developed at the Institute were analysed for toxic elements and nutritive parameters including different amino acids at CFTRI, Mysore. The analysis revealed traces of Cd to the extent of 0.33 mg/kg and Pb to the extent of 1.84 mg/kg, however no trace of As was noticed in the safflower flowers. The nutritive analysis revealed that flowers contained 10.4% protein, 11.81% total sugars and were high in iron (42.5 mg %), Calcium (708 mg %), Magnesium (142 mg %) and Potassium (3264 mg %). The amino acid analysis in flowers of NARI-NH-1 was also carried out and they were found to contain all the essential amino acids like His (2.25%), Thr (4.78%), Val (6.77%), Met (1.49%), Ile (5.63%) and Leu (8.63%). Thus the nutritive analysis of safflower flowers revealed that the flowers are not only safe for human consumption but are rich in essential components needed for good health.
4. The pharmacological investigations of safflower flowers to cure hypertension are being taken up soon in association with Dr. U. M. Thatte, Associate Professor, Dept. 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 cultivation.
- NARI also supplies 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 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 (NATP).

The sweet sorghum improvement programme at NARI is focussed on the aspects below :

1. To develop sweet sorghum cultivars and hybrids giving high grain, fodder and sugar production.
2. To develop agroproduction technology for sweet sorghum cultivation.
3. To identify sweet sorghum genotypes producing high grain and fodder yields and syrup of very high quality.

### **Significant achievements in sweet sorghum improvement program :**

1. NARI has identified six promising sweet sorghum hybrids giving high grain and fodder yields. Two varieties NARI-SS-41 and NARI-SS-83 were taken up for the advanced varietal trial and hybrid NARI-SSH-43 in the initial varietal trial.
2. NARI has also conducted an experiment to study the suitability of 10 different genotypes under bimonthly sowings for their yielding ability, fodder production and syrup quality, to identify the most suitable one for year round syrup production from sweet sorghum.
3. NARI has supplied seeds of sweet sorghum hybrid “Madhura” developed at the institute for testing purposes to Praj Industries, Pune and GMR Technologies and Industries Ltd., Mohan Breweries, Chennai. The seed has been sown on large scale for using the crop for pilot scale alcohol distillation. Praj Industries, Pune provides technology, equipment and services to most alcohol industries in the country and have expressed their keen interest in taking trials on sweet sorghum as an alternative source of raw material for ethanol production to supplement sugarcane based molasses.
4. Due to renewed interest in alcohol because of recent government permission to blend it with petrol on 5% basis, alcohol producing crops and especially sweet sorghum has been promoted as a complementary crop to sugarcane. The technologies developed by NARI with regard to sweet sorghum improvement and its utilization for syrup and alcohol production, in addition to the technology of solar distillation of alcohol have started being recognized widely in the country and as a result numerous queries related to sweet sorghum and alcohol production are pouring in.
5. NARI has produced about 800 Kg seeds of sweet sorghum hybrid “Madhura” during 2000-2003 for distribution to farmers for popularization of sweet sorghum in the country.
6. About 200 bottles of sweet sorghum syrup “Madhura” were given for test marketing during 200-2003.

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., Mr. Y. N. Bhongale, M.Sc., Mr. P. J. Parulekar, M.Tech., Miss. A. T. Ranaware, B.Sc., Mr. S. B. Songire, M.Sc.

## Renewable Energy Research

**Project 1 :** Design and development of motor assisted hand cycle rickshaw for handicapped persons. Funded internally.



After publicity on Motor-assisted pedal rickshaws (MAPRAs) we received many inquiries regarding use of such rickshaws for handicapped persons. The existing hand operated cycle rickshaw is very poorly designed and requires tremendous force to propel it on the part of a handicapped person. Hence a new design of battery assisted hand rickshaw christened as [MANHARA](#) (motor assisted NARI handicapped rickshaw) has been designed and tested extensively. It can take one passenger 25-30 km in one battery charge at 15 km/hr. The handicapped person needs to hand pedal the rickshaw but the motor helps him/her in running it. The rickshaw has a PMDC motor/gear box with an electronic controller and two deep discharge lead acid batteries. Efforts are on to commercialize MANHARA.

