

ANNUAL RESEARCH REPORT 2011-2012



**Nimbkar Agricultural Research Institute,
P.O. Box 44, PHALTAN-415523,
Maharashtra**

September 2012

Nimbkar Agricultural Research Institute (NARI), Phaltan

ANNUAL RESEARCH REPORT 2011-12

Report of the President



I am very happy to place the annual research report 2011-12 of NARI before our readers. Significant research progress at NARI has been presented in brief. For more details of any subject, readers are encouraged to visit our website and/or write an e-mail to us.

The Bajaj Center for Sustainable Development (BCSD) was inaugurated on 12 April 2011. Since then in addition to conducting meetings with visiting dignitaries the centre has been used to conduct one-day trainings for about 40 students each of Welinkar Institute of Management, Mumbai and Nowrosjee Wadia College, Pune. During the current year we hope to have courses of medium to long duration mainly to increase the awareness of young people about the problems of rural areas and their possible solutions.

In 2011-12 NARI Animal Husbandry Division conducted a training course in goat and sheep production technology for the first time for officers of the Sikkim State Animal Husbandry Department. We found out that we have a strong advantage in conducting such a practically-oriented course.

I would like to congratulate Chanda Nimbkar for her editorial in the Journal of Animal Breeding and Genetics, a highly regarded journal published by Wiley Blackwell Verlag GmbH with an impact factor of 1.455. She was invited to write it by Prof. A. Maki-Tanila (Finland), subject editor of the journal.

I wish to sincerely thank Dr. Pradip, Director, Tata Research and Development Centre, Pune for his personal donation to the corpus of NARI as also Shri. R. O. Somani Charitable Trust for their donation. Such largesse makes it possible for us to carry out a lot of our work and so is greatly appreciated.

In contrast to the record rainfall of 2010, we received only 423 mm rainfall at Phaltan in 2011. This year so far it hasn't even been half of that. Unfortunately even our dams haven't filled up this year and that may bode ill for coming rabi and summer seasons unless it rains in their catchment area during the remaining one month.

Dr. N. Nimbkar
President

September 11, 2012

AGRICULTURAL RESEARCH

SAFFLOWER



Dr. K.S. Varaprasad, Project Director DOR, Hyderabad, on a visit to NARI fields.

All India Coordinated Research Project on Oilseeds (Safflower)

Funding agency : Indian Council of Agricultural Research (ICAR), New Delhi

NARI is one of the centers of All India Coordinated Research Project (AICRP) for safflower Research under limited irrigation since 1980. The major objectives of safflower improvement at NARI have been to develop high-yielding and high oil-producing spiny and non-spiny varieties and hybrids with in-built resistance to wilt (*Fusarium oxysporum*), in addition to development of suitable agro-production and crop protection technologies for growing safflower under limited irrigated conditions.

Research Highlights : The major highlights of safflower programme during 2011-12 are furnished below :

I. BREEDING (Rabi 2011-12) :

- 1. Identification of male sterility maintainer genotype for cytoplasmic male sterility in safflower :** A safflower genotype which maintained 100% male sterility in CMS line during 2010-11 was backcrossed to the CMS line in a pairwise fashion to confirm the maintenance of male sterility. Nine pairwise crosses so made were evaluated for maintenance of male sterility in the CMS plants during Rabi 2011-12. It showed complete maintenance of male sterility in each and every plant of all the nine crosses, thus confirming the male sterility maintaining ability of the genotype. The male sterile plants of the CMS line of each pairwise cross have been backcrossed individually with the maintainer parent plants to further evaluate them in next season. The male sterility of the CMS line thus maintained will be assessed under different environmental conditions in order to determine its stability and future use in hybrid development in safflower.
- 2. Evaluation of thermosensitive genetic male sterile line TGMS-3-6-7-9 for male sterility :** The thermosensitive genetic male sterile line TGMS-3-6-7-9 was sown on an area of 56.25 m² for checking its male sterility during Rabi 2011-12. The temperature during capitulum development in the TGMS line varied from 9 to 18°C during night and

28.5 to 34.5°C during daytime. The relative humidity during capitulum development ranged from 27 to 48% during day and 76 to 100% during night hours. The observations on male sterility/fertility of the plants which was recorded during flowering of the crop showed that out of the total population of 526 plants only 15 plants were fertile in nature and rest of the plants were male sterile. Thus male sterility of the TGMS line was estimated to be 97.15%. The high percent male sterility in the TGMS line suggests that the TGMS system can be suitably used for hybrid development in safflower.

3. **Studies with different safflower species :** Safflower species viz. *C. oxyacantha*, *C. palaestinus*, *C. glaucus*, *C. lanatus*, *C. turkestanicus* and *C. creticus* received from Dr. K. Anjani, DOR, Hyderabad were sown during the season. All the six species were characterized for morphological and stomatal traits during the season and were maintained for further investigations.
4. **Crossing programme :** About 75 crosses were made during the season. The details of the crosses made are furnished below :
 - (a) **National crossing programme :** In this programme it was decided to cross the three best genotypes available at each of the centers to the genetic male sterile line GMS-6Y, supplied by DOR, Hyderabad in order to obtain about 250 g seeds from each cross for evaluation at eight safflower centers during 2012-13. In order to do so we used high oil-containing genotypes viz. NARI-52, NARI-57 and NARI-78 to cross with GMS-6Y. Enough seed of each cross was produced to evaluate at eight centers during rabi 2012-13.
 - (b) **Crosses with TGMS and CMS lines :** Thermosensitive genetic male sterile (TGMS) lines developed at the Institute and CMS line EC-675848 obtained from USA were crossed with different promising genotypes to develop high-yielding hybrids in safflower. Using different genotypes, about 72 hybrids were made during the season. The details of the TGMS and CMS lines and pollinator parents used in the crossing programme are as follows :

TGMS and CMS lines :

- | | | |
|-------------------|-------------------|-------------------|
| (1) TGMS-3-4-2-12 | (2) TGMS-6-1-5-1 | (3) TGMS-3-6-7-10 |
| (4) EC-675848 | (5) TGMS-3-6-11-3 | (6) TGMS-3-6-11-5 |

Pollinator parents :

- | | | | |
|------------------|-----------------|-----------------|------------------|
| (1) GMU-3690 | (2) D-130-100-1 | (3) DH-147-80-4 | (4) Montola-2000 |
| (5) Montola-2001 | (6) GMU-3776 | (7) GMU-3731 | (8) NARI-78 |
| (9) NARI-63 | (10) NARI-52 | (11) EC-523373 | (12) EC-523367 |

Sufficient seed was produced for each cross to evaluate them in a replicated trial in rabi 2012-13.

5. **Development of high seed and oil-yielding safflower cultivars :** Five out of the 65 high oil-containing entries evaluated in the preliminary varietal trials recorded higher seed yield than the national check A-1 in the respective trials. Promising hybrids based on thremosensitive genetic male sterility viz. NARI-H-24 and NARI-H-25, which were

evaluated in Initial Hybrid Trial during rabi 2010-11 gave an increase of 7 and 9% in seed yield and 5.8 and 28% in oil yield respectively over the best check NARI-H-15 across the locations under irrigated conditions. Both the hybrids were promoted to IAHT for second year of multilocation evaluation during rabi 2011-12.

6. **Coordinated varietal trials :** Among the three coordinated varietal trials, out of the 29 entries evaluated in IVT, entry IVT-11-10 recorded the maximum seed and oil yields of 3824 and 1092 kg/ha respectively and was statistically on par with the entries IVT-11-2 (seed yield of 3562 kg/ha and oil yield of 1043 kg/ha) and IVT-11-17 (seed yield of 3262 kg/ha and oil yield of 990 kg/ha). In IAHT, of the nine entries screened, entry IAHT-I-11-2 recorded the maximum seed yield of 3306 kg/ha which was at par with the entries IAHT-I-11-3 (3261 kg/ha), IAHT-I-11-9 (3239 kg/ha), IAHT-I-11-6 (3080 kg/ha) and IAHT-I-11-5 (2855 kg/ha). In AVHT, out of the six entries evaluated entry AVHT-II-11-6 recorded the significantly highest seed yield of 3770 kg/ha.
7. **Seed production of safflower varieties/hybrids :** The center produced 45 and 35 kg breeder seed of female and male parents respectively of safflower hybrid NARI-H-15 and 35 kg breeder seed of C-2829-5-3a-6, the male parent of non-spiny hybrid NARI-NH-1. In addition, 200 kg seed of safflower variety NARI-52 and 275 kg seed of NARI-57 besides 180 kg hybrid seed of non-spiny hybrid NARI-NH-1 were also produced during the season.

II. AGRONOMY (Rabi 2011-12) :

- 2.1 **Yield maximization in safflower :** The non-spiny hybrid NARI-NH-1 was planted by following the recommended package of practices for maximizing its seed yield. Due to a severe attack of *Alternaria* leaf spot during pre-flowering stage, a low seed yield of 914 kg/ha and net returns of Rs. 10,949/ha were obtained from the trial.
- 2.4 **Response of AVHT-II entries to fertilizer application :** The results of this trial showed that differences due to fertilizer levels were significant for seed yield, gross returns, net returns and benefit cost ratio. An application of 100% recommended fertilizer dose gave the significantly highest seed yield, harvest index, gross returns, net returns and benefit-cost ratio and was on par with the application of 150% recommended dose of fertilizers. Highest oil yield was recorded in the treatment which received 150% recommended fertilizer and was on par with application of 100% recommended fertilizer dose treatment.
- 2.5 **Evaluation of AVHT-II entries under different sowing dates :** The results of the trial showed that differences due to sowing dates and varieties were significant for seed yield, gross returns, biological yield, harvest index, benefit-cost ratio, oil content and oil yield. The sowing of safflower on October 17, 2011 recorded the significantly highest seed yields which were followed by sowing on October 30 and November 15. Among the entries tested, the entry AVHT-II-11-4 recorded the significantly highest seed yield of 2011 kg/ha which was on par with that of the entries AVHT-II-11-1 (1956 kg/ha) and AVHT-II-11-2 (1884 kg/ha). The gross returns, net returns and benefit-cost ratio also followed the same trend as that of seed yield for safflower entries evaluated in the trial.

2.8 **Assessment of fertilizer recommendation for safflower** : The results of the trial indicated that differences due to different fertilizer levels were significant for seed yield, gross returns, net returns and benefit-cost ratio. The significantly highest seed yield of 2104 kg/ha was recorded by the application of N:P₂O₅:K₂O @ 90:40:40 kg/ha, which was on par with the treatments where N:P₂O₅:K₂O was supplied at 0:0:40 kg/ha (2027 kg/ha), 90:0:40 kg/ha (1972 kg/ha), 30:80:40 kg/ha (1950 kg/ha), 60:40:40 kg/ha (1757 kg/ha) and 60:80:40 kg/ha (1750 kg/ha). The significantly highest net returns in the trial were recorded by the fertilizer treatment of N:P₂O₅:K₂O applied at 90:40:40 kg/ha, which was on par with the treatments of 0:0:40, 90:0:40, 30:80:40, 60:40:40, 60:80:40 and 60:0:40 kg/ha of N:P₂O₅:K₂O. Significantly highest benefit-cost ratio was obtained for 0:0:40 kg/ha of N:P₂O₅:K₂O which was on par with the treatments of 90:40:40, 90:0:40 and 30:80:40 kg/ha of N:P₂O₅:K₂O.

2.14 **Comparative productivity, profitability and resource use of non-spiny safflower to other rainfed rabi crops/systems** : The results of this trial revealed that among the different sole crops evaluated, sole safflower with cultivar A-1 recorded the significantly highest seed yield of 2431 kg/ha which was on par with sole chickpea (cultivar Vijay) recording seed yield of 2145 kg/ha. The safflower hybrid NARI-NH-1 recorded the maximum net returns of Rs. 1,22,205/ha from both seed and petal, which was followed by the non-spiny variety NARI-6 (Rs. 1,05,521/ha) from seed and petal.

III. PLANT PATHOLOGY (Rabi 2011-12) :

3.2 (A) Screening of germplasm against major diseases (*Alternaria* leaf spot)

In this trial 415 germplasm lines were screened against *Alternaria* leaf spot disease. All the entries were observed to be highly susceptible to *Alternaria* leaf spot at the time of flower initiation.

3.3 (A) Confirmation of host resistance against major diseases (*Alternaria* leaf spot)

Fourteen GMU entries along with susceptible check Manjira and Nira were screened for resistance against *Alternaria* leaf spot disease. All the test entries and the checks were found to be highly susceptible.

3.4 (A) Screening of selected elite material against major diseases (*Alternaria* leaf spot)

This trial comprised of 44 entries, including 29 IVT, nine IAHT and six AVHT entries, susceptible check Manjira and the tolerant check HUS-305. They were screened against *Alternaria* leaf spot. All the entries including the checks were highly susceptible to *Alternaria* leaf spot.

3.4 (B) Screening of selected elite material against major diseases (wilt)

In all 44 entries comprising of IVT, IAHT and AVT entries were screened against wilt along with two checks viz. Nira and NARI-38. As far as the disease severity is concerned, out of the 44 test entries seven IVT and three AVHT entries were found to be tolerant to wilt.

3.7 Management of *Phytophthora* damping off and seedling blight of safflower by seed treatment with chemical and biological agents

Five different chemical and four biological seed treatments were evaluated for their efficacy against *Phytophthora* damping off and seedling blight in safflower. The results of the trial showed differences due to treatments to be non-significant for disease grade (0-9 scale), percent disease intensity and wilting %.

3.8 Management of seed/soil-borne diseases of safflower by chemical and biological agents' seed treatment

Six different chemical and two biological seed treatments were evaluated for their efficacy against seed/soil-borne diseases in safflower. Among the seed treatments, all the chemical and biological seed treatments were found to be ineffective against seed/soil borne diseases.

SWEET SORGHUM

All India Coordinated Sorghum Improvement Project (Sweet Sorghum)

Funding agency : Indian Council of Agricultural Research (ICAR), New Delhi

NARI is one of the centers of All India Co-ordinated Sorghum Improvement Project (AICSIP) for sweet sorghum research since 2009. The major objective of sweet sorghum improvement programme at NARI has been to develop high biomass and high sugar-yielding varieties and hybrids.

Objectives : The objectives of the research work on sweet sorghum at the center are :

1. Development of sweet sorghum varieties and hybrids which yield high biomass, sugar and grain.
2. Development of high grain cultivars for rabi season.
3. To develop high brix CMS lines.
4. Development of shoot fly-tolerant sweet sorghum restorers and maintainers.
5. Identification of promising lines for syrup production.
6. Quality improvement of syrup and also enhancing its shelf-life.

Research highlights :

The investigations undertaken in the project are described below.

Kharif (Rainy season) 2011 :

1. In continuing sweet sorghum CMS-line development programme, we made 168 backcrosses. The CMS lines being considered for improvement were NARI-SS-5A, NARI-SS-6A and NARI-SS-11A. Thirty three male sterile lines showed higher brix than their parental lines.

