

# **ANNUAL RESEARCH REPORT 2012-2013**



**Nimbkar Agricultural Research Institute,  
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**September 2013**

# Nimbkar Agricultural Research Institute (NARI), Phaltan

## ANNUAL RESEARCH REPORT 2012-13

### Report of the President



I am very happy to place the annual research report 2012-13 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.

One of the highlights of the past year was the sale of the technology of NARI's low concentration alcohol stove to the Indonesian company P.T. Tapanuli Investasi Agro. They have been given the exclusive rights for manufacturing and selling in ASEAN countries. Since this technology cannot be commercialized in India due to the present stringent excise laws we hope it is disseminated on large scale at least in other ASEAN countries. If this happens the full credit goes to our director Dr. Anil K. Rajvanshi who developed it.

Till recent times since cytoplasmic male steriles were not identified in safflower only GMS hybrids were available. These inspite of their yield advantage could not take off due to the inherent problems of seed production. Thermosensitive genetic male sterility-based hybrids appear to have overcome this problem and one such hybrid NARI-H-23 developed by NARI was identified for release last year. One of its main advantages is that it contains 35% oil in the seed. Dr. Vrijendra Singh, our senior breeder deserves congratulations for this development.

Marico Ltd. who have sponsored our safflower research on and off over last 40 years have been very supportive of our high oil varietal development and have been instrumental in getting the seed production of these varieties done in addition to identifying farmers to grow them on contract basis.

Dr. Chanda Nimbkar has been recently recognized as a member of the post graduate students' advisory committee in the discipline of 'Animal Genetics and Breeding' by the Karnataka Veterinary, Animal Science and Fisheries Science University. We hope that this will enable our A.H. division to get some good students to work on various research projects.

Dr. Chanda Nimbkar submitted an abstract for the competition entitled "Sustainable Improvement in Sheep Productivity in India using the FecB (Booroola) Mutation" which was one of the five case studies selected by FAO and a full paper on it will be published in the FAO publication to come out by September 2013. This is quite a feather in her cap.

I wish to sincerely thank Mr. B. V. Nimbkar, founder of NARI for his donation of Rs. 2,75,000/- for various projects at NARI as also Dr. Pradip Ghalsasi for his donation of Rs. 1,00,000/- for animal husbandry research at NARI. Mr. Nimbkar in addition to his monetary help has been a great source of inspiration to all of us due to his involvement in and tremendous enthusiasm about varied projects at NARI.

Dr. N. Nimbkar  
President

September 16, 2013

## AGRICULTURAL RESEARCH

### ***SAFFLOWER***

#### **All India Coordinated Research Project (AICRP) 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 2012-13 are furnished below :

#### **Summer 2012 :**

Summer season was used for maintenance of thermosensitive genetic male sterile lines in safflower. During summer 2012, 320 selections of thermosensitive genetic male steriles lines were maintained for their further screening and utilization in hybrid development in safflower.

#### **I. BREEDING (Rabi 2012-13) :**

1. **Identification of thermosensitive genetic male sterility (TGMS)-based hybrid NARI-H-23 for release :** The major highlight of the year in safflower was the identification of TGMS-based safflower hybrid NARI-H-23 for release in the varietal identification committee meeting held during annual group meeting of safflower and linseed at Indira Gandhi Krishi Vishwa Vidyalaya, Raipur from September 6-8, 2012. The major advantage of TGMS-based hybrid NARI-H-23 over Genetic Male Sterility (GMS)-based hybrid NARI-H-15 is that it overcomes the hybrid seed production difficulties encountered in GMS-based hybrids, thus making the hybrid seed production commercially feasible in safflower. The TGMS-based hybrid NARI-H-23 recorded seed yield at par with the seed yield of NARI-H-15, however it gave 11.22% increase in oil yield over NARI-H-15. NARI-H-23 has 35% oil in the seed.
2. **Identification of male sterility-maintainer genotype for streptomycin-induced male sterility in safflower :** A sib-mated cross based on streptomycin-induced cytoplasmic male sterile exhibited 100% male sterility indicating thereby the existence of fertile cytoplasm in the pollinator parent. The male sterile plants of the sib-mated cross were further maintained by pairwise crossing with the individual plants of the concerned pollinator parent in order to make the CMS line uniform for different traits and to identify the most promising combinations for further multiplication and utilization in hybrid development in safflower.
3. **Crossing programme :** Eleven non-spiny crosses using four non-spiny TGMS lines as females and seven non-spiny genotypes as males were produced during rabi 2012-13 in

order to develop TGMS-based non-spiny hybrids in safflower. The list of crosses made is furnished below :

- (1) TMS-7-3-23 X NARI-6
- (2) TMS-7-3-23 X C-2829-5-3a-6
- (3) TMS-5-2-2-13 X D-165-7-5
- (4) TMS-5-2-2-13 X C-2829-5-3a-6
- (5) TMS-5-2-2-13 X WR-8-8-4
- (6) TMS-5-2-2-13 X D-167-32-8
- (7) TMS-1-14-1-22 X D-166-45-2
- (8) TMS-1-14-5-16 X C-2829-5-3a-6
- (9) TMS-1-14-5-16 X WR-8-8-4
- (10) TMS-1-14-5-16 X NARI-42-2-3
- (11) TMS-1-14-5-16 X D-166-45-2



Safflower variety NARI-57 at Rajale farm

Sufficient seed was produced for each cross to evaluate them in a replicated trial in rabi 2013-14.

#### 4. Early and advanced generation selections :

- (a) One hundred seventy short duration  $F_4$  populations were assessed for seed yield and other traits during the season. Of them 98 populations recorded relatively higher seed yield than the test entries.
- (b) One hundred fifty eight  $F_5$  high oil selections were screened for seed yield and its components. This resulted in identification of 94  $F_5$  selections giving higher seed yield than the best checks in the concerned trials.

5. **Evaluation of TGMS- and cytoplasmic male sterility (CMS)-based hybrids in safflower :** Thirty two hybrids comprising of 24 TGMS-based hybrids, six CMS-based hybrids and two hybrid checks based on GMS and TGMS were evaluated in a randomized block design with three replications. Sowing of the trial was done on October 12, 2012. Each entry was sown in two rows of 5 m length. Standard agronomic practices were followed to raise a good crop. Five random plants per entry were used for recording observations on physiological traits whereas the whole plot was utilized for recording observations on seed yield and final plant stand.

The results of the trial are as follows :

Sr. No.	Hybrid	Seed yield (Kg/ha)	% increase over NARI-H-15
1.	TGMS-H-342	1202.96	44.23
2.	TGMS-H-358	854.81	2.48
3.	NARI-H-15 (Check)	834.07	-
	CD at 0.05	126.85	-
	CV%	12.35	-

6. **Evaluation of NARI TGMS and DOR CMS-based hybrids in safflower :** Evaluation of 10 NARI TGMS and five DOR CMS-based hybrids resulted in

identification of four CMS-based hybrids giving higher seed yield than the GMS-based hybrid check NARI-H-15.

7. **Development of high seed and oil-yielding safflower cultivars** : Promising TGMS-based hybrids viz. NARI-H-24 and NARI-H-25 which were evaluated in an advanced hybrid trial-I (AVHT-I) during rabi 2011-12 gave an increase of 18.3 and 28.2% in seed yield and 18.8 and 33.5% in oil yield respectively over the GMS-based hybrid check NARI-H-15 across the locations under irrigated conditions. Both the hybrids were promoted to AVHT-II for third year of evaluation during rabi 2012-13.
8. **Coordinated varietal trials** : Among the three coordinated varietal trials, out of the 29 entries in IVT, entry DSI-108 recorded the highest seed yield of 933 kg/ha which was followed by the entries SSF-1185 (738 kg/ha) and SSF-1101 and A-1 (Check) (both 714 kg/ha). In IHT, the entry NARI-H-29 recorded the maximum seed yield of 1078 kg/ha which was statistically on par with the entries NARI-H-30 (911 kg/ha), NARI-H-27 (895 kg/ha) and DSH-250 (896 kg/ha). In AVHT-II, the highest seed yield of 820 kg/ha was recorded by the entry NARI-H-15 which was followed by the entries DSH-185 (737 kg/ha) and PBNS-12 (Check) (631 kg/ha).
9. **Seed production of safflower varieties/hybrids** : NARI has produced 140 kg breeder seed of safflower variety NARI-6, 100 kg seed of male parent of safflower hybrid NARI-H-15, 230 kg seed of safflower variety NARI-38, 550 kg seed of NARI-57 and 1400 kg seed of NARI-52. In addition, 37 kg hybrid seed of NARI-H-15 and 34 kg hybrid seed of NARI-NH-1 was also produced during the season.



Visit of Madhya Pradesh farmers at NARI safflower farm

## II. AGRONOMY :

1. **Crop residue as a component of INM in safflower-based cropping systems** : The results of the trial showed that the system productivity of soybean and safflower crops due to adoption of INM treatments was non-significant for safflower equivalent yield. The treatment of 50% NPK to both safflower and soybean in addition to incorporation of residue of each crop recorded not only the highest seed yield but also the maximum net returns. Thus the incorporation of crop residue saved 50% of the fertilizer used in the soybean-safflower cropping system.
2. **Comparative productivity and resource use of non-spiny safflower to other rainfed rabi crops/systems** : The results of the trial showed that among the different sole crops evaluated, non-spiny hybrid NARI-NH-1 and non-spiny variety NARI-6, by considering the income from both seed and flower, recorded the highest net returns of Rs. 222442/ha and Rs. 193484/ha respectively. The net returns from sorghum, gram, linseed and spiny safflower variety A-1 were observed to be low as compared to non-spiny safflower cultivars.
3. **Effect of temperature on oil content and oil yield of safflower** : The results of the trial showed that safflower entry NARI-52 recorded the highest seed yield of 1357 kg/ha which was followed by the entries SSF-708 (884 kg/ha), A-1 (836 kg/ha) and

NARI-38 (754 kg/ha). The oil content among the entries screened ranged from 23.92% in A-1 to 31.7% in NARI-52. The high-oil entry NARI-57 recorded an oil content of only 28.67%. The highest oil yield of 423 kg/ha was recorded by the entry NARI-52, which was followed by the entries NARI-38 (268 kg/ha) and SSF-708 (249 kg/ha).

4. **Effect of seed priming on germination and plant stand of safflower** : The results of seed priming treatments on safflower cultivars showed that safflower variety NARI-6 gave the highest germination percentage after 12 hours of soaking (85.6%), which was followed by NARI-38 after 24 hours of soaking (81.7%) and NARI-H-15 without soaking (67.5%). Thus the study revealed that different safflower genotypes have different seed priming requirements for optimum germination. However, 8 kg/ha appears to be the better seed rate than 12 kg/ha in case of all the genotypes.
5. **Assessment of suitable plant population for crop diversification** : The results of the trial showed that differences due to different spacings were non-significant for seed yield and other yield-contributing characters indicating thereby that increase in the spacing between rows does not adversely affect the seed yield in safflower. The significantly highest seed yield of 1059 kg/ha was recorded for variety A-1 with 30 X 20 cm spacing which was on par with NARI-38 sown at a spacing of 30 X 20 cm (958 kg/ha), and A-1 sown at a spacing of 60 X 20 cm (935 kg/ha) and 45 X 20 cm (926 kg/ha). The variety NARI-38 which has slightly appressed branching showed considerable reduction in seed yield when spacing between rows increased from the recommended one i.e. 45 cm. Since NARI-38 has recorded significantly higher seed yield at a row spacing of 30 cm than the recommended 45 cm, this variety may be sown at this spacing after confirmation of the present findings.

### III. PLANT PATHOLOGY :

1. **Survey of safflower diseases in different agro-climatic regions** : In irrigated crops, the disease intensity of leaf spot ranged from 1-3 disease grades, whereas it was about 1 in rainfed crops. Intensity of wilt was low and it was recorded to be 1-2 disease grades in all the surveyed districts. In short, none of the diseases posed any serious problem for safflower cultivation during the season.
2. **Development of screening methods for various diseases in safflower** : Development of faster *in vitro* resistance screening methods having broad applications is very important in safflower to assess resistance to *Fusarium oxysporum* f.sp. *carthami*, *Alternaria carthami* and *Macrophomina phaseolina*. Standard susceptible (Nira) and resistant (NARI-38) checks for *Fusarium* and susceptible check (Manjira) for *Alternaria* were selected and were subjected to screening with various methods.

Among the methods tested, soil / sand cup and cotton swab methods are suitable for screening of safflower genotypes for resistance/tolerance to *Fusarium oxysporum* f.sp. *carthami* and cotton swab and detached leaf methods for screening for resistance/tolerance to *Alternaria carthami*.

## **SWEET SORGHUM**

### ***All India Coordinated Sorghum Improvement Project (AICSIP)***

**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 program is monitored by the Directorate of Sorghum Research (DSR), Hyderabad, which is the central agency under ICAR to work on all aspects of sorghum research and development throughout India. The main objective of the AICSIP centre at NARI is to develop high sugar and biomass-yielding hybrids and cultivars giving high yield of good quality grains with the help of collaborative multilocation testing and facilitate production of genetically pure seeds for the farmers.