**Project 2 :** Technology development for safflower petal collection : Funded by Indian Council of Agricultural Research (ICAR), New Delhi. Projected has been completed in March 2003. Report is being sent.

The objectives of the proposal are :

- a) To develop a suitable technology for safflower petal collection.
- b) To study the economics of mechanized petal harvesting in comparison to manual harvesting.
- c) To establish safflower petal collection as an economically feasible proposition for the farmers.

Five PVC knapsack-type, battery-operated petal collectors were fabricated. They have been field tested. These petal collectors run on batteries powered by a stand-alone Solar PV unit. The battery-powered petal collector costs Rs. 7,400/- and the cost of petal collection is Rs. 160-180/Kg. A person can collect, from a spiny safflower variety, almost twice the amount of petals using the petal collector than he could by hand.

An I.C. engine-powered collector with 8-10 collection snouts has been extensively tested. Test data shows that an average collection of 3.6 Kg/day takes place. The cost of I.C. collector is ~ Rs. 7,700/- and the petal collection cost is ~ Rs. 120/Kg. This project showed that safflower petal collector can help tremendously in collecting petals from spiny safflower. With the petal selling as herbal tea at Rs. 300-400/Kg on an average, petal collection via the petal collector can become a very economically viable venture. Five battery operated petal collectors were exported to Nepal.

**Project 3** : Solar-catalyzed chemo-oxidation of distillery waste (ongoing project) : Funded by MNES, New Delhi.

The main objective of the project is to set up a pilot plant so that 100 l/day of diluted anaerobically digested distillery effluent can be cleaned. The distillery effluent, which is polluting the rural areas of India, has high Chemical Oxygen Demand (COD) of 30-40,000 mg/L, is black in color and has foul odour. Secondary and tertiary treatments of this effluent have not succeeded in removing the color.

NARI has therefore developed a technology, which uses solar energy in conjunction with chemicals/catalysts to detoxify this effluent. Tests have shown that, in two days, by using solar energy COD is reduced to < 250 mg/L, transmittance is increased to ~ 90% and the foul odour is removed. A pilot plant has been set up and the use of detoxified waste as irrigation water for crops has shown good results.

Project staff : A. K. Rajvanshi, Ph.D., S. C. Chilekar, B.Tech. (Consultant), A. A. Thorat, M. G. Dhandare, S. C. Parulekar, S. B. Songire (Trainee), S. M. Patil, D. B. Jadhav, A. M. Pawar, D. B. Gadhave

## **Animal Husbandry Research**

The year 2002-2003 has been an eventful year for the Animal Husbandry Division with the conclusion of the first project funded by the Australian Centre for International Agricultural Research (ACIAR) and AusAID, the Australian Government Aid Agency, to develop a "Prolific worm-resistant meat sheep for Maharashtra, India".

An important scientific achievement is the demonstration that the gene for prolificacy in the Garole, *FecB*, is a single gene and it went to Australia in the so-called 'Bengal sheep' from Calcutta and was first detected in the Booroola Merino in early 1980s. Thus the late Dr. Helen Newton Turner's theory was proved. We have also demonstrated that this gene can successfully be introduced in other non-prolific breeds to improve their prolificacy. Another significant achievement has been the gaining of confidence of the shepherd community so that participatory research could be carried out in their flocks.

The key outputs, impacts and practical implications of the work carried out are listed below :

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 its 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. Awassi appears to be a good breed for introducing into the composite. It leads to reasonably high growth rates and is expected to improve milk production.