2. Among the 72 landraces tested, numerically higher fresh biomass, fresh stalk yield, juice yield and juice brix were recorded by NARI-LC-10-1-6, (60.40 T/ha, 47.21 T/ha, 24.20 T/ha and 16%) followed by NARI-LC-10-4-2 (59.45 T/ha, 48.37 T/ha, 16.31 T/ha and 17.5%), NARI-LC-10-2-10 (57.78 T/ha, 42.32 T/ha, 23.17 T/ha and 15%) and NARI-LC-10-5-5 (55.21 T/ha, 39.57 T/ha, 21.78 T/ha and 15%) than the hybrid Madhura (52.72 T/ha, 38.36 T/ha, 17.23 T/ha and 13.83%).
3. Among the 20 selections from station germplasm which were tested, numerically higher fresh biomass of 69.69 T/ha, fresh stalk yield of 51.85 T/ha, juice yield of 20.06 T/ha and juice brix of 17% were recorded by NARI-SS-233-1 over the hybrid Madhura (68.41 T/ha, 44.66 T/ha, 19.18 T/ha and 15.5%).
4. Out of the 21 F₁ Diallel crosses tested, DC-127 recorded significantly highest fresh biomass of 73.43 T/ha, fresh stalk yield of 52.08 T/ha and juice yield of 28.48 T/ha compared to the best check CSV-19-SS (63.89 T/ha, 45.08 T/ha and 19.13 T/ha).
5. Out of the nine F₄ progenies tested F₄ (DC-102)-27 recorded numerically higher juice yield of 16.24 T/ha than the best check RSSV-9 (13.77 T/ha).
6. Out of the 31 early and advanced generation progenies tested, F₆ (D-94)-74 recorded numerically higher biomass (62.16 T/ha), fresh stalk yield (42.29 T/ha), juice yield (18.88 T/ha) and juice brix (19%) than the best check Madhura (57.86 T/ha, 37.37 T/ha 16.67 T/ha and 17.5%).
7. Among the 12 F₆ progenies tested, F₆ (D-91)-9 recorded juice yield of 18 T/ha which was on par with that of the best parent NSS-216 (18.87 T/ha) and it also had numerically highest juice brix of 19.17% among the tested progenies.
8. Out of the nine F₆ progenies tested, F₆ (D-158)-20 recorded juice yield of 10.57 T/ha which was on par with that of the check CSV-19-SS (12.53 T/ha) and it also recorded numerically higher juice brix of 19.83% than the best parent NSS-216 (18.83%).
9. Out of the 14 PVT progenies tested, numerically higher stalk yield of 45.65 T/ha and juice yield of 17.45 T/ha were recorded by (D-158)-32 than those of the best check CSV-19-SS (43.22 T/ha and 17.11 T/ha respectively).
10. Among the 20 CMS-based promising sweet sorghum hybrids tested, numerically highest fresh stalk yield of 38.49 T/ha was recorded by NARI-SSRH-2 followed by NARI-SSRH-5 (38.03 T/ha) and NARI-SSRH-1 (36.35 T/ha). Numerically highest juice yield of 17.13 T/ha was recorded by NARI-SSRH-1 followed by NARI-SSRH-2 (16.49 T/ha). Maximum juice brix of 17.17% was recorded by NARI-SSRH-11 followed by NARI-SSRH-6 (16.83%). Maximum Total Sugar Index of 2.46 T/ha was recorded by NARI-SSRH-2 followed by NARI-SSRH-5 (2.24 T/ha).
11. Out of the 30 CMS-based sweet sorghum hybrids tested SSKH-117 recorded fresh stalk yield of 39.07 T/ha, juice yield of 16.10 T/ha, juice brix of 17.7% and Total Sugar Index of 2.36 T/ha which was on par with that of the best check CSH-22-SS.

12. Among 18 CMS-based sweet sorghum hybrids tested, SSKH-147 recorded fresh biomass yield of 57.50 T/ha and fresh stalk yield of 38.84 T/ha which were on par with those of the best parent NARI-SS-203 (57.88 T/ha and 37.84 T/ha respectively).
13. Among 27 CMS-based sweet sorghum hybrids tested, SSKH-163 recorded fresh biomass of 63.21 T/ha, juice yield of 17.82 T/ha and Total Sugar Index of 2.60 T/ha and was on par with the best check CSH-22-SS (67.39 T/ha, 19.36 T/ha and 2.74 T/ha).
14. In continuation of the programme for developing high biomass and high sugar-yielding shoot fly tolerant restorers, F₄ progenies were evaluated and 119 potential restorers which had greater than 15% juice brix have been selected for further advancement.
15. F₄ progenies were evaluated for developing high biomass and high sugar-yielding shoot fly-tolerant maintainers and 741 individual plant selections have been made. From these 164 progenies which had greater than 15% juice brix were selected for further advancement.
16. A crossing programme consisting of 10 sweet sorghum CMS lines and 10 genotypes possessing desired traits was laid out in a line x tester manner during kharif-2011 to develop sweet sorghum hybrids. The genotypes used as parents in the crossing programme were as follows :

1. **Lines : (CMS lines, Females) :**

- (i) ICSA-34 (ii) ICSA-423 (iii) ICSA-432 (iv) ICSA-448 (v) ICSA-459
(vi) ICSA-467 (vii) ICSA-479 (viii) ICSA-529 (ix) ICSA-565 (x) ICSA-685

2. **Testers (Pollinators) :**

- (i) NARI-SS-31 (ii) NARI-SS-155 (iii) NARI-SS-169 (iv) NARI-SS-172
(v) NARI-SS-180 (vi) NARI-SS-192 (vii) NARI-SS-201 (viii) NARI-SS-203
(ix) NARI-SS-221 (x) IS-19476

1. Center had also conducted four AICSIP trials on sweet sorghum during kharif 2011. The details are as follows :
 - a. **Effect of staggered planting on stalk yield, sugar content and ethanol yield of sweet sorghum for increased harvest window :** CSH-22-SS was found to be the best for ethanol yield and Total Sugar Index at all five planting dates.
 - b. **Characterizing and identification of new sorghum sources for high biomass (Photoperiod-sensitive) for second generation biofuels traits :** SSRG-43, SSRV-44 and SSRV-222 were found to be the best entries for ethanol yield and total sugar index.
 - c. **Assessment of sweet sorghum for post-harvest deterioration of stalk and juice quality :** V₁T₅, V₁T₆, V₂T₃ and V₂T₄ were found to be the best treatments for ethanol yield and Total Sugar Index. V₁ is CSV-19-SS and V₂ is CSV-24-SS. T₃ : Juice and stalk weight and quality assessment at 48 hr after harvesting. T₄ : Juice and stalk weight and quality assessment at 72 hr after harvesting, T₅ : Juice and

stalk weight and quality assessment at 96 hr after harvesting and T₆ : Juice and stalk weight and quality assessment at 120 hr after harvesting.

- d. **IAVHT Trial** : CSV-19-SS, ICSV 25279 (ICRISAT), SSRV 3 (DSR), ICSSH 70 (ICRISAT), and RSSV 197 (Rahuri) have shown shoot fly tolerance. Madhura (L.C.), RSSV-275 (Rahuri), ICSSH 70 (ICRISAT) and NARI-SSH-3 (NARI) have been found to be the best entries on the basis of IPS, FPS, biomass, juice brix, juice yield and Total Sugar Index.

Rabi (Post-rainy season) 2011-12 :

1. In continuing sweet sorghum CMS-line development programme, we have made backcrosses in 93 progenies. The CMS lines being considered for improvement are NARI-SS-5A, NARI-SS-6A and NARI-SS-11A. These backcrosses are currently in BC₅ and BC₄ stages.
2. Out of the 29 CMS-based sweet sorghum hybrids tested SSKH-118 recorded biomass of 27.61 T/ha, fresh stalk yield of 16.85 T/ha and juice yield of 8.63 T/ha which were on par with those of the check CSH-22-SS. Significantly higher juice brix of 15.7% and Total Sugar Index of 1.30 T/ha were recorded by SSKH-118 over the best check CSH-22-SS (9.7% and 0.79 T/ha respectively).
3. Among the 27 CMS-based sweet sorghum hybrids tested SSKH-174 recorded on par biomass yield (31.50 T/ha) with the best check CSH-22-SS (34.42 T/ha). SSKH-174 also recorded fresh stalk yield (16.49 T/ha) and juice yield (7.40 T/ha) on par with those of the best parent NARI-SS-172 (17.93 T/ha and 8.87 T/ha respectively).
4. Among the 12 CMS-based hybrids tested, significantly highest grain yield of 19.36 q/ha was recorded by SSKH-182 followed by SSKH-178 (13.12 q/ha) and SSKH-183 (10.74 q/ha) compared to the best parent NARI-SS-221 (4.83 q/ha).
5. Of the nine F₅ progenies evaluated, F₅ (DC-24)-27-1 recorded numerically higher juice yield (4.60 T/ha), juice brix (21%) and Total Sugar Index (0.97 T/ha) than the best check CSV-19-SS (4.19 T/ha, 17.5% and 0.73 T/ha respectively).
6. Among the 16 F₇ progenies tested, F₇ (D-91)-9 recorded numerically higher biomass (59.86 T/ha), fresh stalk yield (36.66 T/ha), juice yield (19.53 T/ha), juice brix (19%), Total Sugar Index (3.71 T/ha) and grain yield (30.37 q/ha) than the best check CSV-19-SS (42.90 T/ha, 24.79 T/ha, 9.55 T/ha, 17%, 1.62 T/ha and 27.09 q/ha respectively).
7. A total of 108 high brix sweet sorghum selections of advanced generations were evaluated and out of them 38 promising ones were selected for further advancement.
8. Among the seven PVT entries evaluated (D-34)-11-1 recorded biomass (31.23 T/ha), juice yield (12.89 T/ha), juice brix (21%) and Total Sugar Index (2.71 T/ha) on par with those of the best check CSV-19-SS (44.35 T/ha, 11.74 T/ha, 19% and 2.23 T/ha).
9. In continuation with the programme for development of high biomass and high sugar-yielding shoot fly tolerant restorers, 119 F₅ progenies were evaluated and 34 potential restorers which had greater than 15% juice brix were selected for further advancement.

10. 164 F₅ progenies were evaluated for developing high biomass and high sugar-yielding shoot fly-tolerant maintainers and out of them 55 progenies which had greater than 15% juice brix were selected for further advancement.
11. F₂ progenies of six promising crosses were evaluated and 518 individual plant selections were made.
12. A crossing programme consisting of 12 sweet sorghum CMS lines and 108 high brix selections was conducted to develop sweet sorghum hybrids. The genotypes used as parents in the crossing programme were as follows :

1. Lines (CMS lines, Females) :

i) ICSA-38, ii) ICSA-52, iii) ICSA-306, iv) ICSA-318, v) ICSA-320, vi) ICSA-343, vii) ICSA-653, viii) ICSA-735, ix) ICSA-1041, x) ICSA-1061, xi) NARI-SS-1A-43, xii) NARI-SS-15A

2. Testers (Pollinators) :

One hundred eight high brix selections from Trial 10 with dates of flowering which matched those of the CMS lines were used as pollinators.

13. 200 AB lines were maintained by the center during rabi 2011-12.
14. More than 500 germplasm lines were maintained by the center during rabi 2011-12.
15. Seed production of four promising CMS-based hybrids *viz.* NARI-NFSSH-44, NARI-SSRH-15, NARI-SSRH-19 and NARI-SSRH-20 was undertaken. Sufficient amounts of seed of these hybrids were obtained for conducting an evaluation trial. NARI-NFSSH-44 has been tested in AICSIP trials during kharif 2011 and promoted for testing in advanced trial.



Dr.J. V. Patil, DSR Director visiting NARI sweet sorghum program.



Newly developed CMS lines of sweet sorghum by Nimbkar Agricultural Research Institute

16. Seed production of nine promising selections *viz.*, NARI-LC-07-5, NARI-SS-233, NARI-LC-07-52, NARI-LC-07-5-16, (DC-29)-21, (D-102)-12, (D-94)-74, (D-34)-11-1 and (D-91)-9 was undertaken. The selections NARI-LC-07-5, NARI-SS-233 and NARI-LC-07-52 were tested in AICSIP trials during Kharif 2011 and NARI-SS-233 has been promoted for third year of testing in AICSIP trial.
17. Center also conducted four AICSIP trials during rabi 2011-12. The details are as follows :
 - a. **IVHT-SS Trial (Evaluation of grain sorghum entries on shallow soils) :** Phule Maulee, Phule Anuradha and M 35-1 produced the highest grain yield under limited irrigation.
 - b. **AVHT-SS Trial (Evaluation of grain sorghum entries on shallow soils) :** M 35-1, Phule Anuradha, SPV-2048 (Rahuri), SPV-2031 (Akola) and Phule Maulee produced the highest grain yield under limited irrigation.
 - c. **Sweet sorghum evaluation for stalk yield, biomass, juice yield, juice quality (sugar traits) and winter season adaptation :** SPSSV-30 was found to be the best entry for ethanol yield and Total Sugar Index.
 - d. **IAVHT (Sweet Sorghum) :** RSSV-192 (Rahuri), ICSV-25279 (ICRISAT), NARI-SS-2 (NARI) and ICSSH-70 (ICRISAT) have been found to be the best entries on the basis of IPS, FPS, biomass, juice brix, juice yield and Total Sugar Index.

Project staff : N. Nimbkar, Ph.D.; D. R. Bapat, Ph.D. (Consultant); V. Singh, Ph.D.; R. Sharma, Ph.D.; A. Siddique, Ph.D.; M. B. Deshpande, M.Sc.; V. A. Bhagwat, M.Sc.; A. M. Ranaware, M.Sc.; C. S. Khore, M.Sc.; B. R. Waghmode, M.Sc.; S. V. Choudhari, B.Sc.; R. K. Andhalkar; A. M. Nale; A. R. Gholap; M. G. Shirke

RENEWABLE ENERGY RESEARCH

Two main events took place. First was the inauguration of Bajaj Center for Sustainable Development and second was the sanctioning of Lanstove proposal by DST.

1. Bajaj Center for Sustainable Development

The center was [inaugurated on April 12, 2011](#) by Shri. Madhur Bajaj (Vice Chairman, Bajaj Auto) and Shri. Sanjay Kirloskar (CMD of Kirloskar Brothers). The function was well attended and widely covered in mass media.

The center has been used to hold seminars and meetings. Besides that it has also been used to house interns and guests.

The center is a green building with very [innovative sustainable features](#). For example, it is passively cooled during summer months by rooftop cooling using wet gunny sacs. The gunny sacs are wetted by water pumped by a solar PV pump from the tube well. The well is charged by the rainwater harvested from the roof of the building. Also the hostel hot water is provided by a solar thermal system with a back-up of wood-fired boiler.

With the construction of this center, the Institute has now an excellent facility for conducting seminars, courses and conferences.

2. Kerosene Lanstove for Rural Areas

Funding agency : Department of Science and Technology (DST), Government of India

Duration : Two years from October 1, 2011

DST has funded a two-year project on [lanstove](#) introduction in rural areas. The objectives of the project are :



- (a) To fabricate 25 lanstove assemblies and test them in rural households which have no electricity connection.
- (b) To optimize and fix the kerosene control valve design and other parameters of the lanstove.
- (c) To establish lanstove as an economically viable solution for cooking and lighting needs for rural households.

Twenty-five units have been fabricated and are undergoing testing before they will be introduced in the huts. Major problems which were encountered during fabrication have been rectified.

Project staff : Anil K. Rajvanshi, Ph.D.; V. J. Chopade, M.Tech., S. M. Patil; R. S. Bale; A. M. Pawar; D. B. Gadhave

ANIMAL HUSBANDRY RESEARCH

Summary

The main aim of animal husbandry division (AHD) research is to genetically improve local goats and sheep and their feeding and management to increase their productivity and the income earned by their owners. The following major achievements were made during 2011-12 in the pursuit of this goal.

1. The NARI Suwarna strain of twinning Deccani sheep was further improved by selection and by improvements in feeding and management. Now we have ewes with about 90% Deccani proportion or with 60% Deccani and 30% Madgyal (and only 10% Garole) proportion that are capable of producing and raising twin lambs to a weaning weight of 13 kg each (total weaning weight 26 kg) in 3-4 months. NARI Suwarna rams and ewes are available for dissemination. This project was funded from April 2009 to March 2012 by the Department of Biotechnology, Government of India. We now hope to make it self-sustainable.
2. Our sister institute Maharashtra Goat and Sheep Research and Development Institute imported Boer goat embryos in 1993. The Boer is considered to be the world's best meat goat breed. We have been making available Boer buck semen for artificial insemination of local goat does since 1994. Crossing with the Boer produces fast growing, well-proportioned kids that are hardy, adaptable to a range of climates, handsome and fetch high prices for slaughter and breeding. Thousands of goat keepers in Maharashtra and other States have benefited from crossbreeding their goats with the Boer. Since 2010, we have also made available Osmanabadi buck semen. This is from Osmanabadi bucks selected for fast growth, conformation, appearance and mother's twinning and high milk yield in our Osmanabadi goat field unit under the All India Coordinated Research project on Goat Improvement of the Indian Council of Agricultural Research.
3. Now we have made more progress in the dissemination of improved germplasm by starting the production of frozen semen (in straws) of Boer and Osmanabadi bucks in the buck and ram semen freezing laboratory set up with a grant from the Government of India. The laboratory will be fully functional next year when we are able to purchase the remaining equipment after receiving the subsequent installments of funds. This is a pioneering laboratory in India. The only other laboratory in India where buck semen is frozen commercially is that of the Kerala Livestock Development Board.
4. A major break-through made during 2011-12 was the successful multiplication of the highly nutritious and palatable NARI *Nirbeeja* or KX2 hybrid *Leucaena* by the method of rooting of its cuttings. We hope to improve this method further so that we may be able to

offer plants to farmers in large numbers at affordable prices. We believe this tree has the potential to reduce the cost of concentrate feeding in cow, buffalo, goat and sheep rearing and increase animal productivity substantially because of its high protein content.