### **Major thrusts of research and development (R & D) under AICSIP at NARI centre :**

1. Development of sweet sorghum varieties and hybrids which yield high biomass, sugar and grains.
2. To develop high brix CMS lines.
3. Development of shootfly-tolerant sweet sorghum restorer and maintainer lines.
4. Identification of promising lines for quality syrup production.
5. Quality improvement of syrup and also enhancing its shelf-life.
6. Development of high grain-yielding cultivars for Rabi season.

### **Research highlights :**

#### **Kharif (Rainy season) 2012 :**

#### **MS conversion programme**

1. In CMS development programme, a total of 37 pair-wise crosses were evaluated during Kharif 2012. Among the 37 progenies, again 108 pair-wise crosses were made and 33 promising combinations were advanced to Rabi 2012-13 season for evaluation.

#### **R-line development programme**

In R-line development programme, different crosses using parents having desired traits were made following diallel mating system in previous years. All the progenies in different generations were evaluated for plant height, total biomass, stripped stalk weight, juice yield, brix of juice, total sugar index and grain yield.

1. One hundred thirteen F<sub>3</sub> families evaluated in Kharif 2012 were subjected to single plant selection. In all, 325 single plant selections based upon biomass yield, brix of juice and grain yield were made in the promising families.
2. In F<sub>6</sub> generation, 22 progenies of six promising crosses were evaluated during Kharif 2012. Among them line D-118-26-5 gave significantly highest biomass (46.34 t/ha) and stripped stalk (24.77 t/ha) weights as against the biomass and stripped stalk weights of 44.36 t/ha and 24.52 t/ha respectively of the check cultivar CSV-19-SS.



Promising sweet  
sorghum selection  
(D-94)-74

3. The F<sub>2</sub> populations received from DSR under network breeding programme have been advanced to F<sub>6</sub> generation. Thirty four F<sub>6</sub> progenies selected from two different crosses were evaluated during Kharif 2012. Out of these, 17 lines showed significantly higher brix of juice than the check. The line 10R-SS-20-61-1-5 gave the highest juice brix of 19.5% which was followed by 10R-SS-19-16-3-3 and 10R-SS-19-16-5-4 (both 19.0%) as against the check CSV-19-SS (13.0%).
4. Similarly in F<sub>7</sub> generation among the 13 progenies evaluated in Kharif 2012, line D-91-9-2 recorded significantly highest brix of juice of 22 % as compared to 17.7 % in check CSV-19-SS. Lines giving the juice brix at par with the line giving the highest juice brix (D-91-9-2) in the trial were D-91-30-3 (20.2%), D-91-9-5 (19%), D-169-50-3 and D-91-29-5 (both 18.7%).

### **Pre-varietal Trials (PVT)**

Forty two different lines were evaluated as PVT (Pre-varietal Trial) entries in three different trials

1. In the first trial, out of the 15 lines evaluated, line D-158-20 showed numerically higher estimates for brix of the juice (20%) as well as grain yield (3.06 q/ha) as compared to 18.3% brix and 2.35 q/ha grain yield in check CSV-19-SS.
2. In the second trial also, of the 15 lines evaluated D-118-34 showed significantly higher values for total biomass (68.24 t/ha), stripped stalk weight (40.95 t/ha), brix of juice (20.3%) and total sugar index (TSI) (2.54 t/ha) than the check CSV-19-SS (58.40 t/ha total biomass, 34.93 t/ha stripped stalk weight, 17.8 % brix of juice and 2.28 t/ha TSI).
3. In the third trial, out of the 12 lines which were evaluated, two lines *viz.*, D-34-21-3-3 and D-34-21-3-10 recorded significantly higher brix value of 22.3% and 20.7% than the check CSV-19-SS (18.2 %).

### **B-line development programme (Network breeding)**

B-line development programme at the center was initiated during Kharif 2010. Total 55 F<sub>6</sub> progenies produced from seven different crosses were evaluated in three different trials during Kharif 2012.



1. In the first trial of the 15 F<sub>6</sub> entries evaluated, entry 10B-AGR-46-147-2-3 showed promising performance for total biomass (32.68 t/ha), stripped stalk weight (17.31 t/ha), juice yield (6.26 t/ha) and grain yield (7.48 q/ha) as compared to the check 296B (18.29 t/ha total biomass, 8.11 t/ha stripped stalk weight, 2.82 t/ha juice yield and 1.38 q/ha grain yield). Similarly line 10B-AGR-46-147-2-4 showed promising performance for brix of the juice (19.0%), TSI (0.70 t/ha) and grain yield (5.24 q/ha) as against the check 296B (15.5 % brix of juice, 0.36 t/ha TSI and 1.38 q/ha grain yield).
2. In the second trial, among 17 F<sub>6</sub> progenies evaluated, 13 lines showed significantly higher biomass and 11 significantly higher stripped stalk weight than the check 296B. The entry 10B-AGR-47-87-2-2 recorded the highest total biomass (42.07 t/ha), stripped stalk weight (19.94 t/ha) and TSI (0.70 t/ha) as compared to the check 296B (18.29 t/ha total biomass, 8.11 t/ha stripped stalk weight and 0.36 t/ha TSI). Line 10B-AGR-47-71-3-3 produced significantly highest juice yield (8.02 t/ha).
3. In the third trial, line 10B-AGR-66-3-4-4 produced significantly higher juice yield (7.06 t/ha) than the check 296B (5.01 t/ha). Similarly, lines 10B-AGR-66-47-2-2, 10B-AGR-66-49-3-2 and 10B-AGR-66-3-4-4 showed significantly higher juice brix values of 16.3%, 15.8% and 15.7% respectively than the check 296B (14%). 10B-AGR-66-47-2-2 also gave the significantly highest TSI (0.92 t/ha) over the check 296B (0.62 t/ha).

### **Station hybrid trials**

Total 82 CMS-based hybrids along with two hybrid checks *viz.*, CSH-22-SS and Madhura were assessed in four different trials for high biomass and sugar content during Kharif 2012.

1. In the first trial, out of the 21 hybrids evaluated, hybrid SSRH-212 recorded the significantly higher biomass (41.72 t/ha), stripped stalk weight (29.68 t/ha), juice yield (13.63 t/ha) and TSI (1.66 t/ha) than the check CSH-22-SS which had 33.18 t/ha biomass, 21.33 t/ha stripped stalk weight, 8.06 t/ha juice yield and 1.43 t/ha TSI.
2. In the second trial, 18 hybrids were assessed of which, hybrid SSRH-234 recorded significantly higher biomass (48.17 t/ha), stripped stalk weight (28.96 t/ha), juice yield (12.23 t/ha) and TSI (1.59 t/ha) over the check CSH-22-SS (29.53 t/ha total biomass, 17.95 t/ha stripped stalk weight, 7.24 t/ha juice yield and 1.04 t/ha TSI).
3. In the third trial, of the 22 hybrids assessed only one hybrid SSRH-255 showed significantly higher biomass (35.03 t/ha), stripped stalk weight (22.93 t/ha), juice yield (9.45 t/ha) and numerically higher TSI (1.11 t/ha) than the check CSH-22-SS (Biomass 25.94 t/ha, stripped stalk weight 17.33 t/ha, juice yield 6.76 t/ha and TSI 1.02 t/ha).
4. In the fourth trial, among the 21 hybrids assessed, SSRH-279 recorded numerically higher biomass (39.19 t/ha), stripped stalk weight (26.55 t/ha) and TSI (1.41 t/ha) than the check CSH-22-SS (38.43 t/ha total biomass, 24.68 t/ha stripped stalk weight and 1.12 t/ha TSI).

### **Number of trait-based crosses successfully made (with pedigree):**

1. **Traits :** Biomass and grain yield.
2. **Crosses :**

- a. **Set 1.** 10 crosses viz., Phule Chitra x SSV-84, Phule Chitra x M-35-1, NARI-LC-07-52 x SSV-84, NARI-LC-07-52 x NARI-LC-07-5, M-35-1 x Phule Maulee, Phule Maulee x M-35-1, Phule Anuradha x Phule Chitra , Phule Chitra x Phule Anuradha , NARI-LC-07-5 x NARI-LC-07-52, NARI-LC-07-5 x SSV-84.
- b. **Set 2.** 49 crosses with parents involved in crossing being, ICOSA-34, ICOSA-38, ICOSA-479, ICOSA-584, NARI-SS-3A-20, NARI-SS-5A, NARI-SS-6A, NARI-SS-14A-17, NARI-SS-15A, 296A, NARI-LC-07-5, NARI-LC-07-5-16, NARI-LC-07-52, NARI-LC-K-07-1, M-35-1, Phule Maulee, Phule Chitra, Phule Anuradha.

### **AICSIP trials :**

Four trials allocated by DSR were successfully conducted. These trials are :

1. **IAVHT trial.** Entries, NARI-SS-1, SS 2012 (DSR), NARI-SS-5 and NARI-SS-8 were best in this particular trial for biomass, juice yield, brix and TSI.
2. **High biomass trial.** In this trial entries NARI-SS-5 and RSSV-351(Rahuri) gave high biomass.
3. **Characterization and identification of new sorghum sources for high biomass (photoperiod-sensitive) for second generation biofuels.**
  - a. Entries SSRG-164 and SSRG-200 were found to be superior for total biomass, juice yield, TSI and ethanol yield in this particular trial.
4. **Assessment of sweet sorghum for post-harvest deterioration of stalks and juice quality.** In this trial entry CSV-19-SS gave better performance at 24 hrs, 48 hrs and 96 hrs of storage while entry CSV-24-SS gave better performance at 48 hrs and 96 hrs of storage in terms of high ethanol yield and TSI.

**Rabi (Post-rainy season) 2012-13 :**

### **MS conversion programme**

1. In CMS development programme, a total of 33 pair-wise crosses were evaluated during Rabi 2012-2013. Progenies of all 33 crosses were advanced to Kharif 2013 season for evaluation.

### **R-line development programme**

In R-line development programme, in previous years different crosses using parents having desired traits were made following diallel mating system. All the progenies in different generations were evaluated for the characters plant height, total biomass, stripped stalk weight, juice yield, brix of juice, TSI and grain yield.

1. Among seven emasculated crosses which were evaluated for the purpose of grain yield, cross DC-145(48.36 q/ha) produced numerically higher grain yield than the national check cultivar M-35-1 (46.91 q/ha).
2. One hundred nineteen F<sub>4</sub> families evaluated in Rabi 2012-13 were subjected to single plant selection. In all, 504 single plant selections based upon high biomass, brix of juice and grain yield were made in the promising families.
3. In F<sub>6</sub> generation, 21 progenies of six promising crosses were evaluated during Rabi 2012-13. Among them two lines viz., D-118-69-1 (Biomass 46.76 t/ha, stripped stalk weight 34.45 t/ha, juice yield 17.55 t/ha and TSI 2.19 t/ha) and D-118-69-4 ( Biomass 39.96 t/ha, stripped stalk weight 28.70 t/ha, juice yield 13.80 t/ha and TSI 1.83 t/ha) showed superiority over check cultivar CSV-19-SS ( Biomass 27.61 t/ha, stripped stalk weight 16.29 t/ha, juice yield 5.82 t/ha and TSI 0.92 t/ha).
4. The F<sub>2</sub> populations received from DSR under network breeding programme have been advanced to F<sub>6</sub> generation. Thirty four F<sub>6</sub> progenies selected from two different crosses were evaluated during Rabi 2012-13. Out of these, 21 lines showed numerically higher biomass, stripped stalk weight, juice yield and brix of juice than the check. Line 10R-SS-20-61-1-5 (biomass 45 t/ha, stripped stalk weight 32.81 t/ha, juice yield 12.37 t/ha and brix of juice 20%) showed numerically greatest values for the four characters as against the check CSV-19-SS (biomass 27.20 t/ha, stripped stalk weight 14.60 t/ha, juice yield 5.64 t/ha, and brix of juice 19.3%). Whereas, line 10R-SS-20-107-1-7 (biomass 44.34 t/ha, stripped stalk weight 34.52 t/ha and juice yield 14.22 t/ha) gave numerically higher performance for three characters than the check CSV-19-SS.
5. Similarly in F<sub>7</sub> generation, 13 progenies produced from two different crosses were evaluated in Rabi 2012-13. None of the genotypes produced were significantly superior to the control in case of biomass. Line D-91-29-5 recorded significantly highest juice yield (10.32 t/ha), brix of juice (21%) and TSI (1.86 t/ha) over check CSV-19-SS having juice yield (5.43 t/ha), brix (16 %) and TSI (0.65 t/ha).

### **Pre-variatal Trials (PVT)**

Forty two different lines were evaluated as PVT entries in three different trials.

1. In the first trial, out of the 15 lines evaluated, line D-23-21-2 showed numerically higher estimates for biomass (43.47 t/ha), stripped stalk weight (27.18 t/ha), juice yield (13.93 t/ha) and TSI (1.89 t/ha) over the check CSV-19-SS having biomass (43.26 t/ha), stripped stalk weight (23.18 t/ha), juice yield (8.54 t/ha) and TSI (1.44 t/ha).
2. In the second trial also of the 15 lines evaluated, line D-91-30 showed numerically higher values for total biomass (43.47 t/ha), stripped stalk weight (30.21 t/ha), juice yield (13.77 t/ha), brix of juice (22.5%) and TSI (2.61 t/ha) than the check CSV-19-SS (27.52 t/ha total biomass, 18.26 t/ha stripped stalk weight, 6.88 t/ha juice yield, 20.6% brix of juice and 1.10 t/ha TSI).
3. In the third trial, out of the 12 lines which were evaluated, line D-31-44-3- recorded numerically higher juice brix value of 22.4% than the check CSV-19-SS (19.5 %).