6. Garole crosses have superior genetic resistance to worms (gastrointestinal nematodes) compared to the Deccani with the Bannur being intermediate.
7. At the end of the project there are 232 breeding ewes and 20 selected rams carrying one copy of the *FecB* gene (heterozygote) and different proportions of Deccani, Bannur, Garole and Awassi genes and 3 breeding ewes and 1 ram with two copies of the *FecB* gene (*FecB* homozygote) at NARI. In addition, there are 12 *FecB* homozygote and 150 heterozygote lambs (4 m old) available. There are 600 ewes that are non-carriers of the *FecB* gene available for use in the crossbreeding program. The pure Garole flock at NARI comprises 110 pure Garole ewes and 20 rams.
8. Epidemiology of gastrointestinal nematode infections in the semi-arid area has been studied extensively in the project. This will help to guide strategic drenching decisions.
9. A successful participatory research study carried out in four shepherds' flocks over 18 months showed that gastrointestinal nematode infection is not a major constraint to Deccani sheep production.
10. Nine large colour posters in the regional language Marathi on anatomy of sheep, aspects of sustainable parasite control, proper method of dressing wounds etc. have been produced to teach even illiterate shepherds. Marathi booklets have been produced on sustainable parasite control in goats and sheep and the method of feeding wheat straw to sheep. A Marathi video CD has also been produced on sheep management including scabby mouth vaccine preparation and vaccination.

**Projects Sanctioned :** A project "Improved productivity, profitability and sustainability of sheep production in Maharashtra, India through genetically enhanced prolificacy, growth and parasitic resistance" was submitted to and sanctioned by the Australian Centre for International Agricultural Research (ACIAR). This project will be in collaboration with University of New England, Armidale, Australia and National Chemical Laboratory, Pune, India. The duration of the project is to be three years from 1 January 2003 to 31 December 2005.

**Stylo Trial :** NARI conducted a small trial on new stylo strains being tried out under a project financed by ACIAR conducted by IGFRI, Dharwad, Karnataka. We received 50 gm of seed from each of 10 different strains. All of these look very promising under deep soil partially irrigated conditions when compared to the old Stylo hamata.

These strains look promising as leguminous animal forage.

**Breeding Program 2002 :** In the year 2002 NARI conducted a sheep breeding program under the ACIAR-funded project like the previous years. However, this year's breeding program was important as rams with confirmed genotypes for the *FecB* gene were used for breeding.

A total of 488 sheep were artificially inseminated out of which 342 ewes conceived at first AI resulting in the birth of 556 lambs (AI conception rate of 70%).

#### **Hands on training programs :**

- 1) Dr. Michael G Paros, DVM, Paros Veterinary Services LLC, USA visited NARI for the period 10 to 17 December 2002, under the "Farmer to Farmer Program" in India funded by USAID and implemented by Winrock International.

The main objective of his visit was to develop facilities and skills at the NARI laboratory, for accurate diagnosis of sheep and goat diseases.



He gave training on the collection of epidemiological data for assessment of morbidity and mortality, live sample collection and collection of affected part from necropsies. He also trained our laboratory technician on different types of staining of samples and culture of the samples to confirm the type of infection in the animals.

- 2) Dr. Sanjay K. Singh, Scientist 'C' (Mycology Group) from Agharkar Research Institute, Pune visited the AHD at our request on 22 November, 2002. There was an outbreak of facial eczema in one of the AHD sheep flocks. Dr. Singh collected samples of the Congo signal grass on which the sheep were grazing, for microscopic observations. He confirmed that it was a saprophytic fungus *Pithomyces chartarum* that produces toxins, which are often fatal to the sheep on ingestion.
- 3) Dr. P. M. Ghalsasi visited the laboratory of Dr. Jill Maddox Senior Research Fellow, Centre for Animal Biotechnology, School of Veterinary Science, University of Melbourne, Australia from 7 October to 18 October 2002 in order to receive training on the PCR of the sheep DNA samples and also learnt how to do the FecB test. This training was a part of the ACIAR project.