Ongoing projects :

Project I. Increasing profitability of sheep production by genetic improvement using the *FecB* (Booroola) mutation and improved management

Funding agency : Department of Biotechnology (DBT), Ministry of Science and Technology, Government of India.

Collaborating Institute : National Bureau of Animal Genetic Resources (NBAGR) of the Indian Council of Agricultural Research (ICAR)

Duration : 2009-12

Objectives and progress made against targets

Objective I (1) : Multiplication of *FecB* carrier animals in the nucleus flock

Ewes were artificially inseminated in April, July and November-December 2011 and March 2012 at NARI in order to achieve fast multiplication of *FecB* carrier animals in the nucleus flock. Details are in Table 1 below. During the above three AI programmes, 331 ewes were inseminated; the overall conception rate was 80.7%; 289 ewes lambed and total 406 lambs were born.

Each artificial insemination (AI) programme went on for one month, roughly covering two oestrus cycles. Ewes were inseminated in natural oestrus detected by vasectomized teaser rams. All ewes were inseminated cervically once, about 12 hours after oestrus detection. Ewes were inseminated with fresh, diluted semen of the allotted rams. Adequate numbers of unrelated breeding rams were used to keep inbreeding under control (Table 2). Sophisticated genetic analysis was used to estimate breeding values. An advanced 'mate allocation' program was used to maximize genetic merit while keeping inbreeding below a predetermined level.

Deccani and Madgyal rams are being used to improve the physical appearance and conformation of crosses in such a way as to make them more desirable to local smallholder sheep owners. Madgyal or Vijapuri is a breed from southern Maharashtra which is a tall breed with a faster growth rate than Deccani and is preferred by shepherds in the Phaltan area and many other areas of Maharashtra. Breeding ewes and lambs were managed under a system of grazing with a small amount of supplementary feeding. Ewes that returned to oestrus after insemination but within the designated period of each programme, were inseminated once again. A few ewes were naturally hand-mated to rams if the rams were too shy for semen collection or sometimes if a ram had only one ewe allotted to it out of the ewes on oestrus on a particular day. The overall conception rate was 81 per cent. The number of lambs born in April and September 2011 was 193 and 64 respectively and that born in April 2012 was 149, thus making up a total of 406 lambs born during 2011-12. Out of these, 341 lambs or 84% were *FecB^B* allele carriers; 90 lambs or 22% being homozygous *FecB^{BB}* and 62% being heterozygous *FecB^{B+}*.

Dates of AI : 11April -16 May 2011
 29 June – 3 August 2011
 15 Nov. – 16 Dec. 2011

Table 1. Details of AI programs carried out in April, July and November 2011

Particulars	<i>FecB^{BB}</i>	<i>FecB^{B+}</i>	<i>FecB⁺⁺</i>	Total
Ewes available for breeding	81	228	95	404
Ewes inseminated artificially (AI)	65	193	73	331
Total number of first, second and third AI + NS	69	208	81	358
Ewes conceived (AI + NS)	55	170	65	290
Overall conception rate (%)	79.7	81.7	80.2	81.0
Ewes lambed with at least one live lamb	49	154	63	266
Live lambs born per ewe lambed (includes ewes aborted / with all lambs stillborn)	1.67	1.48	1.00	1.40
Live lambs born per ewe conceived	1.38	1.30	0.89	1.23
Live lambs born per ewe available for breeding	1.11	1.10	0.68	1.00

The above table shows that out of the ewes selected and available for breeding based on their age and weight, 80.2% of the homozygous *FecB^{BB}* ewes, 84.6% of the heterozygous *FecB^{B+}* ewes and 76.8% of the non-carrier *FecB⁺⁺* ewes exhibited oestrus and were inseminated. The percentage of ewes lambing with at least one live lamb, out of the ewes inseminated was, 75.4% for homozygous *FecB^{BB}* ewes, 79.8% for heterozygous *FecB^{B+}* ewes and 86.3% for non-carrier *FecB⁺⁺* ewes. Homozygous *FecB^{BB}* ewes produced 1.67 live lambs per ewe lambed compared to 1.48 lambs per heterozygous *FecB^{B+}* ewe lambed and 1.00 lamb per non-carrier ewe lambed. **Homozygous *FecB^{BB}* and heterozygous *FecB^{B+}* ewes produced 63% and 62% more live lambs respectively per ewe available for breeding than non-carrier ewes.**

Table 2. Rams used for breeding in April, July and Nov-Dec 2011 AI programs

Particulars		Apr-May 2011	July 2011	Nov-Dec 2011
Number of ewes available for breeding		178	99	127
Average number of ewes mated to each ram used for breeding		8	11	7
Breed of ram	<i>FecB</i> genotype of ram	Number of rams used		
Fecund Deccani (NARI Suwarna)	<i>FecB^{BB}</i>	1	1	1
	<i>FecB^{B+}</i>	5	3	3
Fecund Deccani with up to 70% Madgyal proportion	<i>FecB^{B+}</i>	4	2	5
	<i>FecB^{BB}</i>	3	1	5
Fecund Composite	<i>FecB^{B+}</i>	3	-	-
	<i>FecB^{B+}</i>	2	-	2
Fecund Composite with 50% Madgyal proportion	<i>FecB⁺⁺</i>	1	1	-
	<i>FecB⁺⁺</i>	2	1	2
Total		21	9	18

Table 3 shows the number of *FecB* carrier and non-carrier ewes in the nucleus flock at NARI. These are animals selected on the basis of their *FecB* genotype (*FecB* carrier genotype preferred but some non-carrier ewes retained to produce heterozygous *FecB* carriers), growth rate at 3, 6, 9 and 12 months and the extent to which their phenotypic appearance corresponds with the preferences of the local shepherds. Adult ewes are further selected on the basis of their reproductive performance. Since the project started in April 2009, the number of homozygous *FecB^{BB}* ewes at NARI has increased by 23%, the number of heterozygous ewes has stayed the same and that of non-carrier ewes has reduced by 40%. During the project, 94 heterozygous *FecB^{B+}* ewes were disseminated to 12 smallholder sheep owners in 2010. Now 30% of the ewes in the NARI flock have 25 to 50% Madgyal proportion in accordance with the preference of the local sheep owners. About half of the 18-months old and younger ewes at NARI are ewes with 25 to 50% Madgyal proportion.



10-month old twin sister ewes born in September 2011 in NARI's flock and weighing 28 and 29 kg respectively. One is *FecB^{B+}* heterozygous and the other a non-carrier.

Table 3. Ewes of the three *FecB* genotypes at NARI in August 2012

Age	Ewes			Total
	Homozygous <i>FecB^{BB}</i>	Heterozygous <i>FecB^{B+}</i>	Non-carrier <i>FecB⁺⁺</i>	
8 months to 8 years	79	204	77	360
4 months	18	39	4	61
Total	97	243	81	421
	Rams			
8 months to 4 years	15	20	6	41
4 months	13	20	-	33
Total	28	40	6	74

Objective I (2) : Dissemination of *FecB* and monitoring progeny performance

From 2004 to mid-2012, 94 *FecB* carrier rams were disseminated for breeding in six States of India. Table 4 below gives the details of ram dissemination. In addition, about 60 rams were sent for breeding to various smallholder shepherds' flocks in Maharashtra for varying time periods. From 2010 onwards, *FecB^B* carrier ewes were also disseminated.

Table 4. Number of *FecB^B* carrier rams and ewes disseminated in different States of India from 2004 to mid-2012

State	Number of rams	Number of ewes
Andhra Pradesh	36	40
Jammu and Kashmir	12	-
Karnataka	17	68
Maharashtra	18	131
Rajasthan	2	-
Tamil Nadu	9	-
Total	94	239

A

questionnaire was designed in July 2011 and sent to 25 sheep rearers/entrepreneurs/institutions that procured *FecB* carrier rams from NARI over the last five years to find out information on the performance of the rams in their flocks, their opinions about the rams and whether the use of the rams increased their profit from sheep rearing. Six of the sheep owners sent written replies to the questionnaires. Shri Anjalalaih, a shepherd in Mahabubnagar district of Andhra Pradesh who purchased two homozygous *FecB^{BB}* rams in 2008 had 60 of his ewes mated by these two rams in three years, out of which 57 lambed. He retained most of these ewe progeny in his flock and found that they gave twin lambs in the majority of lambings. Shri Santosh Venkatappa from Nelamangala near Bangalore who purchased two homozygous rams in 2011, has a flock of 80 ewes and all of them have been mated by these rams. The Krishi Vigyan Kendra (KVK) at Namakkal, Tamil Nadu had 40 ewes mated to two homozygous *FecB* carrier rams purchased by them in 2009 and all of them lambed. The first *FecB* carrier daughter of one of the rams had its first lambing on Dussehra day in 2011 and had twin lambs. They found the growth rate of F1 (NARI ram X Mecheri ewe) lambs higher than that of Mecheri lambs but disapproved of the inferior wool quality of the crosses. NARI Suwarna breed has not been selected for wool quality and none of the breeds included in its composition have good wool quality. So it is expected that crosses with NARI Suwarna would not have good wool quality. The NARI Suwarna breed has been developed with the objective of increasing the quantity of meat produced.

Five of the six respondents expressed satisfaction about the body conformation of the *FecB* carrier rams, their year round adaptability to their local climate and grazing environment and their hardiness as well as their libido and mating and fertilizing ability in the field. They also found that the mothering ability of the ewe progeny of the *FecB* carrier rams from NARI was good. Only the Sheep Husbandry Department in Jammu, of the Government of Jammu and Kashmir, who purchased two homozygous and one heterozygous *FecB* carrier rams in 2007, expressed dissatisfaction about their small size, rough wool coat and lack of adaptability under field conditions in private sheep flocks.

Objective I (3) : Establishment of PCR-RFLP DNA test for detection of *FecB* mutation

Six hundred fifty three rams and ewes belonging to NARI and local shepherds were genotyped at the *FecB* locus using the PCR-RFLP DNA test in the molecular biology laboratory established at NARI under the DBT project. Additionally, 105 sheep including 62 breeding rams were genotyped at the *FecB* locus using a tetra-primer ARMS PCR method to confirm the validity of the RFLP method. 97.7% of the results were the same in both tests.

Genomic DNA was extracted from whole blood of 48 sheep according to the standard protocol of proteinase-SDS digestion followed by phenol-chloroform extraction (Sambrook et al., 1989). DNA was stored at -20° C for further use. DNA quantitation was done by loading samples on 0.8% agarose gel and visualizing the bands in the gel documentation system.

100 *FecB* carrier and non-carrier sheep were tested for the detection of a mutation in the Prolactin (PRL) gene and its association with uterine function and capacity was studied. The frequency of the mutated B allele was 0.22 in Garole, 0.12 in Deccani, 0.09 in crossbred sheep and 0 in Awassi sheep. Since only 17% of the 41 crossbred ewes were found to carry the mutation, it appears that this polymorphism may have been originally present in the Garole breed and was transmitted to the crosses from the Garole. Results showed that ewes carrying one or two copies of the PRL mutation had significantly lower lamb mortality at birth than non-carriers of the mutation (4.6% vs. 13% in Garole ewes and 7.9% vs. 21.6% in crossbred ewes), indicating superior uterine capacity. The proportion of live lambs at every lambing of ewes genotyped at the Prolactin locus was analyzed statistically by fitting the ewe's *FecB* genotype, ewe's PRL genotype, ewe's weight and age, the proportion of Deccani, Garole and Awassi breeds in the ewe's breed composition and the ewe's year and season of lambing. Only the ewe's *FecB* genotype had a significant influence on the proportion of live lambs while the ewe's PRL genotype approached significance. The least squares means for the three PRL genotypes indicated that the proportion of live lambs to total lambs was 1.0 for ewes carrying two copies of the PRL mutation, 0.97 for ewes carrying one copy and 0.90 for ewes not carrying the mutation.

Objective I (4). Estimation of the effect of one and two copies of the *FecB* mutation

The percentage of twins and triplets among lambings of *FecB* carrier ewes that lambed from 2009 to 2011 was calculated.

- Around 55% of lambings of heterozygous *FecB*^{B+} ewes produced twins, 8% triplets and 37% singles, giving an average litter size of 1.7.
- Only 1% of lambings of heterozygous *FecB*^{B+} ewes in shepherds' flocks produced triplets.
- Of the lambings of homozygous *FecB*^{BB} ewes, 43% produced twins, 16% produced triplets, 11% produced quadruplets and 30% produced singles. Thus 70% of their lambings were with multiple births and their average litter size was 2.1.

The least squares mean 3-month weight of single born lambs at NARI was 15.4 kg; that of twin-born lambs 11.9 kg and triplet and quadruplet-born lambs was 10.2 and 10.8 kg respectively. Thus the combined weight of twin-born lambs was 23.8 kg which was 54% higher than that of single lambs. There are some literature reports that lambs carrying one or two copies of the *FecB*^B allele weigh less than non-carrier lambs. Table 5 shows that when the 3 month weights of lambs born at NARI in 2010 were analyzed, non-carrier lambs of the three birth types had slightly (but not significantly) lower weights than *FecB* carrier lambs. Only triplet-born homozygous *FecB*^{BB} lambs had a substantially lower 3-month weight than heterozygous lambs but it was about the same as that of triplet-born non-carrier *FecB*⁺⁺ lambs.

Table 5 : Least squares mean 3-month weight of lambs born in 2010 having different types of birth and *FecB* genotypes

Lamb's birth type	Lamb's <i>FecB</i> genotype		
	<i>FecB^{BB}</i>	<i>FecB^{B+}</i>	<i>FecB⁺⁺</i>
Single	15.1 ± 0.6 (14)	15.7 ± 0.2 (77)	15.4 ± 0.4 (33)
Twin	12.1 ± 0.3 (47)	12.0 ± 0.2 (108)	11.7 ± 0.5 (22)
Triplet	9.2 ± 0.6 (6)	10.9 ± 0.4 (34)	9.4 ± 0.9 (14)
Quadruplet	11.7 ± 1.0 (7)	10.6 ± 0.7 (10)	No records

Objective I(5). Analysis of expression profile of candidate/regulatory genes associated with fecundity

- Garole and crossbred *FecB* carrier homozygous and heterozygous ewes with low (≤ 1.5) and high (≥ 2) average litter size were synchronized for oestrus, examined laparoscopically during the follicular stage and further used for gene expression analysis. There appeared to be two distinct groups among *FecB* homozygous and heterozygous carrier crossbred ewes, one with lower average number of preovulatory follicles and lower average litter size (of previous lambings) than the other. Homozygous Garole ewes which were classified in two different groups according to their average litter size did not appear to have correspondingly different number of preovulatory follicles. They, however, had varying gene expression as described below. The analysis of gene expression was carried out at NBAGR.
- Quantitative real-time PCR used to document the expression profile of the fecundity related genes across *FecB* carrier ewes of different genotypes and average litter sizes, revealed higher expression of *GDF9* and *BMP15* genes which are negative regulators of ovulation, in BB Garole ewes having a low litter size.
- The expression of *LHCGR*, *BMPRII*, *STAT5* and *SMAD9* genes in the ovaries of BB Garole sheep was similar across ewes of varying litter sizes. However, the expression of *SMAD9*, *BMP7*, *BMP4* and *BMPRIA* genes (which cause an increase in ovulation rate) in Graafian follicles was higher in high litter size BB Garole ewes.
- Analysis of genes from forward and reverse cDNA subtraction revealed higher expression of genes related to signal transduction and enzymatic activity in the ovaries of *FecB* carrier animals.

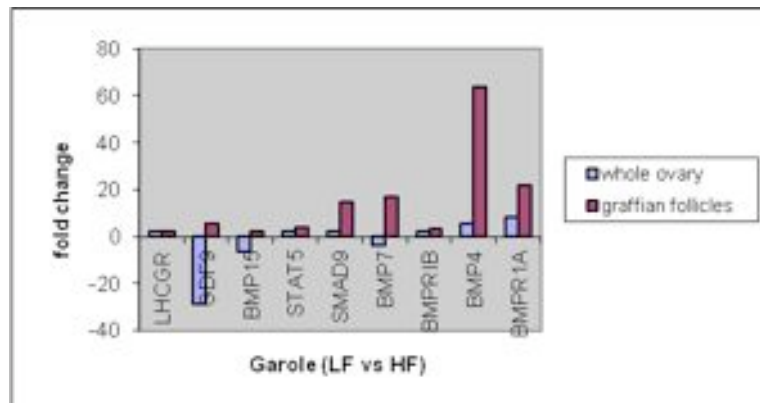


Figure : Fold change expression of various genes in oestrus synchronized ovaries and Graafian follicles of low (LF) and high (HF) fecundity Garole ewes. (Bars below 0 indicate higher expression in LF and above 0 higher expression of genes in HF animals).