### **B-line development programme (Network breeding)**

B-line development programme at the center was initiated during Kharif 2010. Total 55 F<sub>6</sub> progenies produced from seven different crosses were evaluated in an un-replicated manner during Rabi 2012-13.

1. Among the 55 entries evaluated, entry 10B-AGR-48-16-3-2 exhibited promising performance for four characters *viz.*, total biomass (36.48 t/ha), stripped stalk weight (17.17 t/ha), juice yield (5.49 t/ha) and brix of juice (18.5%) as compared to the check 296B (28.91 t/ha total biomass, 13.52 t/ha stripped stalk weight, 4.50 t/ha juice yield and 15.7% brix of juice). Similarly two lines, 10B-AGR-46-147-2-4 and 10B-AGR-47-34-1-1 showed promising performance for three characters *viz.* total biomass (35.46 and 34.21 t/ha), stripped stalk weight (22.30 and 22.00 t/ha) and juice yield (7.49 and 13.73 t/ha) as against the check 296B.

### **Station hybrid trials**

Total 116 CMS-based hybrids were assessed during Rabi 2012-13 in seven different trials (four trials for sweet sorghum and three trials for grain sorghum) along with three hybrid checks *viz.*, CSH-22-SS and Madhura for sweet sorghum trials and CSH-15R for grain sorghum trials.

#### **Sweet sorghum trials**

1. In the first trial, out of the 14 hybrids evaluated, hybrid SSRH-212 recorded numerically higher biomass (39.56 t/ha), stripped stalk weight (26.06 t/ha), juice yield (14.27 t/ha) and brix of juice (17.1%) over the check CSH-22-SS having biomass (38.62 t/ha), stripped stalk weight (20.40 t/ha), juice yield (8.50 t/ha) and brix of juice (8.7%).
2. In the second trial, 18 hybrids were assessed, of which hybrid SSRH-234 recorded significantly highest biomass (44.09 t/ha), stripped stalk weight (29.76 t/ha), juice yield (15.38 t/ha) and brix of juice (15.3%) over the check CSH-22-SS (36.98 t/ha total biomass, 20.11 t/ha stripped stalk weight, 10.15 t/ha juice yield and 9.9% juice brix).
3. In the third trial, 16 hybrids were assessed and hybrid SSRH-257 showed significantly higher biomass (40.01 t/ha), stripped stalk weight (26.77 t/ha), juice yield (13.55 t/ha) and brix of juice (18.1%) than the check CSH-22-SS (Biomass 29.16 t/ha, stripped stalk weight 16.07 t/ha, juice yield 7.88 t/ha and brix of juice 9.6%).
4. In the fourth trial, among the 19 hybrids assessed, SSRH-264 recorded significantly higher biomass (39.91 t/ha), stripped stalk weight (23.56 t/ha), juice yield (11.69 t/ha) and brix of juice (17.3%) as compared to check CSH-22-SS (30.79 t/ha total biomass. 16.50 t/ha stripped stalk weight, 7.82 t/ha juice yield and 9.7 % juice brix).

#### **Grain sorghum trials**

1. In the first trial, out of the 22 hybrids along with their nine parents which were evaluated, hybrid SSKH-202 recorded significantly higher biomass (41.48 t/ha) and grain yield (58.91 q/ha) as against the check CSH-15R which had 33.72 t/ha biomass and 22.67 q/ha grain yield.

- In the second trial, 11 hybrids with their nine respective parents were assessed of which, hybrid SSKH-216 recorded significantly highest fresh biomass (30.78 t/ha) and grain yield (44.90 q/ha) over the check CSH-15R (21.12 t/ha fresh biomass and 25.12 q/ha grain yield).
- In the third trial, 16 hybrids with their 10 parents were assessed where hybrids SSKH-240 and SSKH-237 showed significantly higher grain yield (35.38 q/ha and 32.57 q/ha respectively) than the check CSH-15 R (17.93 q/ha).

**Number of trait-based crosses successfully made (with pedigree) :**

**Line x Tester mating design**

For the purpose of hybridization the identified superior land races with a high grain yield potential were used and subjected to line x tester mating design (Kempthorne, 1957). Two sets were made for maintaining mating design with 16 different landraces belonging to groups like Maldandi, Dagdi, Zilar and Unknown. In the first set of hybridization, six lines were used as female parents and three superior lines were used as male parents. Similarly, in the second set, seven lines were used as female parents and three superior lines were used as male parents. Details of the materials which were used in hybridization programme are given below.

<b>First set (Maldandi x Dagdi)</b>	<b>Second set (Zilar x Unknown)</b>
<b>1. Lines (Females)</b>	<b>1. Lines (Females)</b>
1. NARI-LC-07-05-15	1. NARI- LC-07-06
2. NARI- LC-07-14	2. NARI- LC-07-29
3. NARI- LC-07-22	3. NARI- LC-07-30
4. NARI- LC-07-40	4. NARI- LC-07-44
5. NARI- LC-07-42	5. NARI- LC-07-67
6. NARI- LC-07-50	6. NARI- LC-07-74
<b>2. Testers (Pollinators)</b>	7. NARI- LC-07-89
1. NARI-LC-07-38	<b>2. Testers (Pollinators)</b>
2. NARI-LC-07-75	1. NARI-LC-K-1
3. NARI-LC-07-93	2. NARI- LC-07-25
	3. NARI- LC-07-35-1

**Maintenance and seed production**

- 200 AB lines were maintained by the center during Rabi 2012-13.
- Seed production of three promising CMS-based hybrids *viz.*, NARI-SSH-44, NARI-SSRH-19 and NARI-SSRH-20 was undertaken. Sufficient amount of seeds of these hybrids were obtained for conducting an evaluation trial. NARI-SSRH-19 was tested in AICSIP trial during Kharif-2012 and promoted to the advanced trial (AHT-I).
- Seed production of nine promising selections *viz.*, NARI-LC-07-5, NARI-LC-07-5-16, NARI-LC-07-52, NARI-SS-233, (DC-29)-21, (D-34)-11-1, (D-91)-9, (D-94)-74 and (D-102)-12 was undertaken. The selections (D-94)-74 and (D-102)-12 were tested in AICSIP

trials (IVT) during Kharif 2012 and have been promoted for second year (AVT-I) of testing.

### **AICSIP trials :**

Two AICSIP trials were allocated and they were successfully conducted at the centre during the season as follows :

- a. **IVHT-SS Trial (Evaluation of grain sorghum entries on shallow soils) :** Entry RSV-1514 (Rahuri) showed the best performance on shallow soil for grain yield.
- b. **IAVHT (Sweet sorghum) :** Entries NARI-SS-1, NARI-SS-4, NARI-SS-5, NARI-SS-6 and NARI-SS-7 were found to be the best entries on the basis of total biomass, juice brix, juice yield and TSI in this particular trial.

### **Syrup production from sweet sorghum**

The main objective of syrup research is quality improvement of syrup and also enhancing its shelf-life. A total of seven sweet sorghum lines including three crosses were tested viz., NFSS-19, NFSS-20, NFSS-44, FS-(D-102)-12, 11A x SSV84, 15 A x SSV84, 1039 x SSV74 along with hybrid Madhura for syrup making and quality improvement. Approximately 500 kg syrup was produced during the year 2012-13. Among these lines and crosses which were tested, line FS-(D-102)-12 showed the best performance for syrup quantity and quality, but was not superior in quality to the syrup produced from hybrid Madhura.

For syrup colour improvement, the treatment with bhendi (okra) solution was practised and a fixed quantity i.e. 2 Kg was added to the juice in eight different combinations of stages during syrup making viz., 1) Crushing, 2) Settling, 3) Boiling, 4) Crushing & boiling, 5) Settling & boiling, 6) Crushing & settling, 7) Crushing, settling & boiling and last one was control i.e., syrup made without the addition of bhendi (okra) solution. Out of these eight treatments addition of bhendi (okra) solution at crushing and boiling stages was found to be the best for higher syrup and scum recovery. Colour of the syrup was also improved from dark brown to light brown in this treatment. Organoleptic evaluation was carried out using a panel of 15 judges. They were all requested to identify differences among syrup samples and to evaluate the colour, intensity of flavor (odour and taste), clarity, flow and overall grade. Panelists were drawn from NARI. All the panelists were asked to complete a questionnaire giving their choice ranging from 'like extremely' to 'dislike extremely' The syrup samples were rated on a nine-point hedonic scale as follows: like extremely-9, like very much-8, like moderately-7, like slightly-6, neither like nor dislike-5, dislike slightly-4, dislike moderately-3, dislike very much-2, dislike extremely-1. The syrup prepared after adding bhendi (okra) solution during the crushing and boiling stages was also scored the highest when organoleptic evaluation was performed.

### **CENCHRUS**

**Funding agency :** Self-funded.

We have made a germ plasm collection of *Cenchrus* spp. (Anjan or Buffelgrass). It is a fodder grass native to the Indian sub-continent. In India it has been reported to yield about 2 to 2.5 T dry matter per hectare by cutting at 60-day intervals. Its main attributes are

hardiness, deep-rooting, ability to grow in semi-arid conditions and generally free-seeding habit. It is also persistent, resistant to trampling and drought-tolerant.

A total of 13 accessions as given in Table 1 were received and have been planted in the nursery at Tambmal.

Preliminary evaluation showed Laredo from U.S.A. to give the highest dry biomass of 5.6 T/ha in five months followed by CAZRI-75 from India and Gayndah from Australia both yielding 5.2 T/ha (Table 2).

We hope to acquire some more accessions during the next year and carry out large scale planting on our farms at Rajale and Vinchurni. We have also planned to carry out some agronomic trials with *Cenchrus*.

Table 1 : *Cenchrus* spp. seeds received at NARI

Sr. No.	Accession No.	Seed quantity (g)	Source	Country of origin	Date of receipt	Contact person
1.	IP 21958 (IPW 441)	2	ICRISAT	Tanzania	Nov. 16, 2011	Dr. H. H. Upadhyaya Assistant Research Program Director- Grain Legumes, ICRISAT, Patancheru
	IP 21960 (IPW 443)	2		Tanzania		
	IP 22144 (IPW 627)	2		India		
	IP 22173 (IPW 656)	2		Namibia		
2.	CAZRI 75	50	CAZRI	India	Dec. 5, 2011	Dr. R. K. Bhatt PS & Head, Division of Plant Imp., Prop. and PM, CAZRI, Jodhpur (Thru Dr. C. R. Ramesh, Principal Scientist, Directorate of Onion and Garlic Research, Rajgurunagar)
	CAZRI 358	50		India		
3.	CAZRI 75	2000	CAZRI	India	Jan. 18, 2012	Dr. Shalander Kumar Head, Transfer of Technology, Training and Production Economics Division, CAZRI, Jodhpur
4.	Gayndah	1000	-	Queensland, Australia	May 24, 2012	-
5.	Unknown	3000	CSWRI	India	June 20, 2012	CSWRI, Avikanagar
6.	Laredo	250	-	U.S.A.	August 7, 2012	-
7.	PI 294595	1	ICBA	Australia	April 2013	Dr. Nanduri Rao

	PI 409295	1		S. Africa		International Center for Biosaline Agriculture, P.O. Box 14660, Dubai, UAE
	PI 414513	1		S. Africa		
	Grif 1619 (Gayndah)	1		Australia		
	MAF 74	1		UAE		

Total : 13 accessions

Table 2 : Fresh and dry weights of *Cenchrus* germplasm harvested after five months (sown August-September 2012) at Tambmal, NARI, Phaltan

Sr. No.	Variety	Fresh biomass (Kg/ha)	Moisture (%)	Dry biomass (Kg/ha)	Ranking according to dry weight
1.	Laredo (USA)	15408	64	5581	1
2.	Cenchrus (CSWRI)	14530	69	4204	6
3.	CAZRI 75 (S. Kumar)	12037	60	4815	3
4.	Gayndah (Australia)	11254	53	5243	2
5.	IP 22144 (ICRISAT) India	11154	62	4227	5
6.	Cenchrus (CSWRI)*	10570	63	3932	7
7.	CAZRI 75 (Bhatt)	9800	46	5243	2
8.	CAZRI 75 (S. Kumar)*	9045	50	4523	4
9.	IP 22173 (ICRISAT) Namibia	8421	55	3757	8
10.	CAZRI 358 (Bhatt)	8357	65	2886	10
11.	IP 21958 (ICRISAT) Tanzania	7368	61	2906	9
12.	IP 21960 (ICRISAT) Tanzania	5263	57	2243	11

\* Planted one month later than Sr. no. 2 and 3 respectively.

**Project staff** : N. Nimbkar, Ph.D.; V. Singh, Ph.D., B. C. Nandeshwar, Ph.D.; S. A. Khedekar, Ph.D., M. B. Deshpande, M.Sc.; V. A. Bhagwat, M.Sc.; C. S. Khore, M.Sc.; V. R. Jagdale, M.Sc.; M. Y. Patil, M.Sc.; M. M. Patil, M.E., S. V. Choudhari, B.Sc., R. K. Andhalkar, R. G. Randive, A. R. Gholap, A. A. Dhaygude, N. C. Thorat, M. G. Shirke, V. S. Ghadage



## RENEWABLE ENERGY RESEARCH

- (I) NARI's low concentration alcohol stove technology was sold to an Indonesian Company P. T. Tapanuli Investasi Agro (TIA). They have been given exclusive rights for manufacturing and selling only in ASEAN countries. They plan to manufacture 100,000 stoves in a lot and sell them.