### **Articles, conference papers, presentations made and reports published (author's names in alphabetical order)**

1. Ghalsasi, P. M., Nimbkar, C., Kahn, L. P. and Walkden-Brown, S. W. (2002). Effects of different levels of worm control on meat production of Deccani sheep in shepherds' flocks in Maharashtra, India. Abstracts of the 10th International Congress of the Asian-Australasian Association of Animal Production Societies held at New Delhi, India. September 23-27, 2002. p. 152.
2. Ghalsasi, P. P. (2002). Worm problems in small ruminants and effective measures to control them. Oral presentation by P. P. Ghalsasi at a Workshop on 'Dissemination of appropriate technologies for improving productivity of sheep and goats' organized in Bangalore, Karnataka, India, by BAIF Institute for Rural Development, Karnataka on 28 March 2002.
3. Hegde, D. M., Singh, Vrijendra and Nimbkar, N. 2002. Safflower. P. 199-221 In : Genetic Improvement of Field Crops (Singh, C. B. and Khare, D. eds.) Scientific Publishers (India), Jodhpur.
4. Nimbkar, C. (2002). Gains from Garole – the 'wonder' sheep of West Bengal. Partners in Research for Development. ACIAR 15 : 31-36.
5. Nimbkar, C., Ghalsasi, P. M., Walkden-Brown, S. W. and Kahn, L. P. (2002). Breeding program for the genetic improvement of Deccani sheep of Maharashtra, India. Proceedings 7th World Congress of Genetics Applied to Livestock Production. Montpellier, France. CD-ROM Communication No 25-11. (Oral presentation by C. Nimbkar in the FAO-sponsored Workshop on Developing Sustainable Breeding Strategies in Medium-to Low-Input Systems at the WCGALP) August 19-23, 2002.
6. Nimbkar, C. and Ghalsasi, P. M. (2002). Effective use of cervical artificial insemination in a breeding program for genetic improvement of Deccani sheep. Paper presented at the 9th International Congress on Biotechnology in Animal Reproduction. Chennai, India. December 2-4, 2002. (Poster presentation by P. M. Ghalsasi during the conference).

7. Nimbkar, C. and Ghalsasi, P. M. (2002). Incidence of facial eczema in sheep in Phaltan taluka, Maharashtra state. Invited Papers and Abstracts, V Seminar of the Indian Society for Sheep and Goat Production and Utilization (ISSGPU), Jaipur, India. December 30-31, 2002. pp. 156-157.
8. Nimbkar, C. and Ghalsasi, P. M. (2002). Shelya-mendhyanmadhil janta pradurbhawa wa tyawareel pratibandhatmak upay (Preventive measures for gastrointestinal nematode infections in sheep and goats). Baliraja (Farmers' magazine). Pp. 91-93.
9. Nimbkar, C., Ghalsasi P. M. and Pawar B. (2002). Shelya-mendhyanmadhil janta pradurbhawa wa tyawareel pratibandhatmak upay (Preventive measures for gastro-intestinal nematode infections in sheep and goats). NARI Animal Husbandry Division Marathi Booklet. p. 12.
10. Dr. Nimbkar, Nandini, attended a one-day seminar on "Dryland Agriculture : Problems and Prospects" sponsored by the Shivaji University, Kolhapur at the Shahajiraje Mahavidyalaya, Khataav. She delivered a lecture on "Dryland Agriculture : Cropping Pattern : New Approach" on 22 September 2002 during the seminar.
11. Dr.Nimbkar, Nandini. "[Safflower Rediscovered](#)". Times Agriculture Journal., Nov.-Dec. 2002.
12. Nimbkar, N. "Developing sorghum as an efficient biomass and bio-energy crop and providing value addition to the rain damaged kharif grain for creating industrial demand". Half-yearly (April-September 2002) progress report to NRCS, Hyderabad, March 2003, Pgs. 58.
13. Nimbkar, N. "Developing sorghum as an efficient biomass and bio-energy crop and providing value addition to the rain damaged kharif grain for creating industrial demand". Half-yearly (October-March 2003) progress report to NRCS, Hyderabad, March 2003, Pgs. 42
14. Rajvanshi, A. K., "[Palliative Effect of Good Music](#)". Editorial article in **Times of India**, April 15, 2002.
15. Rajvanshi, A. K., "Sweet Alchemy", **Times Agriculture Journal** (TAJ), Vol. 1, Issue 4, May-June 2002.
16. Rajvanshi, A. K., "Development, Demonstration and Performance Evaluation of Battery Operated Cycle Rickshaw", Final Project report to **MNES**, New Delhi, June 2002. Pgs. 34.
17. Rajvanshi, A. K., "[Taluka Development for Sustainable India](#)". Center Piece article in **TERRAGREEN**, Issue 14, June 15, 2002.
18. Rajvanshi, A. K., "R & D for Sustainable Development" Inaugural lecture of Charles V. and Bertha P. Perrill lecture series on Sustainable Development, Department of Mechanical Engineering, **University of Florida**, Gainesville, USA, July 5, 2002.
19. Rajvanshi, A.K., " R&D for Sustainable Transport", Invited lecture in the Institute of Transport Studies, **University of California**, Davis, USA; 19 July, 2003.
20. Rajvanshi, A. K., "Solar Catalyzed Chemo-oxidation of Distillery Waste". Annual Progress report to **MNES**, New Delhi, July 2002. Pgs. 58.
21. Rajvanshi, A. K., "[Thinking it Through, You can be Happy](#)", Editorial Article in **Times of India**, August 8, 2002.
22. Rajvanshi, A. K., "[Spiritual Counsel for Rio Plus Ten](#)", Editorial article in **Times of India**, August 26, 2002.