- Sheep *Prolactin receptor (PRLR)* gene and *BMPRIB* promoter were amplified and *FecB* genotyped animals screened for polymorphism analysis and SNP discovery at NBAGR. A contig of ~1.7 kb generated for *BMPRIB* had a total of 12 SNPs and 8 SNPs were found to be present in various regions of *PRLR* introns and exons in the sheep screened.
- In order to find out the causes of variation in litter size and the effect of nutrition among ewes of the same *FecB* genotype, crossbred homozygous (8 with high and 6 with low average litter size) and Deccani non-carrier (6) ewes were divided into two groups – one kept on a high and the other on a low plane of nutrition since 30 Sept. 2011. Their ovary and follicle samples were collected in January 2012 and a gene expression analysis carried out at NBAGR.

Project II. Osmanabadi Goat Field Unit under the All India Coordinated Research Project on Goat Improvement.

Funding agency : Indian Council of Agricultural Research (ICAR), Government of India

Executive summary

Objective II(1). To assess the production performance of goat breeds in farmers' flocks under village management system and improve the germplasm through selection

1. An Osmanabadi goat field unit was established at NARI in April 2009 under the AICRP on Goat Improvement. The first centre under this unit was established in Satara district in Bibi and Wadgaon villages, 25 km from Phaltan town. The second centre was established in Kalamb taluka of Osmanabad district in July 2010, in collaboration with the NGO Paryay. The third centre was established in Karmala taluka of Solapur district in October 2010 in collaboration with the NGO Mahatma Phule Samaj Seva Mandal and the fourth centre was established in Jamkhed taluka of Ahmednagar district in August 2011 in collaboration with the NGO Grameen Vikas Kendra.
2. Seven hundred and eighty five adult does (307, 104, 242 and 132 adult female goats in Satara, Osmanabad, Solapur and Ahmednagar districts respectively) are being recorded.

Detailed periodic recording has been done of their body weight, milk yield, reproduction, kid weights, mortality, morbidity, cost incurred for goat rearing and income earned.

3. Increase in sale price of live animals : On comparing the sale prices received for goat kids before the start of the project (information from initial interviews of goat owners) and after the project started, there was found to be an increase in the price of live animals sold by goat keepers. Since now the goat keepers know the weight of their animals, they can insist on a higher price from the butcher based on the animal's weight.

Examples:

- a) Shri Ravindra Bagade from Bibi village of Satara district sold about 60 kids in 2009, the price for which worked out to be about Rs.99/- per kg live weight when the price of meat was Rs. 240/- per kg. In 2011, he sold 16 kids whose weights he knew. The price per kg live weight he managed to obtain in 2011 was Rs.193.70, almost double the price in 2009, while the price of meat increased only by 17%.
 - b) In Kalamb taluka, Shri. Madhukar Shinde sold 6-month old kids for Rs.1100 per kid in June 2010; and later when he knew the weights of the kids, for Rs. 2100 each in 2010 and Rs. 2950 each in 2011.
4. 1453 kids were born in 862 kiddings (in all project villages) from 1 April 2011 to 31 March 2012. Of these, 251 kiddings were in Satara district, 153 in Osmanabad district, 323 in Solapur district and 135 in Ahmednagar district. The average litter size over all districts was 1.68. The average litter size was higher (1.77) in Solapur district.
 5. The average kidding interval of 442 Osmanabadi does (4 kidding records per doe of 32 does, 3 kidding records per doe of 143 does and 2 kidding records per doe of 267 does) in Phaltan, Kalamb and Karmala talukas where at least two subsequent kidding dates were known with certainty, was calculated. It was found to be 283 days indicating about 1.3 kiddings per doe per year or two kiddings every 19 months.
 6. The least squares mean three-month weight of single-born kids (241 records) was 12.1 ± 0.2 kg and that of twin-born kids (548 records) was 9.9 ± 0.2 kg. Thus does giving birth to twin kids weaned almost 64% more kid weight than does giving birth to single kids. The overall least squares mean three month weight of Osmanabadi kids in this study was 11.5 ± 0.2 kg which was higher than the ~ 7 kg reported in the report of the Network Project on Osmanabadi Goats, MPKV, Rahuri (1995-99). The least squares mean three month weight of goat kids in Karmala and Jamkhed talukas (11.3 ± 0.3 and 11.0 ± 0.5 kg respectively) was about 14% higher than in Phaltan and Kalamb talukas (9.9 ± 0.2 kg and 9.6 ± 0.3 kg respectively) under our project.
 7. The number of observations of 6-months and 9-months weights was much lower (164 and 46 records respectively) since most of the kids are sold between the ages of 3 and 6 months. The overall least squares mean weight of goat kids at 6 and 9 months age was 14.6 ± 0.6 kg and 25.0 ± 1.9 kg respectively.
 8. The least squares mean body length, height at withers and heart girth were 27.1 cm, 32.4 cm and 31.9 cm at birth, 42.8 cm, 50.1 cm and 48.9 cm at 3 months and 49.2, 59.4 and 59.3 cm at 6 months. Male kids were bigger than female kids by 1 to 2 cm at all ages. The body length, height at withers and heart girth observed at birth, 3 months and 6 months of age were less than those reported in the Network Project on Osmanabadi Goats, MPKV, Rahuri (1995-99).
 9. The least squares means of the test day milk yield of does suckling one, two and three kids were 538.9 gm (1199 records), 894.8 gm (1271 records) and 1325.8 gm (138 records) respectively. The 100-day milk yield of does that had given birth to single, twin and triplet kids was 62.6 kg (245 records), 91.3 kg (328 records) and 126.1 kg (39 records) respectively. There was large variation in kid weight and milk yield, indicating a

potential for selection. Goats from Kamone in Karmala taluka had 39% higher least-squares mean milk yield than those in Phaltan and Kalamb talukas. We have been able to identify good milk producing does in the villages. Fourteen does (2.9%) out of 476 does whose 100-day lactation milk yields were analyzed, were found to yield more than 200 litres and one doe had a 100-day lactation yield of 330 litres. This indicates the availability of excellent genetic potential for milking in Osmanabadi goats and the scope for developing Osmanabadi as a dairy goat breed for the benefit of village women goat keepers.

10. Overall mortality in different age and sex groups was 0 to 5.9% in different project villages. The highest mortality (13%) was in Jawala and Hasegaon villages in Osmanabad district among kids younger than 3 months' age. Digestive disorders, anorexia/pyrexia and predation were among the main causes of mortality in all project villages.
11. NARI has purchased 29 bucks for dissemination since 2009. The six-month weights of these bucks are 20 to 25 kg. These are 10-15 kg higher than the mean weights reported under the 'Network Project on Osmanabadi Goats' (1995-99) and 6-11 kg higher than the least squares mean weight of the kids recorded under this field unit.
12. NARI has disseminated 18 Osmanabadi breeding bucks so far of which 13 are currently in the project villages – five in Phaltan taluka, three in Kalamb taluka, two in Karmala taluka and three in Jamkhed taluka since there is a severe shortage of breeding bucks and there was persistent demand for bucks from goat keepers. The goat keepers of these villages appreciate having these bucks available for breeding their goats. The performance of the progeny of these bucks will be monitored.
13. We have frozen semen of eight Osmanabadi bucks in pellet form and of three Osmanabadi bucks in straws and now have 395 Osmanabadi buck frozen semen pellets and more than 100 straws available for submission to NBAGR. The post-thaw progressive motility of this frozen semen is >60%. Each dose contains 180 to 200 million spermatozoa. We plan to freeze more semen in straws in the near future.
14. We measured the weight of meat, bones and edible offals separately of 4-7 months old Osmanabadi buck kids slaughtered during village fairs in Bibi and Wadgaon in 2010 and 2011. The kids were weighed before slaughter and their average weight was 20.6 kg (27 kids) and 18.1 kg (9 kids) respectively in 2010 and 2011. The average standard dressing percentage (including only meat, bones, fat, heart, liver and spleen), was 59% and 55% in 2010 and 2011 respectively while the average 'village' dressing percentage (including edible offals also in addition to the components of the standard dressing percentage), was 64% and 62% respectively.
15. We **improved the awareness of goat keepers** of how to increase their profits from goat keeping and **raised the status of the profession of goat keeping**. We know of at least 15 villagers from Bibi and Wadgaon villages from Phaltan taluka who have newly started rearing goats after they heard about the project and its benefits from goat keepers already under the project.
16. Two of our participating goat keepers won the **Breed Saviour Awards** sponsored by the National Biodiversity Authority.

Objective II(2). To evaluate the socio-economic status of goat breeders and the economics of goat production in farmers' flocks

17. Goat rearing was the main occupation of 42-57% of the goat keepers under the project except Sakat village in Ahmednagar district where only 26% of goat keepers under the project carried out goat rearing as their major occupation. In Sakat, almost half the goat keepers did crop farming as their major occupation. 45-80% of goat keepers from all

project villages owned some land. However, in the Kalamb centre, 54% of goat keepers under the project were landless. About half the goat keepers from all project villages were young (31-50 years old) but more than 35% goat keepers in each centre were illiterate.

18. Overall 25% of the kids recorded under the project in six villages were sold. Out of 1968 male kids, 590 or 30% were sold and out of 2140 female kids, 441 or 21% were sold during the report period. Forty three percent of the male kids aged 3-6 months were sold and 68% of the male kids aged 6-12 months were sold. Sale of kids is thus the main source of income from goat rearing.
19. The overall average price per kg live-weight of 3-6 months old kids was Rs. 218. Considering a kidding interval of 9.4 months, the average litter size of 1.68, average sale weight of 15 kg, and less than 5% kid mortality, the minimum gross income of a goat keeper per doe per year is likely to be more than Rs.6500.
20. **Role of women in goat husbandry**
 1. Proportion of women goat owners : 20-36% of the goat owners under the project from the different villages are women. Of the total 69 women goat owners, 40 own one doe each, 19 own 2-5 does each and 9 women own 6-10 goats each. Thus women are also found to own larger goat flocks. About 22% of all the goats are owned by women. The women who own the larger flocks are involved in goat husbandry as the main source of income for the whole household. Whether the women own goats or not, they always do a lot of the work in goat-rearing.
 2. Other reasons for goat-rearing done by women: In landless families, women keep goats to contribute to household income. Some women keep goats for companionship; especially while going out to the fields to work or if the husbands work far away in a city. In the households which own land, women keep one or two goats for their personal expenses.

Objective II(3). To disseminate the pro-poor goat-based technologies under field conditions and assess their impact on goat production

21. Five information booklets in simple Marathi language have been produced to educate participating and other goat keepers in better goat management.
 1. Vaccination in goats,
 2. First aid treatment in goats,
 3. Misconceptions and superstitions in goat treatment,
 4. Abortions in sheep and goats: prevention and care and
 5. Early breeding of young does: Prevention and consequences.

We have started using a new effective method of training of goat keepers in practical goat management. This is a weekly 1.5 hour evening training session with a group of interested goat keepers in three project villages. This has resulted in improving the confidence of goat keepers in their ability to detect sick goats and administer powder and liquid medicines to them safely and spraying them for ectoparasites. These groups are called Pashumitra groups. We consider these groups as the first step towards formation of a society of goat keepers in the village. The members of Pashumitra groups help the project staff in mass treatments as well as individual treatments and routine project work such as weighing of animals and milk recording. In Bibi village Pashumitra Samiti members pooled money and paid for part of the spraying and vaccination cost in 2011 and 2012. Because of the training, general awareness about goat health and better management has improved in the villages.

22. Awareness has been created among goat keepers about the following :
- ◆ Weight of sale goats and expected market rate
 - ◆ Disadvantages of early breeding of young does
 - ◆ Importance of immediate treatment to save the lives of sick goats
 - ◆ Importance of giving supplementary feed to does one month before and three months after kidding and to kids until six months or sale age
 - ◆ Importance of identification of goats and keeping records
 - ◆ Improved animals fetch better prices
 - ◆ Regular vaccination, deworming and spraying can reduce mortality
 - ◆ Reduction in misconceptions about goat treatment for infections: Goat keepers have stopped practicing painful and ineffective methods of treatment such as branding, which sometimes caused more harm to the animals. They have instead adopted effective and appropriate veterinary treatments.
23. We conducted a three-day training programme for goat owners from Kalamb taluka of Osmanabad district with funding from the 'ATMA' project of the Osmanabad Zilla Parishad. Thirty one project goat keepers along with 40 others attended the training. Goat keepers benefited greatly from the hands-on experience and exposure visit. Certificates were given to the participants to enable them to access government schemes for goat development and bank loans to purchase goats.
24. We have constructed a simple feeder made of short wooden poles and old gunny bags at a goat owner's house. It is shown in the picture below. This feeder is easy to make and costs very little. It can be used for concentrate feeding and reduces contamination and waste of expensive feed which is otherwise spread on the ground. The feeder saves the feed from getting trampled on by goats and soiled with their faeces and urine.



Example of pro-poor goat-based technology: a cheap feeder for feeding concentrate to goats, constructed by NARI personnel for Sonba Godse's flock in Bibi

25. **Decrease in sudden mass mortality and improvement in health of animals due to vaccination and treatments :** All goats and kids in the villages are vaccinated against H.S., P.P.R. and E.T. under the project. Vaccination and prompt treatment have reduced the mortality among kids substantially.

Examples :

- a) Shri. Sahebrao Bhise, a goat keeper of Kamone in Solapur district, who has six adult does, said that every year about 2-3 kids of 15 to 30 days' age used to die in his flock but since the project started and all his animals were vaccinated, there has been zero mortality in his flock in the past one and a half years.
- b) In Bibi and Wadgaon villages in Satara district, there was an H.S. epidemic in May 2011 but since most of the animals were vaccinated under the project, the mortality was

checked. Shri Ravindra Bagade had told during his interview that in 2008 eight adult goats belonging to him had died due to H.S. but in 2011, only two of his goats died, all other goats were successfully treated.

Project III. Setting up a State of the Art A.I. Centre for sheep and goats under the Central Sector Scheme 'Integrated Development of Small Ruminants and Rabbits'.

Funding agency : Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Government of India

Total amount : Rs.199.73 lakh

Date of sanction : 24 November 2010

The first installment of Rs.50 lakh released by the Government of India in November 2010 was received by NARI AHD from Government of Maharashtra in October 2011. NARI purchased five major and four minor items of equipment. The equipment was installed by the representative of the company IMV Ltd. from whom all the major equipment such as a biological freezer, automatic semen straw filling and sealing machine, water bath and cold handling cabinet were purchased. Buck semen was frozen successfully in straws in January 2012 although the straw printing machine had not been purchased due to dearth of funds. About 700 straws of frozen Boer and Osmanabadi buck semen were produced by the end of March 2012.

Shri. Sanjay Bhoosreddy, Joint Secretary (P&F), Animal Husbandry, Dairying and Fisheries, Government of India along with Shri Eknath Dawale, Commissioner and Dr. H.D. Gaikwad, Regional Joint Commissioner, Animal Husbandry, Maharashtra State and Dr. H.T. Rawate, District Deputy Commissioner visited NARI on 14 January 2012. They inspected the equipment purchased by the Institute. Dr. Pradip Ghalsasi showed them working of the equipment, laboratory set-up and frozen semen in the form of pellets as well as straws under the microscope. Dr. Chanda Nimbkar, Dr. Pradip Ghalsasi and Shri B.V. Nimbkar had detailed discussions with them about the execution of the project.

NARI submitted the utilization certificate for the first installment to Government of India through the District Deputy Commissioner, Animal Husbandry, Satara in January 2012. The second installment of Rs. 50 lakh was released by the Government of India on 29 February 2012 to Government of Maharashtra. It is expected that the second installment will be disbursed to NARI by September 2012.