(II) **Lanstove project**

**Objectives :** To set up 25 lanstove units in unelectrified huts and establish their feasibility as cooking and lighting devices.

**Funded by :** Department of Science and Technology (DST), New Delhi

**Work done :**

- (1) 25 lanstoves were fabricated by a Pune fabrication shop and assembled in NARI workshop.



Endurance testing of  
lanstoves in lab.

- (2) There were teething problems in final assembly because of faulty fabrication. All those problems were solved and afterwards each lanstove underwent endurance testing of 50 hours in the laboratory. This test was done to ensure that all the parameters like power and light output of lanstoves were as per specification.
- (3) After the endurance testing, the lanstoves were distributed to the beneficiaries who did not have electricity. These huts were identified after doing detailed survey of four villages namely Vadjal, Choudharwadi, Shindewadi and Garpirwadi.
- (4) The biggest problem faced by the beneficiaries was availability of adequate quantity of kerosene. Thus in the initial stages NARI bought the kerosene in the open market @ Rs. 35-40/l and distributed it to the beneficiaries at Rs. 15/l (PDS price). This helped establish the lanstove as a viable cooking and lighting device.
- (5) The beneficiaries had some problems in operating the lanstoves early on, but daily visits and constant tutoring helped them start using them effectively in 2-4 months.

- (6) With the help of Satara Collector we were able to raise the quota of kerosene for these beneficiaries to 12 l/month instead of present 5 l/month. This allowed the beneficiaries to start using the lanstove more, but again the kerosene supply was drastically reduced in recent times and has remained a major bottleneck in smooth functioning of the lanstove project.
- (7) The daily data collection and its analysis is continuing and the project will end in September 2013.
- (8) There has been a good coverage of lanstove technology in mass media. Consequently, stories in press and on TV have periodically appeared. In press major stories appeared in IBN, Statesman, DNA etc.
- (9) The details of lanstove including feedback of the users is given in; <http://www.nariphaltan.org/kerolanstove.pdf> . Another publication on the issue of kerosene is at; <http://nariphaltan.org/kerosene.pdf> .

### (III) Unique water sterilization technology

Funded internally.

A unique and low cost water sterilization technology has been developed. The technology involves filtering the dirty water through four layers of cotton saree cloth and then heating it to 55-60<sup>0</sup>C for 15 minutes. This makes the water completely clean and kills all the coliforms. This method consumes only about 40% of the energy required for boiling the water and with the development of a cheap solar water heater can be a great boon for rural areas.

Also when used in conjunction with the lanstove this method can produce about 15 liters of pure drinking water during its four hour usage.

A paper on this technology was published in [Current Science](#) and a syndicated story on it was published all over the world in [different news lines](#).

**Project staff :** A. K. Rajvanshi, Ph.D.; R. Lokhande, M.Tech., S. Pingale, M.Sc.; K. S. Gangawane, B.E.; A. Pawade, B. E.; A. Agashe, B.E.; K. S. Jagtap, B.Sc.; S. M. Patil; A. S. Kadam; A. M. Pawar; D. B. Gadhawe

## ANIMAL HUSBANDRY RESEARCH

The Animal Husbandry Division made significant advances during 2012-13 in the pursuit of its major goal to increase the productivity of local sheep and goats through genetic improvement and better feeding and management and improve their owners' incomes. One of our objectives is also to improve the social standing and the self-esteem of goat and sheep rearers by creating awareness about the importance of this profession.

Some of the highlights of 2012-13 were :

1. The **start of production of high quality Boer and Osmanabadi buck frozen semen straws** at the Government of India-funded "State of the Art Semen Freezing Laboratory" at the AHD, the first supply of buck frozen semen straws to private AI technicians in Satara, Solapur and Ahmednagar districts and the achievement of average 50% conception rate by them on AI of farmers' goat does on natural oestrus.
2. The **supply of 16 homozygous *FecB* carrier breeding rams and 50 heterozygous and homozygous *FecB* carrier breeding ewes** to the Tamil Nadu Veterinary and Animal Science University, Chennai and the Karnataka Veterinary, Animal and Fisheries Sciences University, Bangalore.
3. The **inclusion of our paper "Sustainable Improvement in Sheep Productivity in India Using the *FecB* (Booroola) Mutation" in the FAO publication** soon to be published: "Biotechnologies at Work for Smallholders: Case Studies from Developing Countries in Crops, Livestock and Fish".
4. Further **refinement of the protocol for rooting of cuttings of the psyllid-resistant, high yielding hybrid *Leucaena* KX2 or NARI Nirbeeja** used as protein-rich fodder.
5. Preparation of a **training manual on goat and sheep management and goat AI in Hindi** and conducting a 5-day practical training course for six Gopal mitra – rural social workers from Bihar.

### Ongoing projects :

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

**Funding agency : Self-sustained project.** The funding from the Department of Biotechnology of the Government of India for this project ended on 31 March 2012. We have continued the project and are happy that we can meet its expenditure from the revenue generated by the sale of breeding rams and ewes and cull animals.

**Scientists :** Dr. Chanda Nimbkar, Dr. Pradip Ghalsasi

**Technical staff :** Mr. Dilip Bhandare, Ms. Padmaja Ghalsasi, Mr. Rupsing Khanvilkar

### Progress made :

We now have a selected nucleus flock of **71 *FecB<sup>BB</sup>* ewes** (homozygous for the *FecB<sup>B</sup>* allele), **169 *FecB<sup>B+</sup>* ewes** (heterozygous for the *FecB<sup>B</sup>* allele) and **60 non-carrier adult ewes**. In

addition, there are **37 young  $FecB^{BB}$  and 61  $FecB^{B+}$  ewes that are 3 to 10 months old**. We have 7  $FecB^{BB}$ , 25  $FecB^{B+}$  and 1 non-carrier Madgyal adult selected breeding rams. Some of these will be sold as breeding rams. Additionally, there are 19 young (3 to 10 months old)  $FecB^{BB}$  and 19  $FecB^{B+}$  selected rams. These animals are either NARI Suwarna (with only Deccani and Madgyal breed proportion and less than 10% Garole breed proportion) or NARI Composite (with additional Awassi and/or Bannur breed proportion). Madgyal rams are being used in NARI's breeding programme 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.

All ewes are bred by artificial insemination (AI) in order to use a large number of breeding rams and maintain accurate pedigree records. Each AI programme in 2012-13 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. Genetic analysis was used to estimate breeding values.

During 2012-13, we sold 27 breeding rams (22  $FecB^{BB}$  and 5  $FecB^{B+}$ ) and 88 young breeding ewes (20  $FecB^{BB}$  and 68  $FecB^{B+}$ ). Out of these, 16  $FecB^{BB}$  breeding rams and 50 breeding ewes were purchased by two universities – the Tamil Nadu Veterinary and Animal Sciences University, Chennai for their Central Sector Scheme on 'Biotechnology Centre for Fecundity Genes' and the Karnataka Veterinary, Animal Sciences and Fishery Science University, Bangalore for their sheep project under the Rashtriya Krishi Vikas Yojana. We managed to sell 88 selected young ewes while keeping the number of adult ewes in the flock roughly the same as 2011-12. This was possible precisely because of the increased prolificacy of ewes due to the *FecB* gene.



**A *FecB* carrier heterozygous ewe at the AHD with its Madgyal cross twin male lambs of 4 months age weighing 14.5 kg each**

**Table 1. Details of AI programs carried out in April, July and November 2012**

Particulars	<i>FecB</i> <sup>BB</sup>	<i>FecB</i> <sup>B+</sup>	<i>FecB</i> <sup>++</sup>	Total
Ewes available for breeding	85	225	88	398
Ewes inseminated artificially (AI)	73	188	73	334
Ewes conceived (AI + NS)	61	171	59	344
Conception rate to first AI (%)	80	84	78	82
Ewes lambing with at least one live lamb	47	141	57	245
Live lambs born per ewe lambing with at least one live lamb	1.66	1.53	1.09	1.45
Live lambs born per ewe lambing or aborted or with all lambs stillborn	1.39	1.33	1.05	1.28
Live lambs born per ewe conceived	1.28	1.26	1.03	1.21
Live lambs born per ewe available for breeding	1.26	1.16	0.73	1.08

**Genotyping of sheep DNA for the *FecB* locus :****Details of local sheep DNA tested at the NARI-AHD laboratory during 2012-13**

Breed	Animals genotyped	<i>FecB</i> <sup>BB</sup>	<i>FecB</i> <sup>B+</sup>	<i>FecB</i> <sup>++</sup>
Garole and crosses	17	14	3	0
Crossbred lambs	289	91	154	44
Awassi and crosses	3	0	1	2
Smallholder shepherds' crossbred lambs	20	2	10	8
<b>Total</b>	<b>329</b>	<b>107</b>	<b>168</b>	<b>54</b>

*FecB* genotyping of 100 samples received from Prof. Abdullah Alowaimer, King Saud University, Saudi Arabia was done in the Molecular Genetics Laboratory of AHD in September 2012. Of the 100 samples, 36 were heterozygous carriers and 64 were non-carriers. The results and gel photographs were sent to him.



Mr. Rajan Reddy, Srikalahasti, Andhra Pradesh, with the *FecB* carrier ram purchased by him from NARI in order to introgress *FecB* into non-prolific Jodipi sheep. The horned ram held by the shepherd is a Jodipi ram.

**Summary of the achievements and findings of the DBT-funded project carried out from April 2009 to March 2012 :** In August 2012, there were 97 homozygous carrier ewes and 28 rams, 243 heterozygous carrier ewes and 40 rams and 81 non-carrier ewes and 6 rams in the NARI flock. Since the project started in April 2009, the number of homozygous *FecB*<sup>BB</sup> 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%. 30% of the ewes in the NARI flock have 25 to 50% proportion of the Madgyal breed, in accordance with the preference of the local sheep owners. Over three years, about 60 rams were sent for breeding to various smallholder

shepherds' flocks in Maharashtra for varying time periods. Ninety four heterozygous *FecB*<sup>B+</sup> ewes were disseminated to 12 smallholder sheep owners in 2010. One hundred eighteen heterozygous and 234 non-carrier ewes in 10 smallholder shepherds' flocks were performance-recorded. Heterozygous ewes in shepherds' and NARI's flocks gave birth to 42% and 48% more lambs respectively and weaned 37% and 43% more lambs respectively than non-carrier ewes. Homozygous ewes gave birth to 67% more lambs and weaned 64% more lambs than non-carrier ewes. There appear to be two distinct groups among *FecB* carrier crossbred ewes, with low and high average litter size. The expression profile of ten fecundity related genes in whole ovarian tissue and Graafian follicles in *FecB* carrier ewes with different levels of prolificacy was studied by quantitative real-time PCR. The expression of GDF9 and BMP15 genes that are negative regulators of ovulation was higher in homozygous *FecB*<sup>BB</sup> Garole ewes having a low litter size. 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. Among ewes kept under different planes of nutrition, Deccani ewes showed higher expression of BMPRIA, BMPRII, FSHCGR and LHCGR genes in higher plane of nutrition without any effect on follicular development. Moderate level of expression difference across all the genes in low litter size homozygous *FecB*<sup>BB</sup> ewes resulted in significantly higher number of follicles developed (average 2.6) in animals under higher plane of nutrition than those on a lower plane of nutrition (average 1.6).

**Project I. B. Analysis of Booroola gene (*FecB*) introgression into a Deccani sheep population.**

**Duration :** March-December 2012

**Scientists :** Dr. Mik Black, Department of Biochemistry, University of Otago, New Zealand, Dr. Peter Amer, AbacusBio Limited, New Zealand and Dr. Chanda Nimbkar, NARI AHD

**Student :** Mr. Chris Harris, University of Otago, New Zealand

Mr. Chris Harris of University of Otago, New Zealand analyzed pedigree and trait data provided by Dr. Chanda Nimbkar from the NARI Suwarna nucleus flock data from 2005 to 2011. Mr. Harris wrote this up as a thesis to fulfill his genetics programme course requirements. He visited the AHD on 5-17 April 2012 to learn more about the data and to organize it for analysis. An MOU was signed among NARI, the University of Otago and AbacusBio Ltd. for the purpose of this research project. NARI provided free accommodation and food to Mr. Harris for the duration of his stay at Phaltan.

**Conclusions :** Direct heritabilities were found to be consistent with previous NARI and other breeding program studies. Maternal heritability for weaning weight was estimated to be practically zero. This may have been due to nutritional supplement for mothers. All fixed effects were significant sources of variation. Garole breed proportion, *FecB* genotype and birth type all had negative effects on both weaning and birth weights. This is not surprising given that these effects have a common genetic component. The direct genetic correlation between weaning and birth weights was found to be moderate, indicating that selection based on birth weight would result in improvement of weaning weight.