23. Rajvanshi, A. K., [“Electric and Improved Cycle Rickshaw as a Sustainable Transport System for India”](#), **Current Science**, Vol. 83, No. 6, 25 September 2002.
24. Rajvanshi, Anil K., “R&D for Sustainable Development”, Invited lecture given to students and staff of **IIT, Guwahati**. October 2002.
25. Rajvanshi, A. K., “Back to basics”, Article in **Down to Earth**, Vol. 11, No. 12, November 15, 2002, pg. 52.
26. Rajvanshi, A. K., [“Significant Gravity of Deep Thought”](#), Editorial article in **Times of India**, November 18, 2002.
27. Rajvanshi, A. K., “Sustainable Development Strategy for India”, Invited lecture at **Auroville, Pondicherry**, February 18, 2003.
28. Rajvanshi, A. K., [“Mystery of the Prepared Mind”](#), editorial Article in **Times of India**. February 20, 2003.
29. Rajvanshi, A. K., [“Web of Love”](#), article in [www.boloji.com](http://www.boloji.com)., March 9, 2003.
30. Rajvanshi, Anil K., “Wealth Creation from Safflower and Sweet Sorghum Crops”, Invited paper in Seminar on **Regional Agro-wealth opportunities for value addition and exports**, held at BARC, Mumbai, March 28-29, 2003.
31. Rajvanshi, A. K., [“Deep faith helps overcome fear”](#), editorial article in **Times of India**, March 31, 2003.
32. A chapter entitled [“Sustainable Development of India – A Gandhian Approach”](#), in the book entitled **Appropriate Technology, Development and Gandhi**. To be published by Gandhi Smriti and Darshan Samiti, New Delhi, April 2003.
33. Rajvanshi, A. K., [“R&D strategy for cooking and lighting energy for rural households”](#), Accepted for publication **CURRENT SCIENCE**, April 2003.
34. Rajvanshi, A. K., [“Rise up for a better World”](#), article in [www.boloji.com](http://www.boloji.com)., June 8, 2003.
35. Sastry R. Kalpana, Chattopadhyay, C., Singh, Vrijendra and Hegde, D. M. 2002. Integrated management of safflower wilt using host resistance, cultural and chemical measures. *J. Mycol. Pl. Pathol.*, 32 (2) : 189-193.
36. Singh, Vrijendra, Nimbkar, N. and Deshmukh, S. R. 2002. Shetisathi Naricha Bin Kanteri Sudharit Kardai Van : NARI-6 (Marathi), (A non-spiny improved variety NARI-6 for safflower production). *Baliraja*, 33 (10) : 56-60.
37. Singh, Vrijendra. Annual Progress Report of All India Coordinated Research Project on Oilseeds (Safflower) 2002. Submitted to DOR, Hyderabad. June 2002 (pgs. 93).
38. Singh, Vrijendra. Annual Progress Report of Frontline Demonstrations in Safflower. Submitted to DOR, Hyderabad, June 2002.
39. Singh, Vrijendra, Half-yearly Progress Report (January to June) of All India Coordinated Research Project on Oilseeds. Submitted to DOR, Hyderabad, July 2002 (pgs. 6).