Project IV. Vegetative propagation of NARI *Nirbeeja* hybrid *Leucaena*

Funding Agency : Self-funded

The AHD, NARI is a pioneer in India in successfully propagating KX2 which is an outstanding hybrid of *Leucaena leucocephala* X *Leucaena pallida* by using the technique of rooting the cuttings of KX2 and grafting KX2 scions on K8 variety of *Leucaena leucocephala*. AHD has named the cross '*NARI Nirbeeja*'. This accession is highly psyllid-resistant, fast growing and produces very little or no seeds and the seed is usually not fertile, hence the name *Nirbeeja*.

Outcomes of propagation through rooting :

Experiments for vegetative propagation of KX2 by rooting cuttings of KX2 were first carried out in March 2005 under the guidance of Shri B.V. Nimbkar. The success rate for rooting achieved at that time was 20-25%. By this method about 50 mother plants were produced and planted on Wadjal farm. The protocol was modified from experience and knowledge gained over time and a batch of NARI *Nirbeeja* cuttings was put in for rooting in December 2011. The success rate achieved this time was 80%. The rooting was done in high humidity chambers of polythene sheets over sand beds which measured about 1 m X 2 m. Indole Butyric Acid (IBA) was used as the rooting hormone. Bi-nodal juvenile cuttings about 10 cm in length and 5–7 mm thick were dipped in IBA and inserted about 2 cm deep into the sand beds. Water was sprayed about four times a day to maintain 95-98% humidity and 28-32°C temperature. After about five weeks the cuttings rooted, and were transplanted in nursery bags containing soil mixture. These plants were kept in a separate humidity chamber where moisture percentage was decreased gradually every week so that hardening of the plants commenced. After about three weeks the acclimatization process was completed and the plants were moved under a shade net for hardening.

The limitation for rooting is that the success rate is unpredictable as the current high humidity chamber is of a rudimentary form. It is expected that if a sophisticated mist chamber is used with automated foggers and temperature control the success rate may improve.

Outcomes of propagation through grafting :

The ‘wedge grafting’ technique was used to propagate NARI *Nirbeeja* since 2007. The root stock used was K8 *Leucaena* and scion KX2 NARI *Nirbeeja*. About six months old K8 plants were used for grafting. The season preferred is monsoon when the success rate is about 90%. After grafting the scions sprout within a week and start growing. It takes about 3-4 weeks for complete joining of the root stock with the scion. After about three weeks the grafts are hardened for 2-3 weeks and then they are ready to go into the soil.

To date NARI has produced over 2000 grafted plants of NARI *Nirbeeja*. We find the grafting procedure is well-standardized and reproducible if performed methodically.

Project V. Assessment of green and dry matter yield and quality of NARI *Nirbeeja* (KX2 or *Leucaena leucocephala* x *Leucaena pallida*) planted on a farm bund and grown without direct irrigation after the first nine months and without fertilizer for use as fodder for ruminants.

KX2 is highly palatable to goats, sheep, cows and buffaloes, highly digestible and has 25 to 30% crude protein, thus having the potential to replace expensive commercial concentrates.

Duration : August 2008 to December 2011

Funding agency : self-funded

Objectives :

- 1) To assess yield of NARI *Nirbeeja* trees harvested at intervals of 12 weeks during the year.
- 2) To compare the difference in yield of leaves for cutting heights of 1 m and 0.5 m from the ground

3) To assess the nutritive value of NARI *Nirbeeja* leaves – Crude protein, ADF and NDF

Material and methods : Five trees were always cut at a height of 1.0 m and five trees at 0.5 m from the ground every 12 weeks. The green leaves and stems were weighed separately from the wet wood.

Research findings :

The edible biomass yield and wood yield of trees almost doubled in the second year compared to the first year but the yield of both edible biomass and wood in the third year was practically the same as that in the second year. The rainfall may have played a role in this as it was 500 mm, 860 mm and 263 mm respectively in the three years.

The ten trees in the trial covered an area of 60 sq m (5 trees cut at 1m height and 5 trees at 0.5 m). Total edible biomass obtained from all ten trees in the first year was 221 kg and fuel wood was 123 kg. During the second year edible biomass obtained was 423 kg and fuel wood was 274 kg. During the third year edible biomass obtained was 445 kg and fuel wood was 232 kg.

Table 6. Yield obtained from NARI *Nirbeeja* trees cut at intervals of 12 weeks from August 2008 to December 2011

Period of growth	Year	Total cuts	No. of trees cut	Total green edible biomass (kg)	Wet wood (kg)
Trees cut at 1 m height					
8-Aug-08 - 17-Jul-09	1	5	5	125	67
14-Oct-09 - 2-Oct-10	2	5	5	241	150
30-Dec-10 - 9-Dec-11	3	5	5	270	134
Trees cut at 0.5 m height					
8-Aug-08 - 17-Jul-09	1	5	5	96	56
14-Oct-09 - 2-Oct-10	2	5	5	182	124
30-Dec-10 - 9-Dec-11	3	5	5	175	98

Conclusions

- The cutting interval of 12 weeks is suitable as it allows substantial growth of the trees between two subsequent cuts.
- Cutting enhances branching of trees.
- There are individual variations among the trees in the trial. The initial circumference of the trees ranged from 8 to 14 cm and the initial diameter ranged from 2 to 4 cm.
- From about 1.5 years of age, the trees yield about 10 kg of green foliage at every cutting when cut at twelve weeks interval at a height of 1 m from the ground.
- The trees cut at a height of 1m from the ground yielded about 30% more edible biomass than those cut at 0.5 m as there was more green material left for photosynthesis. The total average yield in three years per tree cut at 1m was 127.3 kg compared to 90.6 kg per tree cut at 0.5m.

- If there is normal rainfall, the yield from the trees in the monsoon season is about 40% more than that in the summer.
- The nutritive value of NARI *Nirbeeja* is excellent as it contains 25-31% crude protein. There is only 34% NDF and 14.4% ADF. The NDF and ADF in NARI *Nirbeeja* are lower than those in grass roughages such as Napier which contains 63% NDF and 43% ADF .
- It is estimated that about 10 trees need to be planted to feed one sheep ewe or goat doe and its progeny daily in a year (4 cuttings)
- The plantation spacing should be 1.5 m X 1.5 m.

Recommended supplementary fodder for ruminants :

The KX2 leaves should be wilted for about 12 hours before feeding.

- Cows and Buffaloes – 5 to 10 kg daily
- Sheep and Goats – 2 kg daily
- Lambs/kids - 500 g daily

NARI *Nirbeeja* takes time to establish compared to other fodder species but once established is far superior to any other fodder.

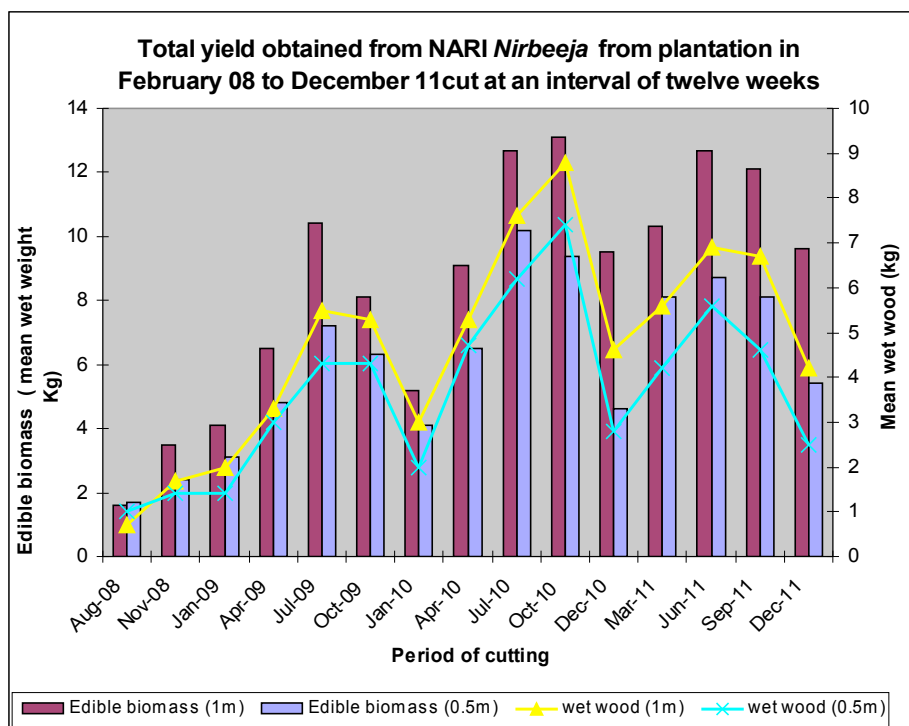


Figure : Average edible biomass yielded by trees cut at different heights

Project VI. Research in veterinary parasitology with special reference to sheep and goats.

Funding agency : self-funded

During the year, we monitored the gastro-intestinal (GI) worm burden under natural infection of NARI's sheep and goat flocks and of goat keepers' flocks participating in NARI's projects. Gastro-intestinal worm burdens of sheep and goat flocks of the shepherds from Ujani village of Indapur taluka, Dist. Pune associated with the NGO Anthra, Pune were also assessed. Pooled faecal samples of sheep from these flocks were brought to NARI by representatives of Anthra to know the extent of the nematode and liver fluke (trematode) infection. NARI provided them detailed reports with appropriate advice on anthelmintic administration.

Research findings :

1. Garole rams and ewes at Wadjal farm were again found to have significantly lower faecal worm egg counts (FEC) compared to the crossbred rams which were under the same grazing and feeding management. The table below shows the differences.

Particulars	Adult crossbred rams	Adult Garole rams	Adult Garole ewes
	August 2011		
Mean FEC (epg ¹)	1618	0	40
Range of FEC (epg)	200-5000	0	0-400
	October 2011		
Mean FEC (epg)	1595	55	111
Range of FEC (epg)	0-5600	0-200	0-800

¹worm eggs per gram of faeces

Garole rams and ewes at Wadjal farm have not been mass drenched for deworming for the last six years. Only individual animals that may develop high FEC due to stress such as sickness are dewormed occasionally.

2. The FEC of sheep and goats on all farms were found to be higher in monsoon (about 2500 epg) compared to other seasons (700 epg). During 2011-12, because of scanty rainfall, the dry period was longer than the rainy period compared to the previous year and so the worm burdens were lower. For example at Lundy farm those ewes which were empty and therefore not under stress had low faecal egg counts and did not require drenching until they lambed. The lambed sheep and kidded goats were found to have high FEC due to peri-parturient relaxation of immunity. These were effectively treated *en masse*. In September 2011, lambed and advanced pregnant ewes had mean FEC of 3168 epg with a range of 900-15,600 epg while empty ewes had mean FEC of 738 epg with a range of 100-2,700 epg.
3. During the year treatment with anthelmintic was given either *en masse* or individually considering the degree of pathogenicity of the worm burden and the season. Moreover, only those animals with FEC > 2000 epg were drenched to minimize use of anthelmintics with a view to delay the development of drug resistance. Some kids at Dhuldeo farm were found to have coccidiosis (protozoal infection). These were effectively treated with a coccidiostat such as Fazole or Pesulin tablets. During the year animals sold for breeding

from NARI's farms were drenched and then handed over to the buyer in order to avoid transfer of worm infection from our farms.

4. On Dhuldeo farm, in March 2012 emerging anthelmintic resistance to Albendazole was detected. It was observed in adult goats when a representative flock was screened for FEC. All of the 58 adult goats were drenched with the recommended dose of Albendazole, 10 mg/kg body weight. In order to test the efficacy of Albendazole, FEC of 36 of the drenched goats was tested. The anthelmintic was not found to be fully effective. The FEC reduction was 87%. According to the guidelines of the World Association for Advancement of Veterinary Parasitology, resistance to anthelmintic may be suspected in the nematode species tested against that drug if the anthelmintic has an efficacy of less than 95%. The larval species obtained from culturing the post-drench pooled faecal samples were found to be predominantly *Trichostrongylus* spp. followed by *Haemonchus contortus*.

Albendazole was fully effective at Dhuldeo farm until 2008. From 2009 to 2011, Albendazole was not used; so the resistance to Albendazole detected now had probably developed much earlier. Owing to the anthelmintic resistance some precautionary measures will be followed henceforth to check the spread of resistant larvae to another farm. All animals from Dhuldeo farm will be drenched with Ivermectin before transfer to another farm or sale for breeding. It has thus become important to use anthelmintic sparingly to cure worm infection as there are only three classes of broad spectrum and one narrow spectrum anthelmintic available.

5. For the shepherd flocks associated with Anthra, FEC was evaluated by pooled faecal sampling method for nematode and trematode (*Fasciola*) infection. It was reported that some sheep had symptoms of Fasciolosis such as oedema under the jaw but no snails were seen. Snails are the intermediate host for trematodes. Three shepherds had drenched their flocks prior to testing with Ivermectin, an oral anthelmintic. On testing, the nematode egg count was found to be virtually zero, indicating that Ivermectin was effective. No *Fasciola* eggs were detected in any of the flocks. It was explained to the Anthra veterinarian that the inflammation under the jaw might be due to low protein in the diet or liver function disorder and not necessarily trematode infection. In the fourth flock nematode infection was not built up to pathogenic level i.e > 2000 epg. The climate was dry and hot at that time hence the shepherd was advised not to drench his flock.

Project advisers : B.V. Nimbkar, Dr. P. M. Ghalsasi, Dr. C. Nimbkar, Dr. A. Siddique, Dr. N. Nimbkar

Project staff : P. P. Ghalsasi, S. R. Saste, K. Chavan, K. Unaune, S. Rajput, N. Qureshi, S. Joshi, R.R. Jadhav

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(In Alphabetical Order)

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 4. Nimbkar, C., October 2011. Progress report of 'Osmanabadi Goat Field Unit at NARI' under the 'AICRP on Goat Improvement' of ICAR for the period 1 July 2011 to 30 September 2011.
 5. Nimbkar, C., November 2011. A write-up for the consolidated Annual report of DBT-funded projects on the collaborative project between NBAGR and NARI funded by DBT, Ministry of Science and Technology, GOI entitled 'Increasing profitability of sheep production by genetic improvement using the *FecB* (Booroola) mutation and improved management' for the period November 2010 to October 2011.
 6. Nimbkar, C., January 2012. Progress report of 'Osmanabadi Goat Field Unit at NARI' under the 'AICRP on Goat Improvement' of ICAR for the period 1 October 2011 to 31 December 2011.
 7. Singh, V. June 2011. Annual Progress Report of All India Coordinated Research Project on Oilseeds (Safflower). Submitted to the Directorate of Oilseeds Research (DOR), Hyderabad. 131 pp.
 8. Singh, V. June 2011. Annual Progress Report of Frontline Demonstrations in Safflower. Submitted to the Directorate of Oilseeds Research (DOR), Hyderabad. 45 pp.
 9. Singh, V. March 2012. Annual Progress Report of All India Coordinated Sorghum Improvement Project. Submitted to the Directorate of Sorghum Research (DSR), Hyderabad. 117 pp.

II. CONFERENCES/SEMINARS/MEETINGS/WORKSHOPS **ATTENDED BY STAFF AND LECTURES GIVEN**

(In Chronological Order)

1. Dr. Anil K. Rajvanshi gave a speech entitled, "Bajaj Center for Sustainable Development – its history and philosophy". at the inauguration of the Center at Phaltan on April 12, 2011.
2. Dr. Rishika Sharma, Dr. Anaytullah Siddique and Mr. Vilas Bhagwat attended the 41st Annual Group Meeting of Sorghum held at University of Agricultural Sciences, Dharwad, Karnataka from April 15-17, 2011.