## 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

**Scientists :** Dr. Chanda Nimbkar, Dr. Pradip Ghalsasi

**Technical staff :** Mr. Kanhaiya Chavan, Ms. Nadia Qureshi, Mr. Anil Pisal, Mr. Navnath Patange, Ms. Bharati Pawar, Mr. Haribhau Thombare, Ms. Archana Nimbalkar

### Executive summary

**Objective 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. (This centre was, however, closed on 31 March 2012 due to non-cooperation from goat keepers and unsatisfactory working of staff members of the NGO 'Paryay', deputed for the project.) 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. NARI has now severed ties with the latter NGO because of non-performance of its workers. NARI has appointed its own village worker to carry on the work in this centre.
2. **Six hundred and twenty two adult does** (249, 260 and 113 adult female goats in Satara, Solapur and Ahmednagar districts respectively) are being recorded. These belong to 200 goat keepers, making the average number of goats per household 3.11. 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.



Mrs. Pushpa Demunde of Kamone village in Karmala taluka of Solapur district gives supplementary feeding to her kids.

Kamone is one of the villages adopted under the project.

3. **Drought:** 2012-13 was the second year of drought in a row in all project areas, making the situation extremely difficult for all goat owners with respect to water and feed for their goats. It was, however, found that goat owners in Solapur and Ahmednagar districts managed to maintain their goats very well despite the drought being more severe there than in Satara district. Adult and kid mortality did not increase; in fact it reduced and there was no substantial distress sale of animals. The efforts made by goat keepers to maintain their goats were highly impressive. Details of good management of animals by goat keepers are given in the report.
4. **Increase in number of saleable kids produced per doe and sale price of live kids:**  
The project has created awareness among goat keepers about culling unproductive does and giving good feed to does before and after kidding. The project has also achieved better disease control due to vaccination, deworming and early detection and treatment of minor infections. This has led to an increase in the number of saleable kids per doe. Additionally, because the goat owners now know the weight of the kids they sell, the price obtained per kid has also increased. An example is that of Mr. Ashok Murumkar of Sakat village in Jamkhed taluka, who used to get 1.4 kids per doe per year and used to sell them for Rs.1500 per kid before the project started but from July 2011 to July 2012 obtained 2.5 kids per doe and sold them for Rs. 3194 each.
5. **One thousand three hundred and thirty kids were born in 777 kiddings (in all project villages) from 1 April 2012 to 31 March 2013.** Of these, 262 kiddings were in Satara district, 363 in Solapur district and 152 in Ahmednagar district. The average litter size over all districts was 1.71 which was slightly higher than 2011-12 (1.68). The average litter size was the highest (1.90) in Ahmednagar district, followed by Solapur district (1.78).
6. The average kidding interval was  $320 \pm 73$  days in Satara district (641 records),  $273 \pm 86$  days in Solapur district (495 records) and  $274 \pm 35$  days in Ahmednagar district (163 records). The average over all three districts was 297 days or 9.9 months, indicating 1.2 kiddings per doe per year. This works out to about 2.4 kiddings in 2 years while the ideal for non-seasonal does is considered to be 3 kiddings in 2 years.
7. The least squares mean three month weight of single-born kids (304 records) was  $12.1 \pm 0.2$  kg and that of twin-born kids (771 records) was  $10.1 \pm 0.1$  kg. Thus **does giving birth to twin kids weaned almost 67% 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  $10.5 \pm 0.2$  kg** which was higher than the  $\sim 7$ 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 ( $11.3 \pm 0.3$  and  $11.0 \pm 0.5$  kg respectively) was about 14% higher than in Phaltan and Kalamb talukas ( $9.9 \pm 0.2$  kg and  $9.6 \pm 0.3$  kg respectively) under the project.
8. The number of observations of 6-months and 9-months weights was lower (249 and 75 records respectively) since most of the kids are sold between the ages of three and six months. **The overall least squares mean weight of goat kids at 6 and 9 months age was  $15.7 \pm 0.6$  kg and  $22.7 \pm 1.9$  kg respectively.**



9. The least squares mean body length, height at withers and heart girth were 27.1 cm, 31.2 cm and 30.9 cm at birth, 41.7 cm, 47.2 cm and 49.2 cm at three months and 51.3, 58.4 and 57.0 cm at six months. Male kids were bigger than female kids by 3 to 4 cm at 3 and 6 months but there wasn't much difference between the measurements of male and female kids at birth. The least squares mean height at withers, length and heart girth at birth estimated here were slightly less than those reported in the Network Project Report on Osmanabadi Goats, MPKV, Rahuri (1995-99). The height at withers and heart girth at 3 and 6 months measured here were about the same as those reported in the Network Project on Osmanabadi goats. The length at 3 and 6 months as measured in this project was, however, 8 to 12% less than that reported in the Network project report.
  
10. The least squares means of the test day milk yield of does suckling one, two, three and four kids were 891.5 g (1440 records), 1276.4 g (1917 records), 1672.0 g (248 records) and 1837.0 g (13 records) respectively. The 100-day milk yield of does that had given birth to single, twin, triplet and quadruplet kids was 60.4 kg (258 records), 90.0 kg (406 records), 125.0 kg (52 records) and 140.5 kg (2 records) respectively. There was large variation in kid weight and milk yield, indicating a potential for selection. Goats from Kamone in Karmala taluka had 31 to 35% higher least-squares mean 100-day milk yield than those in Phaltan, Kalamb and Jamkhed talukas. We have been able to identify good milk producing does in the villages. 14 does (2.8%) out of 499 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 the Osmanabadi as a dairy goat breed for the benefit of village women goat keepers.
  
11. Overall **mortality in different age and sex groups was 0 to 3.9% in different project villages.** Digestive disorders, anorexia/pyrexia and predation were among the main causes of mortality in all project villages.
  
12. NARI helped a goat keeper Shri Dnyandev Maruti Shinde of Wadgaon village, Satara district to obtain compensation from the Maharashtra State Forest Department for his does and kids killed and wounded by wolves.
  
13. **NARI purchased 32 bucks for dissemination since 2009. The six month weights of these bucks were 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. The dams of these bucks had above average milk yields and one was from the top 3% milk yielders. Six of these bucks died or were culled due to various reasons over the last four years.
  
14. NARI has **disseminated 19 Osmanabadi breeding bucks** so far of which seven were in the project villages on 31 march 2013 – two in Phaltan taluka, two in Karmala taluka and three in Jamkhed taluka. 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.

15. We have **frozen 2315 semen doses of 20 Osmanabadi bucks in straws** in the ‘State of Art Buck Semen Freezing and AI Centre’ set up at Nimbkar Agricultural Research Institute with a grant from the Government of India under the ‘Integrated Development of Small Ruminants Scheme’. One hundred seventy of these have been given to AI technicians in Satara and Solapur districts for field trials and we now have in storage 2145 frozen semen doses of Osmanabadi bucks. Out of these, we **will give 500 semen doses to NBAGR for long term breed conservation, as per the technical programme of the AICRP-Goat Improvement**. Each dose contains 100 million spermatozoa and the post-thaw progressive motility of this frozen semen is >60%. **The conception rate using frozen semen, on cervical AI of does in natural oestrus carried out at the goat keepers’ door or brought to our farm was 45 to 50% on average**. We plan to freeze more semen in the near future.

**About 100 Osmanabadi does belonging to farmers in the Phaltan area were inseminated with the frozen semen of outstanding Osmanabadi bucks purchased under the project. The superior Osmanabadi genetics obtained under the project is thus being spread widely outside the project villages.**

**Objective 2.** To evaluate the socio-economic status of goat breeders and the economics of goat production in farmers’ flocks

16. Goat keeping was clearly a supplementary occupation to crop farming in Jamkhed taluka whereas in Phaltan taluka, almost an equal number of goat owners reared goats as their main occupation as crop farming. **Goat rearing was more important than farming in Karmala taluka**. Most of the goat keepers under the project in Karmala taluka reared goats as their main occupation. Up to 85% of goat keepers from all project villages owned some land. 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.
17. The main source of income from goat rearing is sale of animals, where mainly kids below the age of one year are sold. **Forty nine per cent of the 751 male kids of the age group 3-6 months and 25% of the 3-6 months old female kids (172 out of 695) were sold. Seventy three per cent of 287 male kids from the age group 6-12 months were sold whereas 41% of 461 female kids of this age group were sold.** The sale of 41% females from the age group 6-12 months was higher in 2012-13 compared to 32% in 2011-12. This could be because of the drought. Most of the animals sold were 3-12 months’ of age. The percentage of male and female kids sold of the <3 months, 3-6 months and 6-12 months age groups was roughly the same as in earlier years.
18. The average sale price of 3-6 months old male kids increased in Ahmednagar district from Rs. 2600 per head in April-September 2012 to Rs. 2900 per head in October 2012-March 2013. In Satara district also this price increased from Rs. 2800 to Rs. 3300 per head. In Solapur district, it was about Rs. 2900 – Rs. 3000 throughout the year. The average price of 3-6 months’ old females in all districts was about Rs. 2500. If we consider the average sale weight of 3-6 months old kids to be about 13 kg, the price per kg live weight works out to Rs. 200 to Rs. 225 per kg. Considering an average kidding interval of 9.9 months, the average litter size of 1.71, average sale weight of 13 kg, average sale price of Rs. 2700 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. 5000.**

## 19. Role of women in goat husbandry

1. **Proportion of women goat owners :** 19-34% of the goat owners under the project from the different villages are women. There are total 54 women goat owners. 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 3.** To disseminate the pro-poor goat-based technologies under field conditions and assess their impact on goat production

20. 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.

21. **Awareness has been created among goat keepers** about

- ◆ 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 fetching better prices
- ◆ Reduction mortality due to regular vaccination, deworming and spraying
- ◆ Misconceptions held by them 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.

22. We have constructed a **simple feeder** made of short wooden poles and old gunny bags at a goat owner's house. 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 due to spreading it on the ground. The feeder saves the feed from getting trampled on by goats and soiled with their faeces and urine.

23. **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.

**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’.**

**Scientists :** Dr. Pradip Ghalsasi

**Technical staff :** Mr. Kanhaiya Chavan, Mr. Rupsing Khanvilkar, Ms. Padmaja Ghalsasi, Ms. Rupali Bandgar

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

NARI AHD submitted the utilization certificate for the first installment of Rs. 50 lakhs to the Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Government of India in January 2012 and received the second installment of Rs. 50 lakhs (released on 29 February 2012) on 1 September 2012. This amount was used to purchase a straw printing machine, liquid nitrogen containers, a water purification system and a DIC Trinocular microscope. Utilization certificate was submitted on 27 November 2012. Subsequently, the Govt. of India released the third installment of Rs. 18.24 lakhs on 25 February 2013 and fourth installment of Rs. 31.76 lakhs on 25 March 2013 to the Government of Maharashtra for further release to NARI. This total amount of Rs. 50 lakh is yet to be received.

With the straw printing machine we now produce frozen semen straws showing the breed and tag number of buck and date of freezing. We supplied 655 frozen semen straws (325 Boer and 330 Osmanabadi) to 12 private A.I. technicians in Satara, Kopergaon and Solapur districts of Maharashtra in August 2012. Preliminary data shows that they are achieving on average, a 50% conception rate on ‘does kidded’ basis. Apart from these about 732 straws were supplied to other buyers in Maharashtra, Assam, Karnataka, Rajasthan, Tamil Nadu and Uttarakhand states.



**Frozen semen doses of Boer and Osmanabadi bucks were given for a trial to private AI technicians in Phaltan taluka.**

**Table : Production and utilization of buck frozen semen doses (straws) at NARI up to 31 March 2013**

Particulars	Number of frozen semen doses (straws)		
	Boer bucks	Osmanabadi bucks	Total
Doses frozen	1107	1595	2702
Doses given for a free trial to private AI technicians	325	330	655
Doses sold	717	15	732
Doses stored	65	1250	1315

From June to September 2012, 43 goat does belonging to farmers were inseminated with frozen buck semen on Wadjal farm out of which 40 does were monitored and 22 kidded, indicating a **55% conception rate**.

Dr. A. Batobyal, Joint Commissioner (SR & MP), Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India visited AHD on 20 July 2012 to inspect the equipment purchased under the project and see the progress of the project. He was accompanied by Shri Eknath Dawale, Commissioner, Animal Husbandry, and Dr. H.T. Rawate, District Deputy Commissioner, Animal Husbandry, Maharashtra State. Dr. Pradip Ghalsasi showed them the laboratory set-up, the working of the equipment and frozen semen under the microscope. Dr. Chanda Nimbkar, Dr. Pradip Ghalsasi and Shri B.V. Nimbkar had discussions with them about the project. They visited Wadjal farm and Lundy farm at Rajale village to see the nucleus breeding flock of NARI Suwarna sheep.

The Commissioner, Animal Husbandry, Maharashtra State has placed an order with AHD for 1000 Boer buck and 4000 Osmanabadi buck frozen semen straws to be used from government AI centres in five districts in Maharashtra – Ahmednagar, Aurangabad, Buldhana, Osmanabad and Solapur. Twenty five officers of the Animal Husbandry Department, Govt. of Maharashtra will be trained at AHD in goat AI.