40. Singh, Vrijendra, Annual Progress Report of Ad-hoc Project on “Identification of early plant growth male sterility marker in existing GMS systems and search for cytoplasmic genetic source of male sterility in safflower. Submitted to ICAR, New Delhi. September 2002. (pgs. 39).
41. Singh, Vrijendra. Annual Progress Report of Ad-hoc Project on “To study the usefulness of petal from Indian cultivars of safflower for developing value added products of edible nature. Submitted to DST, New Delhi. December 2002 (pgs. 6).
42. Singh, Vrijendra, Rathod, D. R., Deshpande, M. B., Deshmukh, S. R. and Nimbkar, N. 2003. Breeding for wilt resistance in safflower. In : Extended Summaries : National Seminar on Stress Management in Oilseeds for Attaining Self-Reliance in Vegetable Oils. January 28-30, 2003. Indian Society of Oilseeds Research, Hyderabad, pp. 368-370.
43. Singh, Vrijendra. Annual Progress Report of Adhoc Project on “Biometrical investigations of flower yield and its components and their maximization in safflower. Submitted to ICAR, New Delhi. January 2003 (pgs. 18).
44. Dr. Vrijendra Singh was invited to deliver a lecture on “Problems and prospects of 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 20, 2003.
45. Singh, Vrijendra. Half-yearly Progress Report (July to December) of All India Coordinated Research Project on Oilseeds (Safflower), Submitted to DOR, Hyderabad, March 2003 (pgs. 6).
46. Dr. Vrijendra Singh was invited to deliver a lecture at ASC College, Lonand. on “Biotechnology in agriculture and the environment” in the conference on Biotechnology in agro-industry and environment organized by ASC College, Lonand, Dist. Satara and Shivaji University, Kolhapur.

## General

1. Dr. Rajvanshi has been nominated as a member of Core Group on rural technologies in the office of Principal Scientific Advisor to the Government of India, New Delhi. This core group, set up on the advice of Dr. Rajvanshi, will work on all the aspects of technologies for rural areas.
2. Dr. Rajvanshi has been nominated as member sub-group, Planning Commission, GOI on “Rural Technology Transfer”. The mandate of this group is to review the entire gamut of arrangements for technology transfer to small scale rural enterprises and to suggest mechanisms of how rural areas can help in technology development.
3. Dr. Rajvanshi has been inducted as a member of Jannalal Bajaj Awards Committee.
4. Dr. Rajvanshi was honored by his alma mater, University of Florida, U.S.A. when he was invited to deliver the inaugural lecture of Charles V. and Bertha P. Perrill lecture series on sustainable development in July 2002.
5. NARI’s rickshaws were exported to Sweden. Serious inquiries have been received from Mauritius & Ireland.
6. Dr. Rajvanshi’s paper on cooking and lighting energy strategy has set the stage for setting up a national technology mission on this subject. Consequently, MNES Secretary; DG, CSIR and Principal Scientific Advisor to GOI are helping in this process.
7. Dr. Nandini Nimbkar attended the proceedings of the Scientific Advisory Committee Meeting held on 11 November 2002 at the Krishi Vigyan Kendra, Baramati.

8. Dr. Vrijendra Singh, Safflower breeder in the AICRP (Safflower) at the Institute received the Hexamar Agricultural Research and Development Foundation Award for the year 2001-2002 for making significant contribution in varietal improvement in safflower. The award was given to Dr. Singh on January 28, 2003 by Shri. V. Sobhanadreeswara Rao, Hon'ble Minister for Agriculture, Government of Andhra Pradesh and Dr. Mangala Rai, Secretary, DARE and DG ICAR during National Seminar on Stress Management in Oilseeds held at Acharya N.G.R.A.U., Hyderabad.
9. On 24-25 April 2002 on ACIAR-sponsored workshop was held by the AHD in Pune, Maharashtra, on 'Wasteland Improvement'. The main objective of the workshop was to assemble experienced technical personnel and shepherds to identify primary causes of land degradation. A total of 25 participants attended the workshop that was facilitated by Dr. Julian Prior and Dr. Lewis Kahn, University of New England, Armidale, Australia and Mr. B. V. Nimbkar from NARI.
10. National Chemical Laboratory, Pune and NARI A.H. Division organized fourth and final project Coordination meeting of the Aus/AID/ACIAR funded project "Prolific worm-resistant meat sheep for Maharashtra, India" jointly on 3-7 February 2003. There were presentations on the progress made on the objectives of the project.