3. Dr. Anil K. Rajvanshi who is a member of the Jamnalal Bajaj Awards Selection Committee attended the selection meeting for 2011 awards for application of science and technology for rural development on April 28, 2011 in Mumbai.
4. Dr. Anil K. Rajvanshi attended the Dean of Engineering Selection Committee meeting at Sardar Krushinagar Dantiwada University in Gujarat in April 2011.
5. Dr. Anil K. Rajvanshi gave a university lecture “Energy from agriculture” to students and staff at Sardar Krushinagar Dantiwada University (SKDU) in Gujarat on June 16, 2011.
6. Dr. Anil K. Rajvanshi gave an inspirational talk to Class X, XI and XII students of Vidya Pratishthan’s English Medium School at Baramati on July 8, 2011.
7. Dr. Anil K. Rajvanshi gave a talk “R&D at NARI” to IIT Kanpur alumni group visiting NARI on July 23, 2011. About 10 IITK alumni from Pune visited NARI to see the research activities.
8. Dr. Anil K. Rajvanshi gave an inaugural talk [“Issues in food and energy security”](#) at International Conference on Food Security and Hunger Management, Organized by Vishva Yuvak Kendra in New Delhi on July 28, 2011.
9. Dr. Anil K. Rajvanshi gave an invited talk in Achiever series entitled [“Nation building and happiness” to probationers at the Railway Staff College](#), Vadodara on August 2, 2011.
10. Dr. Chanda Nimbkar attended the annual review meeting of ‘Network project on sheep improvement’ and ‘Mega Sheep Seed Project’ of ICAR held at Central Sheep and Wool Research Institute, Bikaner, Rajasthan on August 4, 2011. She chaired a session of presentations on ‘Network Project on Sheep - field and farm-based units’.
11. Dr. Chanda Nimbkar participated in the ‘Scientists Meet of AICRP on Goat Improvement’ held at College of Veterinary and Animal Sciences Bikaner Rajasthan on August 5, 2011. She presented the Osmanabadi Field Unit’s report depicting staff position, budget provision, targets, salient achievements and progress comparing performance of current financial year with that of the previous year.
12. Dr. Anil K. Rajvanshi gave a public lecture entitled [“Sociobiological basis of corruption – Relevance to Corporate World”](#). It was organized by Indsearch, Pune and delivered in ILS College Auditorium, Pune on August 9, 2011. The lecture was widely covered in local mass media.
13. Dr. Anil K. Rajvanshi gave a Gymkhana lecture “Social entrepreneurship, IITians and happiness”, at IIT Kanpur on August 21, 2011.
14. Dr. Anil K. Rajvanshi gave an invited talk “Spirituality and technology” to Lucknow Management Association, Gominagar, Lucknow on August 23, 2011.
15. Dr. Vrijendra Singh, Mr. M. B. Deshpande and Mr. A. M. Ranaware attended the Annual Rabi Oilseeds Research Workers’ Group Meeting for safflower from August 27-29, 2011 at the Directorate of Oilseeds Research (DOR) at Rajendranagar, Hyderabad.

16. Dr. Anil K. Rajvanshi and Dr. N. Nimbkar attended the “Interaction meet with NGOs and farmer entrepreneurs” organized in New Delhi on September 17, 2011. This meet was organized by the Intellectual Property and Technology Management Division of ICAR in the A. P. Shinde Auditorium in NASC complex.
17. Dr. Anil K. Rajvanshi attended the State Advisory Committee Meeting of Maharashtra Electricity Regulatory Commission (MERC) in Mumbai in September 2011.
18. Dr. Chanda Nimbkar, Dr. Nandini Nimbkar and Shri B.V. Nimbkar attended the inaugural function of the opening of the International Bachelor’s Programme in Agricultural Education at Agricultural College, Baramati in collaboration with Van Hall Larestein University, the Netherlands on September 23, 2011.
19. Dr. Anil K. Rajvanshi gave an invited talk “Social entrepreneurship and happiness” to students and staff of Symbiosis Institute of Technology in Pune on September 24, 2011.
20. Dr. Anil K. Rajvanshi gave an invited talk “Social entrepreneurship and management”. to students and faculty of Amity University, Lucknow Campus on October 10, 2011.
21. Dr. Anil K. Rajvanshi attended the Jamnalal Bajaj Awards function in Mumbai in November 2011. He also had a detailed meeting with Dr. R. A. Mashelkar regarding setting up of High-Tech Research Center for Rural Areas at Phaltan.
22. Dr. Anil K. Rajvanshi gave an invited talk [“Social entrepreneurship, management graduates and nation building”](#) to MBA students of IIM Lucknow on November 27, 2011. Dr. Rajvanshi was also a judge to evaluate business plans of MBA students from various national colleges. They were participating in a competition organized by IIM Lucknow.
23. Dr. Chanda Nimbkar (as a member) attended the GALVmed (Global Alliance for Livestock Veterinary Medicines) South Asia Regional Advisory Committee meeting held at New Delhi on November 29-30, 2011.
24. Smt. Nadia Qureshi and Shri Sachin Rajput attended the ‘National Seminar on Sheep and Goat Production’ held at Sheep Breeding Research Station, Sandynallah, The Nilgiris, Tamil Nadu organised by Tamil Nadu Veterinary and Animal Sciences University and Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Govt. of India on December 28-29, 2011. Nadia Qureshi presented a paper ‘Non-Osmanabadi and non-true-to-type Osmanabadi does had a higher milk yield than true-to-type Osmanabadi does in six villages in Maharashtra’. Shri Rajput presented a paper ‘Exploring a new method of educating poorly educated village goat owners about goat health and nutrition management’.
25. Dr. Chanda Nimbkar attended on January 11, 2012 a meeting of Research Advisory Committee (RAC) of the National Bureau of Animal Genetic Resources (ICAR), Karnal, Haryana as a member of the RAC appointed on August 19, 2011.
26. Dr. Chanda Nimbkar attended on January 12, 2012, a meeting to give advice to the committee formed by the Prime Minister’s Office for deciding the policy framework for ‘Research and Development in Agriculture and Allied Sectors’.

27. Dr. Vrijendra Singh attended the 8th International Safflower Conference held at the Directorate of Oilseeds Research (DOR), Hyderabad from January 19-23, 2012 and presented a research paper.
28. Dr. Anil K. Rajvanshi gave an invited lecture “Nation building, engineers and happiness”, to staff and students of National Institute of Science and Technology (NIST), Behrampur, Odisha on January 30, 2012. Later on Dr. Rajvanshi also gave an inspirational talk to about 400 toppers of Odisha Schools. He was the chief guest of INSPIRE program funded by DST and organized by NIST.
29. Dr. Chanda Nimbkar, as an invited speaker, gave a lecture on ‘Business opportunities related to goats and sheep’ at the International conference on ‘Business Opportunities in Life Sciences’ organised by Modern College of Arts, Science and Commerce, Pune on January 30, 2012.
30. Dr. Chanda Nimbkar attended a meeting ‘National Stakeholders’ Consultation on the Mission on Goats Platform’ for the 12th Five Year Plan at the Central Institute for Research on Goats, Mathura on February 6, 2012 and contributed her thoughts to the development of the ‘Mission on Goats Platform’.



31. Dr. Anil K. Rajvanshi gave a talk entitled “Social entrepreneurship and nation building”, to 40 MBA students and faculty of Wellingkar Institute of Management Development and Research, Mumbai who came for a one day rural sensitization programme at NARI on February 15, 2012.
32. Dr. Anil K. Rajvanshi attended the UGC-sponsored national seminar “Inclusive Growth in India : Varied Dimensions and Challenges” on February 17-18, 2012. He presented a paper on “NGO’s role in development of agriculture and renewable energy”. This fourth seminar in Dr. V. M. Dandekar Memorial Series was carried out by the Symbiosis College of Arts and Commerce, Pune in collaboration with Maharashtra Chamber of Commerce, Industries and Agriculture (MCCIA) and National Bank for Agriculture and Rural Development (NABARD).
33. Dr. Chanda Nimbkar attended, on January 11, 2012, a meeting of the Research Advisory Committee (RAC) of the National Bureau of Animal Genetic Resources (ICAR), Karnal, Haryana as a member of the RAC appointed on 19 August 2011.

34. Dr. Chanda Nimbkar and Ms. Nadia Qureshi attended the 'IX Annual Convention of Society for Conservation of Domestic Animal Biodiversity and National Symposium on Role of Indigenous Animal Genetic Resources in Rural Food Security vis-à-vis Climate Change 2012' organised by BAIF Development Research Foundation, Pune, Maharashtra and SOCDAB, Karnal, Haryana at BAIF Pune Campus on February 24-25, 2012. Smt Nadia Qureshi presented two papers 1) Rearing of Local does as profitable as rearing Osmanabadi does: an assessment of kid weights in smallholder flocks in seven villages of Maharashtra and 2) Importance of livestock identification ear tags for field performance recording and their acceptance by smallholder livestock owners. Dr. Nimbkar presented a poster on "Dressing percentage of Osmanabadi goat kids slaughtered at village fairs and income earned by goat owners in two villages in Phaltan taluka, Maharashtra".
35. Dr. Anil K. Rajvanshi gave a speech "[Social entrepreneurship, nation building and happiness](#)", as a chief guest at the North India HR Conference organized by Lucknow HR Association at Taj Hotel on February 25, 2012.
36. Dr. Anil K. Rajvanshi attended the Kay Bouvet Ltd. board meeting in Satara in March 2012.
37. Dr. Anil K. Rajvanshi attended the quarterly SAC meeting of MERC in March 2012.
38. Dr. Anil K. Rajvanshi gave a talk on rural development to 55 graduate students of Economics department of Nowrosjee Wadia College, Pune who attended a one day programme at NARI Center on March 22, 2012.
39. Dr. Chanda Nimbkar attended during the year, four meetings of the ICAR governing body as a member. These meetings were held at the NASC complex of the ICAR in New Delhi.

III. TRAINING AND EXTENSION ACTIVITIES

Training :

1. AHD conducted a training course in 'Artificial Insemination in goats' on 5-7 April 2011 for 10 candidates deputed by Shetkari Sahakari Doodh Utpadak va Puravatha Sangh (Farmers' Cooperative Milk Production and Supply Union), Kavathemahankal, Dist. Sangli.
2. Dr. Pradip Ghalsasi delivered a lecture on 'Goat and sheep management' to 30 undergraduate students at Krantisinh Nana Patil College of Veterinary Sciences, Shirwal, Dist. Satara on 15 June 2011.
3. AHD gave training in 'technical and practical aspects of sheep and goat rearing and breeding of sheep and goats including artificial insemination' to nine under-graduate students (from Maharashtra and Bihar) of College of Veterinary and Animal Science, Udgir, Dist. Latur who worked at AHD from 28 June to 12 July 2011 under their internship program during their final year of the BVSc degree. They worked in two groups on AHD's farms at Wadjal, Dhuldeo and Rajale. These students were also given

practical work experience of Institute's extension work in Bibi and Vadgaon villages of Phaltan taluka.

4. Dr. Pradip Ghalsasi delivered a lecture on 'Recent advances in A.I. technique in relation to sheep and goats' in the training course in 'Artificial Insemination (A.I.) in goats' conducted by the Maharashtra State Livestock Development Board at Solapur on 18 August 2011. Forty Livestock Supervisors of Maharashtra Government Animal Husbandry Department participated in the course.
5. Shri. Haribhau Thombare and Shri. Akshay Shinde of Mahatma Phule Samaj Seva Mandal, Karmala, Dist. Solapur working as livestock caretakers and recorders in the Kamone (Karmala) centre of the Osmanabadi Field Unit of the AICRP on goat improvement were given practical training in goat management at AHD on 26-28 August 2011.
6. AHD conducted a training program in 'Goat and sheep management, semen collection and artificial insemination in goats' for three social workers Shri. V. N. Awasthi from Vishwas Sansthan, Rai Bareli (U.P.), Shri. Hari Singh Yadav from 'Ibtada', Alwar, Rajasthan, and Shri Bhishma Singh from the Goat Trust, Lucknow, U.P. on 2-13 September 2011. These trainees stayed at AHD's Wadjal farm and were given theoretical and practical training in the subject.
7. AHD conducted a training program in 'Goat Production Technology' for eight veterinary officers deputed by the Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services, Government of Sikkim on 19-24 September 2011. They were given theoretical and practical training in the major areas of goat production technology such as genetic improvement, nutrition, reproduction, sustainable internal parasite control, the *FecB* gene for prolificacy in sheep and the DNA test for its detection and practical breeding programmes. The AHD prepared a training manual for this course. The AHD gave six grafts of 'NARI Nirbeeja' subabul free of cost to the course participants.



Trainee officers from Sikkim Animal Husbandry Department learning how to measure faecal worm egg counts of sheep during the training programme at NARI AHD

8. Shri B.V. Nimbkar organised a demonstration program on 'Laser Land levelling' at Krishi Vigyan Kendra, Sharadanagar, Baramati on 15-17 November 2011. He provided his own laser land leveller unit and tractor for this training. Shri Ashish Sood of A.S. Laser Systems, New Delhi and one of his technical staff gave demonstrations of laser land levelling to farmers. Shri Prabhakar Deshmukh, Commissioner, Agriculture, Maharashtra State paid a visit to the programme and appreciated the demonstration.

9. Dr. Pradip Ghalsasi gave a lecture on 'Goat farm management' to three academic staff members and 10 undergraduate students of Bombay Veterinary College, Mumbai who visited AHD on 24 December 2011.
10. Shri Ananda Hubale from Nagole village in Kavathemahankal taluka stayed on AHD's Wadjal farm and was given practical and theoretical training in 'Goat management' for a month from 1 February 2012.
11. AHD gave training in 'Extension programmes for goat keepers' to seven staff members of Vishwas Sansthan, Raibareli (U.P.) on 18 February 2012. They were taken to the AHD's AICRP field unit of Osmanabadi goats at Bibi village in Phaltan taluka. Shri Kanhaiya Chavan gave them detailed information of the unit and showed them goats under the project. They were also given demonstrations of artificial insemination in goats and faecal worm egg count testing to assess worm burden in sheep and goats.
12. AHD organised a one-day training program on 'New technologies in sheep and goat rearing' for 25 Livestock Development Officers of Animal Husbandry Department, Maharashtra State (Maharashtra Animal Husbandry Services Class I cadre) on 8 March 2012 under the Maharashtra Agricultural Competitiveness Project.
13. Dr Pradip Ghalsasi gave demonstration of and a lecture on 'ultrasonography in sheep and goats' to 46 Livestock Development Officers of the Maharashtra government who visited AHD in three batches on 27 December 2011 and 2 and 15 March 2012 under the training program on 'Modern diagnostic equipments in veterinary practice' organised by Krantisinh Nana Patil College of Veterinary Science.
14. Dr. Pradip Ghalsasi of AHD conducted a training course in 'Artificial insemination in goats' for two Assistant Professors, Dr. S. Manokaran and Dr. K. Ravikumar of Veterinary College and Research Institute, Namakkal, of the Tamil Nadu Veterinary and Animal Sciences University, Tamil Nadu on 13-15 March 2012.
15. Training in 'Sheep management' was given to Shri Naman Tyagi from Noida, U.P. on 29 March 2012. He wants to set up a sheep farm in U.P. Dr. Chanda Nimbkar, Dr. Pradip Ghalsasi and Shri Rupesh Khanvilkar gave practical demonstrations and theoretical knowledge of sheep management to him.
16. Mr. Mahesh Shinde, Mr. Sachin Kharade, Mr. Ganesh Gore and Mr. Dipak Gangurde-four final year M.Sc. students in the department of Plant Biotechnology at K. K. Wagh College of Agricultural Biotechnology carried out 4-month study on cytology of safflower species at NARI from 12 December 2011 to 12 April 2012.
17. A sensitization workshop on rural development and technology entitled "Exploring the grassroots" was carried out on 15th February 2012 for the PGDM Business Design students of Prin. L. N. Welingkar Institute of Management Development and Research, Matunga, Mumbai. A total of 36 students, two faculty members and two support staff attended the workshop.

Extension activities :

A. Shepherds' workshop for dissemination of advanced technique :

AHD purchased a Mechanical sheep shearing unit with financial support from the State Bank of India in February 2011. The AHD organized an inaugural and demonstration program of the unit on the AHD's farm at Wadjal, Tal. Phaltan, Dist. Satara on Saturday 23 July 2011. Hon. Minister for Water Resources (Krishna Valley), Maharashtra Government and Guardian Minister, Satara District, Shrimant Ramraje Naik Nimbalkar inaugurated the unit. The function was attended by 60 shepherds having about a total of 4000 sheep from surrounding villages. The other dignitaries who attended the function included Shri Y.A. Nimbalkar (Dadaraje Khardekar), Director, Satara District Central Cooperative Bank Ltd., Shri Rambhau Dhekale, Chairman, Phaltan Taluka Panchayat Samiti, Phaltan and Shri Shankar Devkar, Sarpanch, Kashidwadi, Taluka Phaltan.

Dr. Chanda Nimbkar in her introductory speech explained the importance of the shearing machine as it reduces the time taken to shear and causes less hardship to the shearers and sheep than hand shearing.