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

**Scientists :** Mr. B.V. Nimbkar, Dr. Nandini Nimbkar

**Technical staff :** Ms. Padmaja Ghalsasi

**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*. KX2 provides high quality fodder for ruminants with >35% dry matter and 25-30% crude protein. This can replace expensive commercial concentrate feed to a large extent. AHD has named the cross 'NARI *Nirbeeja*'. This accession is highly resistant to the psyllid, an aphid-like pest which attacks and destroys Subabhul leaves for three or more months in winter. KX2 is fast growing and produces very little or no seed and the seed is usually not fertile, hence the name *Nirbeeja*. The propagation of KX2 therefore needs to be vegetative.

#### **Propagation through rooting of cuttings :**

**Objective :** To develop a simple and consistently reproducible protocol for rooting of cuttings of NARI *Nirbeeja* (KX2) hybrid *Leucaena* (Subabhul).

**Duration :** For each trial: 6-8 weeks

Ten trials were conducted during 2012-13 to standardize the protocol for rooting of NARI *Nirbeeja* cuttings in high humidity polythene tunnels (5 m X 1 m) erected in a shade-net house that allows 50% sunlight. A total of 425 rooted and hardened plants were produced and planted in an open plot at the AHD's Wadjal farm.

### **Salient findings :**

1. For a high rate of success, use cuttings from plants which themselves have been developed by rooting of cuttings.
2. It is easier to grow cuttings in cocopeat in nursery tray cups than in sand.
3. The age of the cuttings to be used for rooting should be 30-45 days.
4. The cuttings should be 15 cm long, have an 8-10 mm diameter and have two axillary nodes. The terminal leaves at the tip should be retained; two pinnae on the upper leaves should be retained and the lower leaves should be cut in half.
5. Two rooting hormones – 1% Indole Butyric Acid (IBA) and 0.5% Naphthalene Acetic Acid (NAA) (dissolved in an organic solvent such as absolute alcohol) should be used for rooting of cuttings.
6. Fogging has to be done to cover the leaves with mist droplets so that they do not wilt or dry.
7. 70-75% humidity and 30-33<sup>0</sup>C temperature should be maintained in the tunnels.
8. Fungus should be controlled by spraying a 1% systemic fungicide solution weekly.
9. The cuttings which retain the original leaves up to 14 days, develop a root system.
10. A strong fibrous root system develops after 4-5 weeks.
11. Rooted plants should be lifted gently from the cups and transferred to pots filled with soil. The plants should be drenched in a nutrient-rich solution with dissolved NPK for the first two days.
12. The plants in the pots should be kept in a separate humidity chamber where moisture percentage should be decreased gradually every week to start the hardening process. After about two weeks, the plants are moved under a shade net for further hardening for about 2-3 weeks.
13. If all the above steps are followed meticulously, a rooting percentage >70% can be obtained.

### **Project V. Comparison of wet biomass yield from psyllid-resistant KX2 hybrid *Leucaena* trees developed using three different methods – rooting of cuttings, grafting on to rootstock of K8 seedlings and growing from seed**

**Scientists :** Mr. B.V. Nimbkar, Dr. Nandini Nimbkar, Dr. Chanda Nimbkar

**Technical staff :** Ms. Padmaja Ghalsasi, Mr. Dattatraya Mulik, Mr. Rupsing Khanvilkar, Ms. Rupali Bandgar

### **Material and Methods :**

#### **Location**

Plants propagated using the three different methods were planted on plot No. 5 on Wadjal farm of AHD. The soil pH was 7.32 (within the normal range 6-8) and the electrical conductivity was 0.19 (within the normal range 0-1.0)

## Propagation methods

1. **Rooting of cuttings :** The rooting of bi-nodal cuttings of KX2 was done in high humidity chambers of polythene sheets over sand beds which measured about 1.8 m X 0.9 m. Rooting hormones 1% Indole Butyric Acid (IBA) and 0.5% Naphthalene Acetic Acid (NAA) were used. Bi-nodal juvenile cuttings about 10 cm in length and 5–7 mm thick in diameter were dipped in IBA and NAA and inserted about 2 cm deep in the sand beds. Water was sprayed about four times a day to maintain 70-75% humidity and 30-32°C temperature. After about 4-5 weeks the cuttings rooted and were transplanted to nursery bags containing a soil mixture. The 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 two weeks the acclimatization process was complete and the plants were moved to a shade net house for further hardening to enable transplanting out in the field.
2. **Grafting :** Wedge grafting was done using scions of KX2 (*Nirbeeja*) and rootstock of *Leucaena leucocephala* which is one of the parents. A perpendicular slit was made on the rootstock. A bi-nodal scion having the same length as the slit was fitted exactly in the slit. The scion and rootstock were then tightly tied together using stretchable plastic ribbons. Care was taken to protect the graft area from contact with air or water. The grafts were individually covered with plastic bags to protect the scion from drying out and increase the humidity to promote new shoots. After grafting the scions sprouted within a week and the new shoots started to grow. It took about 3-4 weeks for complete joining of the rootstock with the scion. After about three weeks the grafts were hardened for two weeks and were then ready to go into the soil.
3. **Seedlings :** A packet of 95 KX2 sample seeds was obtained from ECHO seed bank, Florida, USA. The seeds were planted in the nursery of AHD in September 2011. The emergence of the seedlings was slower (taking more than 8 days) than the 4 days taken by normal local *Leucaena* and the germination was 52%. The vigour of these plants was also found to be low and they grew at a slow pace.

**Measurements :** There were 15-16 plants in each row and one row each of rooted, grafted and seeded trees was chosen for measurement. The trees were cut every 12 weeks at a height of 1 m from the ground. The wet edible biomass from each tree was weighed. The weights from two cuttings – on 13 December 2012 and 1 March 2013 are reported here.

### Least squares means of wet biomass (kg) per tree from two cuttings

Trees propagated by	n	wet biomass (kg)
i. Rooting cuttings	15	1.72 ± 0.13
ii. Grafting	13	0.96 ± 0.14
iii. Seeding	16	0.76 ± 0.12

**Conclusion :** The wet biomass yield from rooted cuttings of KX2 (*Nirbeeja*) was 79% higher than grafted plants and 126% higher than that of seeded plants. Rooting of cuttings is therefore the best method of propagation of KX2 (*Nirbeeja*).

Further measurements will be recorded two more times at 12-week intervals.

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

**Funding agency :** self-funded

**Scientists :** Dr. Pradip Ghalsasi, Dr. Chanda Nimbkar

**Technical staff :** Ms. Padmaja Ghalsasi, Ms. Rupali Bandgar, Mr. Kanhaiya Chavan, Mr. Rupsing Khanvilkar, Mr. Dattatraya Mulik, Mr. Dilip Bhandare, Mr. Anil Chavan

During 2012-13, the gastro-intestinal (GI) worm burdens under natural infection of NARI's sheep and goat flocks and of goat keepers' flocks participating in NARI's projects were monitored and animals were dewormed either *en masse* or individually considering the severity of the worm burden and the season. At Wadjal farm, breeding rams transferred from Lundy farm and Dhuldeo farm were all drenched while the other animals were screened twice and only severely infected individuals were dewormed. At Dhuledo farm, all goats and sheep were dewormed once and screening of the whole flock and individual treatments of infected animals were done three times. At Lundy farm two groups of lambed ewes were dewormed at different times; pregnant and empty ewes and weaned lambs were mass drenched once while individual treatment of lambed ewes was done once.

**Findings :**

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

Particulars	n	Adult crossbred rams	n	Adult Garole rams
Date of drenching		April 2012 (only highly infected ones)		Not drenched at all in 2011-12
		<b>May 2012</b>		
Mean FEC (epg)	24	788	-	Not sampled
Range of FEC (epg)		0-2800		Not sampled
		<b>July 2012</b>		
Mean FEC (epg)	37	1884	8	0
Range of FEC (epg)		400-6200		0
		<b>September 2012</b>		
Mean FEC (epg)	44	1418	14	392
		0-5400		0-1200

It is thus established that the Garole breed is more resistant to gastro-intestinal worms than other breeds or crosses at NARI.

**Validation of FAMACHA<sup>®</sup> anaemia guide card in sheep and goats of different physiological status to detect and treat only those animals showing anaemia symptoms due to the gastro-intestinal nematode *Haemonchus contortus*:** The FAMACHA<sup>®</sup> method was tried in NARI flocks since September 2012 since *Haemonchus contortus* is the predominant (70-95%) nematode species found in NARI's and smallholders' animals. This system helps to minimize the use of anthelmintics with a view to reduce the chances of



development of anthelmintic resistance in worms. The FAMACHA<sup>®</sup> method was developed by the South African scientist Dr. Francois Fafa Malan in 1992. He developed a chart with pictures of sheep conjunctivae classified into five categories ranging from normal or red (1), through pink to practically white (5) in severe anemia which generally correspond to the *Haemonchus* burden the animal is carrying. The colour inside the animals' eyelid is matched with the FAMACHA score card. *Haemonchus*, being a blood-sucking parasite, causes anaemia in sheep and goats which is detected using the FAMACHA<sup>®</sup> chart. It is advised that only the animals with a FAMACHA score  $\geq 3$  should be dewormed.

In Sept 2012 the first FAMACHA<sup>®</sup> observations were done at NARI on sheep and goats of different physiological status, maintained under separate management. The study was conducted on 32 crossbred breeding rams, 44 weaned lambs aged 4-5 months, 56 parturient ewes (lambd one month before) and 36 does. Faecal Worm Egg Count (FEC) and Packed Cell Volume (PCV) were measured and the animals were visually scored for anaemia using the FAMACHA<sup>®</sup> anaemia guide.

### Findings :

1. 77 to 83% of the animals from different groups had eye colours corresponding to a picture in the FAMACHA<sup>®</sup> chart. However, considering that 17 to 23% of the animals' eye colour did not match any of the pictures in the chart, a different chart needs to be prepared for Indian goats and sheep.
2. The FEC of all animals were generally higher compared to those given by Malan *et al.* (2001) for each FAMACHA score category. This means that our animals did not have the degree of anaemia predicted for the parasite burden they were carrying or that our animals were more resilient to the worm infection than those in South Africa which formed the basis for the FAMACHA chart.
3. The PCV of animals generally matched the PCV levels given by Malan *et al.* (2001) for each FAMACHA score category. Some animals, however, had higher PCV levels although their eye colour showed a greater degree of anaemia.
4. We now routinely inspect animals' eye colour according to the FAMACHA method and usually deworm only those animals showing signs of anaemia. We are thus able to reduce the expenditure on deworming by minimizing the use of dewormers and have also reduced the chances of the development of anthelmintic resistance in worms.

**A herbal dewormer trial :** A trial was conducted using a herbal dewormer which was supplied to AHD by an NGO SEVA from Tamil Nadu who had found the dewormer to be effective against GI nematodes in ruminants. The mixture contained the following herbs: one kg each of Nochi (*Vitex negunda*) leaves, Peenari changu (*Clerodendrum inerme*) (or *Adhatoda vasica*) leaves, Chothukathalai (*Aloe vera*) leaves, Neem seeds and *Calotropis* leaves ground together with water.

The trial was conducted on rams and bucks at Wadjal farm in August 2012. Twenty four animals were divided in three groups, each comprising 6-7 crossbred rams and 1-2 bucks. Pre-drench FEC was recorded of all the animals in the trial. One group of eight animals was drenched with the chemical drench Ivermectin (Hitek<sup>TM</sup> @ 0.25 ml/kg body weight), another group of eight animals was drenched with 30 ml each of the said herbal dewormer, and the

remaining eight maintained as a control group. Post drench FEC was measured on day 12. Following were the results obtained:

Group	Number of animals	Mean Faecal Egg Count (epg)	
		Pre-drench	Post-drench (day 12)
Chemical dewormer	8	1757	0
Herbal dewormer	8	1800	2044
Control group	8	1742	1400

The herbal dewormer was thus found to be ineffective against gastro-intestinal nematodes.

### I. NEWS ITEMS AND TV BROADCASTS ON NARI

1. A 4 page feature story on Dr. Anil Rajvanshi was published in June 2012 issue of [Harmony magazine](#). Harmony Magazine is edited and published by Tina Ambani.
2. Dr. Anil Rajvanshi was featured in [Pan IIT alumni newsletter](#) as one of the 18 social entrepreneurs who are transforming India. Vol. 2, Issue 2, August 2012.
3. Anil K. Rajvanshi's half hour interview on Sustainable Development was broadcast by All India Radio, Nashik on 24 October 2012.
4. An 11 page feature story (in Marathi) on NARI's work was published in Diwali special issue of [Saptahik Sakal](#), November 2012.
5. Front page story on lanstove came in [Daily Sakal](#), 31 January 2013.
6. A feature story on Dr. Anil Rajvanshi's journey from IIT Kanpur to America and back to rural India was [written by the President of IIT Kanpur Alumni Association and published on IITK alumni site](#), February 2013.
7. An eight minute story segment on NARI's research was broadcast by SAM TV (Sakal group) on 1 February 2013.
8. An article on Food and Energy security written by Dr. Anil K Rajvanshi was published as [Cover Story in Change for Better magazine](#).
9. A news story on NARI's research in water sterilization was syndicated by IANS and appeared in many mass and electronic media. It was carried in [MSN news website](#), Daily Mail of UK, [India Today](#), and dozens of other leading news sites, 8 February 2013.
10. A half page feature story on NARI's kerosene lanstove appeared in [The Statesman](#) newspaper on 21 February 2013.