Hon. Minister Shri Ramraje Naik Nimbalkar in his speech emphasized the importance of sheep rearing in Satara district considering the unreliable and scanty rainfall and the necessity of introducing such technologies for improvement of sheep rearing. He urged young shepherds not to give up this very profitable employment opportunity of rearing prolific sheep developed by the AHD using new technologies.

This machine was used to give training and shear sheep belonging to the AHD and shepherds.

1. Twenty nine sheep belonging to Krishi Vigyan Kendra, Malegaon Colony, Baramati were shorn by trained staff of AHD on 18 May 2011. At this time AHD staff members trained two shepherds Shri Nitin Sopan Walkunde and Shri Balasaheb Pandurang Mote of Malegaon, Baramati in machine shearing.
2. Sixty four sheep of Shri Bhausahab Jadhav, Malegaon, Baramati were shorn on 5 December 2011.
3. One hundred sheep of Shri Dattatray Tarate, Wadjal were shorn on 23 January 2012 by Shri. Rupsing Khanvilkar of AHD.

B. **Dissemination of animals** : The following *FecB* carrier breeding rams and ewes were supplied to sheep owner individuals and organizations during the year.

Sr. No.	Date	Name of the person	No. of animals supplied			
			Rams		Ewes	
			<i>Fec</i> <i>B^{BB}</i>	<i>Fec</i> <i>B^{B+}</i>	<i>Fec</i> <i>B^{BB}</i>	<i>Fec</i> <i>B^{B+}</i>
1.	4 July 2011	Krishi Vigyan Kendra, Chintamani, Karnataka	1	1	-	-
2	21 July 2011	Shri Dilip Deokar, Saswad, Tal. Purandar, Maharashtra	-	-	1	1
3.	23 July 2011	Shri Vinod Dagade, Varkute (k), Tal. Indapur, Maharashtra	-	2	-	-
4.	5 August 2011	Shri L. Ranganath Yenegere, Solur Hubli, Karnataka	5	5	4	7

5.	12 December 2011	Shri Dhiraj D. Deshpande, Ilkal Karnataka	2	-	-	-
6.	16 December 2011	Shri Rajendra Nath Reddy, Srikalahasthi, Andhra Pradesh	-	3	1	19
7.	8 February 2012	Anil Bhausahab Salgude, Sangvi, Tal. Baramati, Maharashtra	1	1	-	-
8.	11 February 2012	Taralabalu Krishi Vigyan Kendra, Davangere, Karnataka	2	-	1	-
9.	11 February 2012	Shri Raghvendra Naik Davangere, Davangere, Karnataka	1		2	2
10.	21 February 2012	Shri Dattatraya Dhulaji Sonwalkar, Bhadali, Tal. Phaltan, Maharashtra	-	-	3	16
11.	21 February 2012	Dattatray Sopan Pisal, Bhadali, Tal. Phaltan, Maharashtra	-	1	2	11
Total			12	13	14	56

$FecB^{BB}$ = homozygous, $FecB^{B+}$ = heterozygous

C. *FecB* genotyping

FecB genotyping of the following sheep belonging to different NGOs was done in the Molecular Genetics Laboratory of AHD. The results along with the gel photographs were sent to the owners. Advice for their future breeding programmes was also given.

- Four sheep blood samples received from Prof. S. Panneerselvam, Dept. of Animal Genetics and Breeding, Veterinary College and Research Institute, Namakkal, Tamil Nadu were tested in May 2011.
- Fifty two and 91 sheep blood samples received from Prof. Abdullah Alowaimer, King Saud University, Saudi Arabia were tested in July 2011 and October 2011 respectively.

D. Dissemination of NARI Nirbeeja hybrid *Leucaena* grafted plants

- During this year 61 'NARI Nirbeeja' (hybrid subabhoole) grafted plants were supplied to various institutions and farmers.
 - One graft was given free of cost to Nimbkar Seeds Pvt. Ltd. to hand over to the personnel of Monsanto for micro-propagation.
 - Six plants were supplied free of cost to the Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services, Govt. of Sikkim.
 - One plant and a few cuttings were supplied to H.U. Gule Biotech Lab, Jamkhed, Dist. Ahmednagar free of cost to motivate them to standardize a tissue culture propagation method for this hybrid *Leucaena*. Their trials were unfortunately not successful.

The following farmers/institutions purchased more than two grafted plants each.

- Shri. Siddu Pujari Powar, Bijapur, Karnataka – 4 plants
- Shri. Dilip Pandurang Devkar, Pune – 5 plants
- Shri. Dhiraj D. Deshpande, Ilkal, Karnataka – 4 plants
- Shri. S. Rajendra Nath Reddy, Srikalahasthi, Andhra Pradesh – 4 plants

AHD planted 260 ‘NARI Nirbeeja’ grafted plants during 2011-12 on its own farms.

2. For the past two years Vidya Pratishthan’s School of Biotechnology (VSBT), Baramati conducted trials on micro-propagation of NARI *Nirbeeja*. During the year about 800 cuttings of NARI *Nirbeeja* were supplied to them to conduct trials for propagation through tissue culture. These trials, however, were not successful.

E. Pashumitra groups

Under ‘AICRP project on Osmanabadi Goat Improvement’ groups of interested goat owners have been formed in Bibi, Jawala and Kamone villages. Jay Malhar Pashumitra group in Bibi village had nine members. NARI’s staff members conducted a meeting of the group every Friday evening from 8 to 9.30 p.m. since January 2011. A second Pashumitra group was started in Jawala village in Kalamb taluka of Osmanabad district from July 2011. There are five members in the group but usually about 10 people attend the meetings regularly. A third group has been formed in Kamone village and their meetings have started from August 2011. The weekly meetings of groups in Jawala and Kamone are conducted by the extension staff provided by the NGOs ‘Paryay’ and ‘MPSSM’ respectively.

The groups discussed improved goat rearing practices in relation to the current practices used by members. Members were also taught about clinical signs of disease, vaccination, castration, wound dressing, deworming/drenching procedures and preparing simple devices for drenching. They also discussed methods to plant fodder trees. Examples and cases from the village were used and demonstrations and practicals were emphasized. Teaching materials such as Marathi posters, and pamphlets produced by NARI AHD were used in the meetings. This made the training more effective.

F. Dissemination of seed and other products

During this year about 40 kg ‘Madhura’ sweet sorghum syrup was test-marketed. About 75 kg dried safflower flowers were test-marketed as herbal health tea and also supplied to Kancor. Ingredients Ltd. for testing. About 165 kg seed of Madhura sweet sorghum hybrid was disseminated. About 500 kg seed of safflower varieties (NARI-38, NARI-6, Nira, NARI-52 and NARI-57) and hybrids (NARI-NH-1 and NARI-H-15) were distributed during the year.

G. Review meetings under AICRP on Osmanabadi goat improvement

AHD organised following meetings of participating goat keepers under the project to discuss the progress of the project and its outcomes and to provide encouragement to cooperating goat keepers. Posters with photos of outstanding does, bucks and kids along with their owners were displayed at the meetings.

1. Vadgaon village, Dist. Satara – 7 April 2011
2. Kamone village, Dist. Solapur – 22 August 2011
3. Jawala and Hasegaon villages, Dist. Osmanabad – 5 and 6 January 2012.

H. Weather data

Students of Krishi Vidyalaya, Phaltan and Vidyapratishthan School of Biotechnology, Baramati visited NARI throughout the year to collect the weather data.

IV. TRAINING RECEIVED BY NARI STAFF

1. Dr. Pradip Ghalsasi, Smt Padmaja Ghalsasi and three research fellows of AHD obtained training in performing the Brucella melitensis test of sheep and goats. Dr. Vivek Gupta, Sr. Scientist, Animal Health Division of the Central Institute of Research on Goats, Makhdoom, U.P. conducted this training course at AHD on April 8-10, 2011. AHD also made available this training opportunity to Dr. R.S. Jadhav and Dr. D.P. Bhoite of Agricultural Development Trust Baramati's Krishi Vigyan Kendra. Dr. Gupta gave a comprehensive presentation on Brucellosis at the start of the training programme. Serum samples from sheep and goats belonging to AHD, Nimbkar Seeds Pvt. Ltd., Phaltan, Agricultural Development Trust, Baramati, Kamshet Dairy Farm, Mawal and smallholders' goat flocks were evaluated for the presence of Brucellosis antibodies. A total of 291 serum samples of ewes and does with history of abortion /stillbirth /weak kids and of breeding rams and bucks were tested with the Dot Elisa test developed by Dr. Gupta and the Serum agglutination test. Out of these, 48 samples were found positive. Some of these animals were treated with antibiotics and their Brucellosis tests after treatment were found to be negative. Some animals were tested with the Serum agglutination test which is more accurate and they were found to be negative.

Brucellosis is a disease which affects reproduction performance. The disease is of zoonotic nature which means it can be transmitted from animals to humans. The significance of testing rams and bucks for Brucellosis is that they might be carriers of Brucella and they can transmit the disease, if they are used for breeding. NARI staff will perform the tests in future on their own using the Brucellosis antigen supplied by Dr. Gupta.

2. Mr. Vilas Bhagwat obtained training at the Directorate of Sorghum Research, Hyderabad (Andhra Pradesh) from September 16-17, 2011 on "Plant Protection in Sorghum".
3. Smt. Padmaja Ghalsasi participated in the National Training Course on 'Genetic dissection of complex trait analysis with special reference to genetic resistance to gastro-intestinal nematodes in goats' organised by Central Institute for Research on Goats, Makhdoom, Mathura on November 15-28, 2011.
4. Mr. M. B. Deshpande obtained training at the Directorate of Oilseeds Research, Hyderabad (Andhra Pradesh) from January 24-25, 2012 on "Guidelines for conduct of agronomy experiments, soil sampling, providing basic data of experiments, recording observations, data processing and presentation of analyzed data".

V. VISITORS TO THE INSTITUTE

1. Mr. Abay Tsehaye, Director General, Mr. Ambachew Demetie, Dy. Director General (Res. & Training), Mr. Gebremedhin Kebede, Dy. Director General, Mr. Edessa Gutema, Dy. Director General and Mr. Mewaha Negate, Director (Sugar Projects) from Ethiopian Sugar Commission, Addis Ababa came to the Institute on April 5, 2011 to discuss about sweet sorghum program. They were accompanied by Mr. Abhay Deshpande, MD and

CEO, Mr. Satish Deshpande, G. M. (Projects) and three other officials of KBK Chem Engg. Pvt. Ltd., Pune.

2. Dr. Ramaswamy from U.S. and Dr. L. Ramakrishna from Pune visited NARI on April 19, 2011 and had discussions with Dr. Rajvanshi regarding solar energy.
3. Shri Alagesa Pandian, Software Engineer from Bangalore visited AHD on April 23, 2011 to get information about improved goat and sheep rearing. He had detailed discussions with Dr. Ghalsasi with regard to starting a commercial goat farm.
4. Mr. Anand Sehgal, Mr. Parthiv Hejmadi and Mr. Girish Jathar of Watershed Organization Trust (WOTR) in Ahmednagar visited to see NARI programmes on April 28, 2011.
5. Dr. Yoganand Barve and Mr. Nitin Phadke of Praj Industries Ltd., Pune visited on April 25, 2011 regarding safflower improvement programme at NARI.
6. Prof. Gopal Nimbalkar and his three colleagues from Jeevandhara Sanstha, Nandurbar visited AHD on April 23, 2011 to get information about improved goat rearing.
7. Dr. B. A. Chopade, professor and director and his Ph.D. student Suchitra Mokashi, from Institute of Bioinformatics and Biotechnology at University of Pune visited for getting information on sweet sorghum syrup preparation April 30, 2011.
8. Mr H. D. Sherkar and his colleagues from H.U. Gule Biotech Lab, Karmala Road, Jamkhed, Dist Ahmednagar visited AHD on May 17, 2011 to discuss about setting up a tissue culture laboratory at AHD. They had discussions with Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi about multiplying of NARI Nirbeeja subabhul by tissue culture. They saw the molecular genetics laboratory of AHD. They were given a few cuttings and a grafted plant of NARI Nirbeeja to conduct trials for its propagation.
9. Dr. R. Divakar from Hyderabad and Shri Thakur Prasad Pain and Shri Ajay Charan Ojha, Field Organisers of the NGO 'Swayam Krishi Sangam' from Odisha visited AHD on May 19, 2011 to get information about research and development work of AHD in goats and sheep.
10. Dr. Ashok Harne, Executive Director of ILFS and of MSEDCL, Government of Maharashtra came to see Dr. Rajvanshi on May 30, 2011 and discussed various issues on renewable energy.
11. Mr. Bala Chandran Warriar, the managing trustee of Manipal Foundation, Bangalore and his team visited NARI on June 7, 2011 and had discussions with Dr. Rajvanshi on how Manipal group and NARI can work together on various issues.
12. Dr. Peter Amer of Abacus Bio Limited, New Zealand visited AHD on June 7-10, 2011 to get information of sheep and goat improvement programs and research activities of the Institute. He visited Lundy farm of AHD, Boer goat farm of Nimbkar Seeds Pvt. Ltd and shepherds's flocks having *FecB* gene carrier ewes at Bhadali village in Phaltan Taluka. He was also taken to visit the Osmanabadi field unit activities at Bibi and Vadgaon villages and the livestock market at Lonand market yard held every Thursday.

13. Mumbai Doordarshan team visited AHD on June 8, 2011 to interview Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi with regard to the success story of introduction and dissemination of 'NARI Suwarna' prolific sheep among shepherds. The team also visited the shepherds' flocks having *FecB* gene carrier ewes at Bhadali Village in Phaltan Taluka. They filmed these interviews for a film they are making on the National Chemical Laboratory, Pune.
14. Dr. Sushama Chaphalkar, Vidya Pratisthan's School of Biotechnology (VSBT), Baramati visited AHD on June 21, 2011 to familiarize herself with the activities of AHD. She was given samples of some fodder seeds and seed setts to create fodder plots for demonstration to students at VSBT.
15. Mr. Dinesh Castellino, Head of Cummins Megasite, Phaltan, Mr. Ravi Chandran Subramanian, Head CSR and their colleagues came to visit NARI on June 22, 2011 and had discussions with Dr. Rajvanshi regarding helping NARI in its lanstove propagation.
16. Eight students from various engineering colleges in Pune working with the NGO Swarup-Wardhini came on July 1, 2011 to discuss with Dr. Rajvanshi the possibility of setting up a rural NGO and working in the area of rural development.
17. Mr. Mohd. Noordin from Malaysia and Mr. Tang Kah Wai and Mr. Ng Qee Heng from Singapore visited NARI on July 6, 2011 to discuss various issues involved in introducing sweet sorghum in Malaysia. They were accompanied by three officials of KBK-Chem Pvt. Ltd., Pune.
18. Dr. Krishna Kanta Neupane, Senior Livestock Development Officer, Dr. Gyan Bahadur Thapar, Livestock Development Officer and Shri Ishwari Khatiwadi, Technical Assistant from Central Pig and Poultry Promotion Office, Hariharbhawan, Nepal visited AHD on July 7, 2011 to take 300 frozen semen pellets of Boer bucks. They had discussions with Dr. Ghalsasi about the dissemination of Boer goats in Nepal. They were shown the buck semen freezing laboratory of AHD.
19. Mr. Jyoti Prasad Deka and Mr. Ritu Paban Deka, two students from Beltola, Assam and Mr. Sebastien Tronel from Paris, France came to NARI on July 11, 2011 and had discussions with Dr. Rajvanshi regarding the issue of setting up a rural R&D NGO in Assam.
20. Mr. Anand Satpute, the Chairman of Duplex Industries Ltd., Pune visited NARI on July 12, 2011 and had discussions with Dr. Rajvanshi on various issues of renewable energy.
21. Eight members of Cummins India Ltd., Pune team including Mr. Sunil Rajopadhye, G. M. (Product Engg.) and Mr. Vilas Chinchankar, G.M. (Advanced Engg. And PEM) visited NARI on July 18, 2011 and had discussions with Dr. Rajvanshi regarding lanstove fabrication and its commercialization. This was a part of their CSR activity initiated by Mr. Dinesh Castellino and Mr. Ravichandran.
22. Mr. Ajay Jaiswal from Gorakhpur visited NARI on July 19, 2011 and had detailed discussions regarding transfer of technology of NARI gasifier to their Rishipooja Energy & Engg. Co.

23. Nine IIT Kanpur alumni and researchers in Tata Research Development and Design Centre (TRDDC) from Pune visited NARI on July 23, 2011 to see the activities of the Institute and to explore the possibility of helping the Institute.
24. Shri C. M. Pandit, Editor 'Ajacha Sudhakar' and Shri Ramesh Padhye, an Economist visited AHD on August 3, 2011 to get information about the AHD's work.
25. Dr. R. K. Patil, Veterinary Advisor, Essar Agrotech Ltd., Tung, Pune visited AHD on August 3, 2011 and had discussions with Dr. Pradip Ghalsasi about animal reproduction.
26. Mr. Aruda Okara, a researcher from Kenya and Mr. Manish Khare from Khargapur, M. P. visited NARI on August 5, 2011 to get information about energy work.
27. Shri K. Shivram (IAS), Principal Secretary, Animal Husbandry and Fisheries, Karnataka and Smt. Rashmi Kamal, Additional District Magistrate, Nadia, West Bengal visited AHD on August 22, 2011 to familiarize themselves with research and development activities of AHD.
28. Shri Giriraj Singh, Honourable Minister, Animal and Fisheries Resources Department, Government of Bihar, Patna visited AHD on August 27, 2011 to study the working pattern and development programmes at AHD. He had discussion about the future collaboration regarding goat development in Bihar with Dr. Chanda Nimbkar, Dr. Pradip Ghalsasi, Shri B.V. Nimbkar and Shri Zia Quraishi. He was taken to the Boer goats farm of Nimbkar Seeds Pvt. Ltd., Phaltan.
29. Shri Digambar N. Wishe, former MLA of Murbad, Dist. Thane visited AHD along with his colleagues on September 5, 2011. Dr. Pradip Ghalsasi and Shri K.M. Chavan showed them around the sheep and goat farm and gave information about the activities of the Institute.
30. Dr. D. M. Hegde, Former Director DOR, Hyderabad and Shri. Nitin Kathuria, Buying Manager, Marico Industries visited NARI on September 14, 2011 and had detailed discussions regarding how to popularize safflower in the country.
31. Shri Eknath Dawale, IAS, Commissioner, Animal Husbandry, Maharashtra State along with the government Livestock Development Officers Dr. R.S. Kadam, Dr. J. G. Sapkal, and Shri M. M. Taware, Shri S.A. Sangar, Livestock Supervisor, all from Panchayat Samiti, Phaltan visited AHD on September 15, 2011 to familiarize themselves with the research and development activities of the AHD. He had discussions with Shri B.V. Nimbkar, Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi about the setting up of an A.I. centre for freezing semen of goats and sheep at NARI, about the State government livestock breeding policy and the future plans to increase meat production from sheep and goats and improve its profitability.
32. Ms. Shivaranjani Popli receiving training at Indian Railways Institute of Civil Engineering (IRICEN), Pune visited on September 28, 2011 to see NARI research.
33. Dr. L. Ramakrishna, former Vice President of R&D at Philips India visited NARI on October 2, 2011 and had detailed discussions regarding various activities.

34. Dr. Narayan Pisharoty, Professor and Head Electronics and Telecom Department and three of his colleagues from the Symbiosis Institute of Technology (SIT), Lavale visited NARI on October 20, 2011 to discuss various issues on how NARI and SIT can work together specially in guiding Ph.D. students at SIT.
35. Dr. J. V. Patil, Directorate of Sorghum Research, Hyderabad visited NARI to assess the progress of AICSIP on November 17, 2011.
36. Dr. Jagdish Singh, Principal Scientist (breeding) at AICRP (Safflower), Indore, Dr. P. C. Uke, Jr. Agronomist at Crop Research Unit (Oilseeds), PDKV, Akola and Dr. R. D. Prasad, Principal Scientist (Pathology) at DOR, Hyderabad visited NARI on December 19, 2011 for monitoring the safflower programme.
37. Shri. Girish Sohani, President, Shri Ramesh Rawal, Executive Vice President and Dr. Ashok Pande, Sr. Vice President of BAIF Development Research Foundation, Urulikanchan, Pune visited AHD on December 21, 2011. They had discussions with Dr. Chanda Nimbkar, Shri B.V. Nimbkar and Dr. P.M. Ghalsasi regarding goat improvement program.
38. Managing Director of Karnataka Sheep and Goat Corporation accompanied by Prof. Nadim Fairoze, Professor and Head, Dept. of Livestock Products Technology, Veterinary College, Hebbal, Bangalore visited AHD on December 26, 2011 to see AHD's research and development activities.
39. Shri Anil Gote, MLA and Chairman, Loksangram, Dhule visited AHD on January 2, 2012. Dr. Chanda Nimbkar gave him the information about research and development work of the Institute.
40. Mr. Shailendra Agarwal, Chairman of Veena Industries and Mr. Madhav Chowdhary visited NARI on January 6, 2012 to discuss the modality of transfer of technology of NARI gasifier to them.
41. The Enza Zaden Export BV, The Netherlands delegation consisting of Shri Jakob Vos, Shri Joep van Balen and Shri Jan Panman visited AHD on January 12, 2012. Dr. Pradip Ghalsasi gave information about the activities of AHD to them.
42. Shri Pratap Bhosale, Director, Provet Genetics Ltd., Pune and Dr. T.A. Kadarbhai, Head, Krishi Vigyan Kendra, Baramati visited AHD on January 13, 2012 to see the semen freezing laboratory and had discussions with Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi.
43. Dr. Kadirvel Palchamy, Senior Scientist at the Directorate of Oilseeds Research, Hyderabad spent two days (February 7 and 8, 2011) with Dr. Singh familiarizing himself with the safflower breeding program. He was given the seeds of seven varieties/hybrids and hybrid parental lines to initiate breeding of high oil content safflower at DOR.
44. Dr. K. S. Varaprasad, Project Director, Directorate of Oilseeds Research, Hyderabad visited on February 29, 2011 to familiarize himself with safflower research being carried out at NARI.

45. Mr. Vishnu Saraswat, Horticulturist, Diana Naturals (India) visited NARI on March 16, 2012 regarding commercialization of safflower flowers for natural dye production.
46. Mr. Santosh Kumar, Mr. Ramdarsh Mishra, Mr. S. M. Patil and Mr. Suhas from Marico Ltd., Mumbai visited on March 22, 2012 regarding availability of seeds of high oil-containing safflower varieties.
47. Dr. S. K. Shinde, Breeder, AICRP (Safflower), Solapur visited on 30 March 2012 for the inspection of breeder seed plots of safflower.

Visits by groups during the year to see research and development activities of AHD

1. Under the 'refresher training program' of Livestock Development Officers of Animal Husbandry Department, Maharashtra Government conducted by the Krantisinh Nana Patil College of Veterinary Sciences, Shirwal, Dist. Satara, total 50 Livestock Development Officers visited AHD in two batches in April 2011.
2. Dr. A.D. Patil, Livestock Development Officer, Livestock Dispensary at Bhilari, Tal. Parola, Dist. Jalgaon brought a study tour of 24 farmers to AHD on April 29, 2011.
3. Under the Agri Clinic and Agri Business training program of Krishna Valley Advanced Agricultural Foundation of Sangli, 50 agricultural students visited AHD on June 17, 2011 to obtain information about sheep and goat rearing.
4. Twenty students of Maharashtra Industrial Development Training Institute, Pune visited AHD on June 24, 2011 to obtain information about developments in goat and sheep rearing.
5. Dr. Madhav P. Aryal from Department of Livestock Services, Government of Nepal, Ministry of Agriculture and Cooperatives along with 10 farmers visited AHD on July 4, 2011 to get information about improved goat and sheep rearing.
6. Four deputy directors and four veterinary officers from the animal husbandry department of Sikkim government visited on September 19, 2011 to familiarize themselves about NARI's work.
7. Twelve students and two teachers of Dattakala International School and Junior College in Bhigwan visited on September 24, 2011 to see the activities of NARI.
8. Under a training program on 'goat rearing' of IDBI Rural Self-employment Training Institute, Satara, 25 women belonging to Self Help Groups from Mhaswad in Man taluka visited AHD on November 4, 2011. They were given information about improved varieties of goats and sheep and their management.
9. Twenty students of the Maharashtra Centre for Entrepreneurship Development (MCED), Pune visited AHD on December 10, 2011 as a part of one of their training programmes.
10. Twenty members of Krishimitra Shetkari Bachat Gat, Khodad, Tal. Junnar visited AHD on January 4, 2012.

11. Two subject matter specialists and one supporting staff member from KVK, Namakkal along with 20 farmers visited AHD on January 7, 2012.
12. On February 13, 2012 50 students of B.Sc. (II and III year) Botany and Zoology Department of Vidnyan Mahavidyalaya, Sangola visited along with two teachers and were shown the research which is being carried out on sorghum and safflower.
13. Twenty five farmers from Bangalore Urban and Rural Districts Sheep Breeders' Association, Kanakapura, Ramnagara District, Karnataka visited AHD on February 26, 2012 to study the sheep rearing activities and other aspects of sheep management.
14. On March 2, 2012 37 students of Padmabhushan Dr. Sukhatme Institute, Phaltan accompanied with Four teachers visited the institute to see the research being carried out.
15. Three batches of total 85 second and third year students and two Professors of College of Agriculture, Baramati visited AHD on December 23 and 30-31, 2011 and March 2-3, 2012. Dr. Singh, Mr. Bhagwat and Mr. Deshpande showed them field plots of safflower and sweet sorghum and explained the research being conducted. Smt Bharati Pawar gave them a presentation about the activities of AHD in relation to sheep and goats and Smt Sonali Saste gave a presentation about the *FecB* mutation in sheep. They were shown animals on the Wadjal farm and given information about nutritious fodder varieties.

VI. VISITS BY STAFF

1. Dr. Chanda Nimbkar visited Bosco Gramin Vikas Kendra, Ahmednagar on 28 July 2011 to meet Shri Bhaskar Mitra of Sir Dorabji Tata Trust (SDTT) and Shri Sanjeev Kumar of The Goat Trust, Luknow. They had discussions about the SDTT's project proposal on 'Goat development'. This project is going on in five states – Rajasthan, Bundelkhand (U.P.), Marathwada and Vidarbha (Maharashtra), Andhra Pradesh and North Karnataka. They expect NARI-AHD to be involved in this project as technical consultant and a training centre.
2. Dr. Chanda Nimbkar visited on 4 August 2011, the Marwari sheep unit under the 'Network Project on sheep improvement' of the ICAR and the Magra sheep unit at the Arid Region Campus in Bikaner, of the Central Sheep and Wool Research Institute.
3. Smt. Padmaja Ghalsasi visited Jagtap Nursery of Tukai Exotica at Loni Kalbhor, Pune on 26 August 2011 to obtain detailed information on Green house mist chambers to help mass production of 'NARI Nirbeeja' subabhul. Shri Sangram Jagtap, owner of the nursery gave her details of mist chambers and advice on multiplication of 'NARI Nirbeeja' subabhul.
4. On 12 September 2011, Dr. Nandini Nimbkar, Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi visited the modern abattoir to slaughter sheep and goats established by the Ahmednagar District Goat Rearers' Cooperative Federation near Ahmednagar and inspected the excellent and sophisticated facility.

VII. OTHER ACTIVITIES

1. AICRP team of the AHD submitted entries of three goat keepers for the 'Breed Saviour Award' to the LIFE Network [Local Livestock for Empowerment] through the NGO SEVA at Madurai, Tamilnadu. This is a network of NGOs and individuals concerned about the future of local livestock breeds, and about the people who manage and breed them and also rely on them for their livelihood. Activities of this network include documentation of breeds, traditional knowledge and promoting Livestock Keepers' Rights. LIFE Network shared the entries submitted by AHD among all the members of this network as 'ideal documentation for the award'.

Two of the three Osmanabadi goat keepers for whom entries were submitted for the Breed Saviour Award, got the cash award of Rs.10,000 each and a certificate. Shri Dnyandev Shinde from Vadgaon village in Satara district and Shri Arjun Demunde from Kamone village in Solapur district received the award on 10 January 2012 in Chennai. Shri Kanhaiya Chavan of AHD accompanied them.

2. Dr. N. Kandasamy, Professor of Animal Genetics (Retd.), Tamil Nadu visited AHD on 10-15 February 2012 to assess the "Results and Impact of the Introduction of the FecB Gene in the Deccani Sheep Breed" carried out by AHD. He was appointed as National Consultant in the field of 'small ruminant breed conservation and improvement' by the Food and Agriculture Organisation (FAO) of the United Nations under the South Asia Pro-Poor Livestock Policy Programme (SA PPLPP), a joint initiative of FAO and the National Dairy Development Board. He visited the nucleus flock of NARI Suwarna sheep of AHD at Rajale farm and shepherds' flocks which have FecB carrier ewes and rams. These were of Dattatraya Sopan Pisal and Kisan Sargar at Bhadali Village, D.S. Sonwalkar at Dudhebawi village all in Phaltan taluka, and Digambar Kharat at Kamone village in Karmala taluka. Dr. Chanda Nimbkar provided him the data collected under the sheep improvement program and had discussions with him. Smt Nadia Qureshi and Shri K.M. Chavan accompanied him on the field visits.
3. On 16 February 2012, Shri B. V. Nimbkar, Dr. Pradip Ghalsasi and Dr. Chanda Nimbkar provided information on the telephone to Ms. Joy Sun of McKinsey & Company, Seattle, USA, associated with the Gates Foundation's agriculture team, on the AHD's research on sheep and goats and any relevant learnings for vaccines, our perspective on the livestock vaccine market in India and our thoughts on opportunities for Gates Foundation partnerships.

VIII. STAFF APPOINTMENTS TO PRESTIGIOUS POSITIONS

1. Dr. Chanda Nimbkar was re-nominated as a member of the General Body and Governing Body of the ICAR Society under the category 'Representative of Rural Interests' by the Union Agriculture Minister and President of the ICAR Society for a period of three years from 9.6.2011 to 8.6.2014.
2. Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi were appointed as National Consultants in the field of 'small ruminant breed conservation and improvement' by the Food and Agriculture Organisation (FAO) of the United Nations under the South Asia Pro-Poor Livestock Policy Programme (SA PPLPP), a joint initiative of FAO and the National

Dairy Development Board, for a period of 40 days between 17 August and 15 December 2011. The mandate given to them was the documentation of secondary data, studies, field approaches and interventions related to Small Ruminant Breed Conservation and Improvement and of their impact on the livelihoods of smallholder livestock rearers. Dr. Nimbkar visited projects in Alwar in Rajasthan, Kollam, Thiruvananthapuram, Wayanad, Mallappuram, Kannoor and Kasaragod districts in Kerala and Satara and Solapur districts in Maharashtra while Dr. Ghalsasi visited projects at Tirupur in Tamilnadu, Madhubani and East Champaran districts in Bihar, Pune and Ahmednagar districts in Maharashtra and Bangaluru in Karnataka. They submitted their report to SA PPLPP which will be published and available on the SA PPLPP web site.

3. Dr. Chanda Nimbkar was appointed as a member of the Research Advisory Committee of National Bureau of Animal Genetic Resources, Karnal, Haryana on 30 June 2011.
4. Dr. Chanda Nimbkar continues to review papers for the international journals 'Tropical Animal Health and Production' published by Springer in association with the Centre for Tropical Veterinary Medicine, University of Edinburgh and the journal 'Animal Genetic Resources Information' published under the joint auspices of the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Environment Programme (UNEP). She has now been invited to review manuscripts for the Wiley Blackwell Journal – Journal of Animal Breeding and Genetics.
5. The Director General of ICAR nominated Dr. Chanda Nimbkar as a member of the judging committee for the annual 'Panjabrao Deshmukh Outstanding Woman Scientist Award 2011' instituted by the ICAR.

IX. NEWS ITEMS ON NARI WORK

(All items listed below are at the [NARI's website](#))

1. A front page story on Bajaj Center for Sustainable Development came in Speaking Tree Newspaper (Times of India), 5 June 2011.
2. Featured story on Dr. Anil K. Rajvanshi in India Today, 16 July 2011.
3. News story on the public lecture on corruption by Dr. Anil K. Rajvanshi in DNA (Pune), 13 August 2011.
4. An interview with Dr. Anil K. Rajvanshi appeared in Hindustan Times (Lucknow), 24 August 2011.
5. News story on Dr. Anil K. Rajvanshi in iNext (Lucknow), 28 September 2011.
6. News story in Naphthenics (A Swedish Magazine Published in Stockholm) on NARI's work in Renewable Energy, Vol. 3, November 2011.