## **II. PUBLICATIONS** (In Alphabetical Order)

### **Refereed publications :**

1. Ghalsasi, P. P., Saste, S. R., Ghalsasi, P. M. and Nimbkar, C. 2012. Detection of emerging Benzimidazole resistance in nematodes in sheep and goats in an organized farm and some smallholder flocks in Phaltan Taluka, Maharashtra. *Journal of Veterinary Parasitology*. 26 (2) : 95-98.
2. Nimbkar, C. and Ghalsasi, P. M. (SA PPLPP) 2012. Small ruminant rearing: Breed conservation and genetic improvement. A report written for the South Asia Pro Poor Livestock Policy Programme, a joint initiative of NDDDB and FAO, New Delhi, India. pp. 69.  
<http://sappplpp.org/goodpractices/smallruminants/small-ruminant-rearing-breed-conservation-and-genetic-improvement>
3. Nimbkar, C. 2013. Sustainable Improvement in Sheep Productivity in India Using the *FecB* (Booroola) Mutation. *In Press*. In *Biotechnologies at Work for Smallholders: Case Studies from Developing Countries in Crops, Livestock and Fish*. Edited by J. Ruane, J. D. Dargie, C. Mba, P. Boettcher, H. P. S. Makkar, D. M. Bartley and A. Sonnino. FAO.
4. Nimbkar, N. and Rajvanshi A. K. "Simple filtration and low temperature sterilization of water", *Current Science*. 25 Feb. 2013. 104 : 519-522.
5. Saste, S. R., Ghalsasi, P. M., Kataria, R. S., Joshi, B. K., Mishra, B. P. and Nimbkar, C. 2012. ARMS-PCR as an alternative, cost effective method for detection of *FecB* genotype in sheep. *Indian Journal of Biotechnology*. 11 : 274-279.

### **Non-refereed publications :**

1. Nimbkar C. Profile : Osmanabadi Goat Breed conserved by Shri Dnyandev Shankar Shinde. 2012. In *Breed Keepers and best practices: Linking breeds, traditional knowledge, natural resources and institutions*. Sustainable Agriculture and Environmental Voluntary Action (SEVA), Madurai, Tamil Nadu. pp.50-52.
2. Nimbkar C. Profile: Osmanabadi Goat Breed conserved by Shri Arjun Manikrao Demunde. 2012. In *Breed Keepers and best practices: Linking breeds, traditional knowledge, natural resources and institutions*. Sustainable Agriculture and Environmental Voluntary Action (SEVA), Madurai, Tamil Nadu. pp. 53-54.
3. Nimbkar, C. 2012. Biotechnology for the benefit of smallholder sheep owners in the context of a theory of livestock breed improvement. Sixth Dr. C. M. Singh Memorial Lecture delivered at Indian Veterinary Research Institute on 30 November 2012. Dr. C.M. Singh Endowment Trust, Bareilly, Uttar Pradesh, India. pp.18.
4. Rajvanshi, Anil K. "Simple living, high thinking", Article in *Speaking Tree*, Times of India, April 15, 2012.
5. Rajvanshi, Anil K. "Reaching for the stars", Article in *Speaking Tree*, Times of India, May 13, 2012.

6. Rajvanshi, Anil K. “Rural restaurants for food security and jobs too”, Syndicated article by IANS and published on many news websites like [Yahoo News](#) etc., May 16, 2012.
7. Rajvanshi, Anil K. “Trees as spiritual antennas”, A blog on Speaking Tree website, May 24, 2012.
8. Rajvanshi, Anil K. “Layers of reality”, A blog on Speaking Tree website, June 13, 2012.
9. Rajvanshi, Anil K. “What should be the true price of electricity”, June 2012. A discussion paper submitted to MERC.
10. Rajvanshi, Anil K. “Mental peace and cell phones”, Article in Speaking Tree, Times of India, September 16, 2012. This article was featured in TED conversations.
11. Rajvanshi, Anil K. [“Neurological basis of ego and anger”](#), A blog on Speaking Tree website, October 6, 2012.
12. Rajvanshi, Anil K. “Conquering greed”, Sajag, Vol. XX, Page 13. Oct. 2012, Published by ONGC, New Delhi.
13. Rajvanshi, Anil K. “K. C. Pant - an eulogy”, Nov. 2012.
14. Rajvanshi, Anil K. “Energy and food security – The way forward”, Cover story in Change for Better, January 1, 2013.
15. Rajvanshi, Anil K. “When you give back to society”, Op-Ed article in Times of India, January 21, 2013.
16. Rajvanshi, Anil K. “Blessed by a thought for God”, Article in Speaking Tree, Times of India, February 3, 2013.
17. Rajvanshi, Anil K. “Is deep sleep like meditation ?”, Op-Ed article in Times of India, March 4, 2013.

### **Reports :**

1. Nimbkar, C. May 2012. Third Annual Report of ‘Osmanabadi Goat Field Unit at NARI’ under the All India Coordinated Research Project (AICRP) on Goat Improvement of Indian Council of Agricultural Research (ICAR) for the period 1 April 2011 to 31 March 2012. Submitted to the Director, Central Institute for Research on Goats, Makhdoom, U.P.
2. Singh, V. July 2012. Annual Progress Report of Frontline Demonstrations in Safflower. Submitted to the Directorate of Oilseeds Research (DOR), Hyderabad. 47 pp.
3. Singh, V. July 2012. Annual Progress Report of All India Coordinated Research Project on Oilseeds (Safflower). Submitted to the Directorate of Oilseeds Research (DOR), Hyderabad. 68 pp.
4. Nimbkar, C. October 2012. Combined three-year report of ‘Osmanabadi Goat Field Unit at NARI’ under the ‘AICRP on Goat Improvement’ of ICAR for the period 1 April 2009

- to 31 March 2012. Submitted to the Director, Central Institute for Research on Goats, Makhdoom, U.P.
5. Rajvanshi, A. K. October 2012. Annual Progress Report on Lanstove Project, submitted to the Department of Science and Technology, DST, New Delhi.
  6. Nimbkar, C. November 2012. Final report of the completed collaborative project between NARI and the National Bureau of Animal Genetic Resources (NBAGR) funded by the Department of Biotechnology (DBT), Ministry of Science and Technology, Government of India, "Increasing profitability of sheep production by genetic improvement using the *FecB* (Booroola) mutation and improved management" for the period 25 March 2009 to 25 March 2012.
  7. Nandeshwar, B. C. April 2013. Annual Progress Report of All India Coordinated Sorghum Improvement Project. Submitted to the Directorate of Sorghum Research (DSR), Hyderabad. 95 pp. for the period 1 April 2012 to 31 March 2013.
  8. Nimbkar, C. 2013. Potential implications on sheep husbandry of the study under the DBT-funded project "Increasing profitability of sheep production by genetic improvement using the *FecB* (Booroola) mutation and improved management" p.1.

### **III. INVITED TALKS/LECTURES**

1. Anil K. Rajvanshi, "Rocket science for rural development", an invited talk given to faculty and students of Mechanical Engineering Department, IIT Bombay in April 2012. During this visit Dr. Rajvanshi also had an hour long meeting with the faculty of Energy Research Department.
2. K. M. Chavan "Goat rearing and management" a lecture given in the workshop on Animal rearing and management organized by Sphurti Tarun Mandal of Bibi village, Taluka Phaltan, District Satara, 10 April 2012.
3. Anil K. Rajvanshi, "Wholesome food for rural poor - Need to set up rural restaurants", presented in workshop entitled Paths of convergence for Agriculture, Health and Wealth. Funded by Bill Gates Foundation and organized by McGill World Platform for Health and Economic Convergence, Canada and The INCLEN Trust International, New Delhi, 22-24 June 2012, New Delhi.
4. Pradip Ghalsasi "Boer goat" a lecture given to about 1500 farmers in the seminar Goatery-2012 organised by Royal Livestock Technologies, Coimbatore, Tamil Nadu, 4-5 August 2012.
5. Chanda Nimbkar, "Breeding strategies and challenges in increasing fecundity of sheep breeds in India" an invited lecture given at a one day workshop on *FecB* gene and breeding strategies for increasing fecundity in sheep breeds of Tamil Nadu held on 6 September 2012 at Madras Veterinary College, Chennai. The Workshop was presided over by Dr. Prabakaran, the Vice Chancellor of the Tamil Nadu Veterinary and Animal Science University.
6. Chanda Nimbkar "Regional status of sheep and goat enterprises and strategies for growth in Maharashtra" an invited presentation given in the meeting of the 'Sub Committee on Agriculture, animal husbandry, dairy and fishery' of the Dr. Vijay Kelkar Committee

formed by the Government of Maharashtra' to identify indicators of regional imbalance and suggest the ways for 'Balanced Development of Maharashtra' held at Yashada, Pune on 16 September 2012.

7. Anil K. Rajvanshi, "[Innovations for rural poor](#)", Keynote address in International Conference entitled Towards a better Innovation Ecosystem, organized by the Indian National Academy of Engineering, 20-21 September, 2012, India International Center, New Delhi. This was a part of Silver Jubilee Celebration of National Academy of Engineering. Dr. Rajvanshi was one of the 16 speakers which included Dr. Sam Pitroda, Dr. R. A. Mashelkar, Dr. Arun Maira, Dr. R. C. Chidambaram, etc.
8. Nandini Nimbkar, "Mahilanche Shetimidheel Yogadan" a talk given in a women's gathering arranged by the Ideal Rural Development Society, Phaltan. The gathering was chaired by Mrs. Sattvasheela Prithviraj Chavan on 29 October 2012.
9. Anil K. Rajvanshi, "Energy technologies for rural areas", Invited talk given to faculty and students of Babu Banarasi Dass Institute of Technology, Gaziabad, 3 November 2012.
10. Chanda Nimbkar, the Sixth Dr. C. M. Singh Memorial Lecture on "Biotechnology for the benefit of smallholder sheep owners in the context of a theory of livestock breed improvement" delivered at Indian Veterinary Research Institute, Izatnagar, U.P. on 30 November 2012.
11. Anil K. Rajvanshi, "Sweet sorghum R&D at NARI", An invited talk given at one day meet entitled "Brainstorming for future of Sweet Sorghum in India", organized by ICRISAT, Hyderabad on 17 December 2012.
12. Anil K. Rajvanshi, "Have Junoon be Happy", [Gymkhana lecture given to students of IIT Kanpur](#) as a part of Techkriti 2013 festival, 16 March 2013.

#### **IV. CONFERENCES/SEMINARS/MEETINGS/WORKSHOPS ATTENDED BY STAFF (In Chronological Order)**

1. Dr. Chanda Nimbkar attended the meeting of the judging committee (as a member) for the 'Punjabrao Deshmukh Outstanding Woman Scientist Award 2011' of the Indian Council of Agricultural Research at Krishi Bhawan, New Delhi on 18 April 2012. There were 20 applications submitted for this award.
2. Dr. Vrijendra Singh and Mr. Vilas Bhagwat attended the 42<sup>nd</sup> Annual Group Meeting (AGM) of the All India Coordinated Sorghum Improvement Project (AICSIP) held on 28-30 April 2012 at the G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand and presented the annual progress report of the AICSIP centre at NARI.
3. Dr. Chanda Nimbkar attended the Committee meeting of the 'Network Project on Sheep Improvement and Mega Seed Project' organised to 'recommend and suggest suitable uniform management and feeding practices for farm-based units' at Central Sheep and Wool Research Institute, Avikanagar, Rajasthan on 18 June 2012.

4. Dr Chanda Nimbkar participated, as a member of the Governing Body of ICAR, in an informal discussion with the Minister of Agriculture and Food Processing, Government of India, Hon. Shri. Sharad Pawar on 20 June 2012 at Krishi Bhawan, New Delhi.
5. Dr. Chanda Nimbkar as a member attended the Institute Management Committee (IMC) meeting of the Project Directorate on Foot and Mouth Disease held at Mukteswar on 4 July 2012.
6. Dr. Vrijendra Singh and Mr. Mukund Deshpande attended the Annual Group Meeting of Safflower and Linseed of the All India Coordinated Research Project (AICRP) on Oilseeds held on 6-8 September 2012 at the Indira Gandhi Krishi Vishwa Vidyalaya, Raipur, Chhattisgarh and presented the annual progress report of the safflower research at NARI.
7. Dr. Chanda Nimbkar chaired a session at the 'XXVI Annual Convention of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases and International Seminar on Future of Livestock Health: A Paradigm Change to Maximize Productivity for International Economic Gains' held at Madras Veterinary College, Chennai, T.N. on 6-8 September 2012.
8. Dr. Anil Rajvanshi and Mr. Ashwin Pawade attended Group monitoring workshop of the Department of Science and Technology (DST) held at Birla Science and Technology Institute, Jaipur on 3-5 October 2012. Dr. Rajvanshi presented the annual report of DST-funded research project entitled "Kerosene lanstove for rural areas" for the period 1 October 2011 to 31 September 2012.
9. Dr. Chanda Nimbkar attended the 'Annual Review Meet-2012-13' of the All India Coordinated Research Project on Goat Improvement held on 1-2 November 2012 at the Central Institute for Research on Goats, Makhdoom, U.P. and presented the annual progress report of the Osmanabadi Goat Field Unit at NARI-AHD.
10. Dr. Nandini Nimbkar attended the meeting Second of the Research Advisory Committee of the National Institute of Abiotic Stress Management (NIASM) on 19 November, 2012.  
  
She also visited the experimental fields at NIASM and the Agricultural Development Trust, Shardanagar with other RAC members. The members were also shown the progress of construction of administrative building and residential sites.
11. Dr. Chanda Nimbkar attended the meeting of the Task Force on Animal Biotechnology-I of the Department of Biotechnology (DBT) held at SK University of Agricultural Sciences and Technology of Kashmir, Jammu on 5 December 2012. She presented the final report of the DBT-funded research project entitled "Increasing profitability of sheep production by genetic improvement using the *FecB* (Booroola) mutation and improved management" for the period 25 March 2009 to 25 March 2012.
12. Dr. Anil K Rajvanshi attended the State Advisory Committee meeting of Maharashtra Electricity Regulatory Commission (MERC) meeting in Mumbai on 28<sup>th</sup> December 2012.
13. Dr. Chanda Nimbkar attended the meeting of the Research Advisory Committee of the National Bureau of Animal Genetic Resources, Karnal, Haryana on 4 February 2013.

14. Dr. Chanda Nimbkar as a member attended the Board of Management meeting of the National Dairy Research Institute (NDRI), Karnal, Haryana on 15-16 February 2013. She visited the cattle yard and cloned animal section at NDRI.
15. Dr. Chanda Nimbkar, as a member, attended the Governing Body meetings of ICAR Society and Regional Committee Meetings of ICAR, New Delhi held during the year 2012-13.

## **V. TRAINING AND EXTENSION ACTIVITIES**

### **Training manuals published by the AHD :**

1. Training manual in Hindi 'Goat and sheep management and artificial insemination in goats'. 2012. Nimbkar Agricultural Research Institute, Animal Husbandry Division. p.30.
2. Training manual in English 'Goat and sheep management and artificial insemination in goats'. 2013. Nimbkar Agricultural Research Institute, Animal Husbandry Division. p.38.

**Training :** During the year NARI conducted the following seven training courses.

<b>Date</b>	<b>Subject</b>	<b>Participants</b>
23-28 July 2012	Goat management and Artificial Insemination in goats.	Six 'Gopal Mitra' (social workers) working under watershed and other development programs of BAIF Development Research Foundation, Patna, Bihar. One more candidate from Mumbai attended this course.
2 November 2012 and 19 January 2013	First aid in sheep and goats. (Two courses)	Six project staff of All India Coordinated Research Project on Goat Improvement – Osmanabadi field unit at NARI.
9-10 November 2012	Oestrus synchronization, artificial insemination and <i>FecB</i> carrier sheep management.	Dr. A. Krishnaswamy, Professor and Head, Department of Veterinary Gynaecology and Obstetrics, Veterinary College, Hebbal, Bangalore.
15-16 January 2013	Sheep and goat management	Ten farmers and two Government Veterinary Officers from Taluka Sira, Dist. Tumkur, Karnataka
18-19 February 2013	Laparoscopy in goats and sheep	Two Asst. Professors Dr. G. Sudha and Dr. B. M. Ravindranath from Veterinary College, Bangalore and one Asst. Professor, Dr. Roopa Devi Y.S. from Livestock Research and Information Centre, Nagamangala, Karnataka.
26-27 February 2013	Improved technology of crop production for sweet sorghum, safflower and	CAT-exposure visit and training of 24 participants arranged by the NGO Siddhidatri Vikas Evam Samraddhi Sansthan, Sehere, Madhya Pradesh



	renewable energy	(supported by NABARD) including three functionaries of the NGO.
28 February 2013	Stall-fed and partially grazed sheep and goat management	Exposure visit of 24 participants from Sehore and Dewas arranged by Siddhidatri Vikas Evam Samraddhi Sansthan, Sehore, Madhya Pradesh.

### Volunteers :

The following interns were trained at the Institute during last year.

Sr. No.	Country	Name	Place	Duration (months)	Purpose
1.	India	Mr. R. R. Nalawade	Padmashree D. Y. Patil College of Agricultural Engineering & Technology, Talsande, Dist. Kolhapur	4	Small grain thresher, improved biomass cookstoves, Lanstove-testing
2.		Mr. R. L. Dombale			
3.		Ms. S.R. Pawar			
4.		Ms. V. N. Mane			
5.		Ms. S. R. Jaybhay			
6.		Mr. Ashutosh Anand	Department of electrical and other energy sources, College of Agricultural Engineering and Technology, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri	4	Economic analysis of research farm data, Lanstove-testing
7.		Mr. Aniket More			
8.	France	Mr. Pierrick Fossez	ICAM (Engineer School), Toulouse	4	3-D drawings of Lanstove
9.	Ireland	Mr. Jack McCarthy	M.Sc. Environment Culture and Society, Univ. of Edinburgh	2	Making of NARI website
10.	France	Ms. Rachel Nannette	ESIGELEC (Specialist school of engineering), Le Madrillet	4	Testing of Lanstove

### Extension activities :

**A. i) 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>FecB<sup>BB</sup></i>	<i>FecB<sup>B+</sup></i>	<i>FecB<sup>BB</sup></i>	<i>FecB<sup>B+</sup></i>
1.	5 May 2012	Dr. Giridhar Rahul, Bapatla	-	4	7	13

		Andhra Pradesh				
2.	2 September 2012	Sudha Livestock Farms Tamil Nadu.	1	-	3	1
3.	14 September 2012	College of Food and Agricultural Sciences, King Saud University, Riyadh, Saudi Arabia	-	1	-	1
4.	9 November 2012	Post Graduate Research Institute in Animal Sciences, Kattupakkam, Tamil Nadu	12	-	-	-
5.	19 January 2013	Mr. Melwyn Lewis Harohalli, Bangalore	4	-	5	5
6.	21 January 2013	RKVY Project- Department of Veterinary Gynaecology and Obstetrics, Veterinary College, Hebbal, Karnataka	4	-	5	45
7.	8 March 2013	Mr. V. Ramesh Palur Village, Chennai, Tamil Nadu	1	-	-	5
Total			22	5	20	70

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

- ii) NARI-AHD succeeded in exporting two *FecB* carrier Awassi sheep (1 male, 1 female) to Saudi Arabia on 14 September 2012. This resulted from the visit of Prof. Abdullah Alowaimer from College of Food and Agricultural Sciences, King Saud University, Riyadh, Saudi Arabia to AHD in January 2011. He was given training in laparoscopic insemination in sheep and also given consultancy on the appropriate breeding program for *FecB* gene introgression. He showed interest in purchasing Awassi lambs which were carriers of the **FecB** gene.

Prior to dispatch of the animals they were tested by the Disease Investigation Laboratory, Pune and CADRAD, IVRI, Bareilly and Mukteswar as per the quarantine requirement of the Saudi government. Both animals were found negative. A health certificate was provided accordingly.



Two *FecB* carrier Awassi sheep were exported by AHD for breeding to the King Saud University in Riyadh, Saudi Arabia. This photo shows them with NARI staff at Mumbai airport.

## **B. Dissemination of NARI Nirbeeja hybrid *Leucaena* grafted plants**

During this year 77 'NARI Nirbeeja' (KX2 hybrid subabhoor) grafted plants were supplied to various institutions and farmers. The following farmers/institutions purchased more than three plants each.

1. J. K. Papers Ltd., Songad, Gujarat – 5 plants. These plants were derived from rooted cuttings which were developed in the green house of AHD.
2. Shri Namdeo Hanumant Madane, Malshiras, Dist. Solapur – 4 plants
3. Shri Digvijay Singh, Nahvi Sandas, Dist. Pune – 4 plants
4. Shri Jayant Mahadu Shinde, Khopoli, Dist. Raigad. – 4 plants
5. Shri Suraj Rajendra Raut, Tirakwadi, Dist. Satara – 4 plants
6. Shri Dattatraya Hanumant Shinde, Kalaj, Dist. Satara – 5 Plants
7. Shri Sachin Balu Shinde, Dist. Satara – 5 Plants
8. Shri Mangesh Patil, Dabhadi, Dist. Buldhana – 4 plants

AHD planted 389 "NARI Nirbeeja" grafted plants during 2012-13 on its own farms.

## **C. Dissemination of seeds and other products**

During this year more than 10 Kg dried safflower flowers were test-marketed as herbal health tea. Nearly 300 Kg 'Madhura' sweet sorghum syrup was also test-marketed. About 750 Kg seed of Madhura sweet sorghum hybrid was disseminated including 600 Kg to Arya energy Ltd. of Raipur, (Chhattisgarh). There was demand for more seed which could not be fulfilled due to shortage of seed. About 850 Kg seed of safflower hybrids (NARI-NH-1 and NARI-H-15) and safflower varieties (NARI-38, NARI-6, Nira, NARI-52 and NARI-57) was distributed including 350 Kg to Marico Ltd., Mumbai.

- D. Weather data was supplied to M/s Kay Bee Exports, India's largest exporter of pomegranates. Several persons made use of the library facilities during the year.

## **VI. TRAINING RECEIVED BY NARI STAFF**

1. Dr. Pradip Ghalsasi and Ms. Padmaja Ghalsasi attended the workshop organized by IMV India Ltd. to train participants in 'Use of IMV equipment for semen freezing and solve difficulties of the users of this equipment' on 5-6 October 2012 at Dama Lab, Palanpur, Gujarat. About 25 participants from three regions Gujarat, Rajasthan and Maharashtra attended this workshop. Mr. Joel Grosos, Technical Director of IMV, France was present. IMV demonstrated their newly launched machinery in semen freezing – straw counting, filling and sealing inside a cold handling cabinet and straw thawing. Lectures on various software programmes for semen analysis such as CASA – Computer Assisted Sperm Analyser were organized.

A group discussion was held with Mr. Joel Grosos where delegates actively participated in discussing functioning and minor problems of their machines. This session proved useful to us, especially regarding the maintenance of the straw printer and its ink


consistency. A visit to the commissioned AI laboratory at Banas Cattle Dairy was organized which was informative. The participants saw how all the equipments were arranged for smooth working of the laboratory. Importance of separate rooms for media preparation, filling and sealing, sterilization and quality control was explained. This will also prove useful when the AHD designs its separate laboratory for semen freezing. Dr. and Ms. Ghalsasi found the technical IMV team in India cooperative and the visit very worthwhile.

2. Mr. Rupesh Khanvilkar, Livestock Farm Manager, of AHD-NARI is trained in sheep shearing. To improve his technique he was given some additional training in sheep shearing and sharpening of combs and cutters by Mr. Tim Bowden from Western Australia during his visit to AHD on 25 January 2013. Mr. Bowden had nearly 6,000 sheep and therefore a lot of practical knowledge of sheep management and shearing. He also gave some suggestions regarding the design of an ideal sheep race.

## **VII. VISITORS TO THE INSTITUTE**

### **1. Visits by individuals during the year to see research and development activities**

Sr. No.	Date	Visitor's name	Visitor's organization	Purpose of visit
1.	10 April 2012	Mr. Rajendra S. Rite	Malegaon	Get information on the rickshaw for the handicapped.
2.	17 April 2012	Mr. Ashok Benegal	Pune	He had discussions with Dr. Anil K. Rajvanshi and Dr. Nandini Nimbkar about planning programme at BCSD.
3.	17-18 April 2012	Dr. B. L. Chidananda and Mr. K. C. Alex	Dept.of Animal Sciences, University of Agricultural Sciences, Veterinary College, Bangalore and India Representative- Y. N. Antoniadis & Sons Ltd, ( Breeders & Exporters of Cyprus Shami Goats, Cyprus) respectively.	They had discussions with Shri B.V. Nimbkar, Dr. Pradip Ghalsasi and Shri Zia Quraishi regarding goat breeding in India and import of frozen semen of Shami goats into India. Dr. Ghalsasi showed them the semen freezing laboratory of AHD.
4.	18 April, 2 May and 27 July 2012.	Mr. O. P. Shukla, Sr. General Manager (R.M.), Mr. Surendra Narkhede and Mr. R. K. Khare	J.K. Paper Ltd., Fort Songadh, Gujarat	<p>They were directed by BAIF to see the seedless and psyllid-resistant hybrid <i>Leucaena</i> being propagated by NARI . They wanted to see the girth of the mature 'NARI Nirbeeja' trees to assess its suitability to obtain cellulose for paper. Ms. Padmaja Ghalsasi gave them detailed information. They had discussions with Shri B.V. Nimbkar regarding propagation of this plant, their requirement of such seedless <i>Leucaena</i> and training of their personnel in grafting or rooting.</p> <p>They paid two more visits to AHD. They had discussions with Dr. Chanda Nimbkar about their</p>

				requirement and further collaboration in the propagation of 'NARI Nirbeeja'.
5.	4 May 2012	Mr. Vikram Bedekar, Metallurgist	Timken Research,USA	See the renewable energy and animal husbandry work.
6.	4 May 2012	 Dr. Swapan K. Datta D.D.G. (Crops)	Indian Council of Agricultural Research, New Delhi	See the agricultural research work being carried out at the institute.
7.	7 May 2012	Mr. Gyanesh Pandey	Husk Power System, Patna, Bihar	Get information about the biomass gasifier.
8.	9 May 2012	Mr. Sunil Patil, TA and Mr. Gurjeet Singh, Tech	Northern Region Farm Machinery Training and Testing Institute Mechanical and Technology Division, Hissar, Haryana	Assess problems with laser-levelled plots at NARI. They looked at all the plots with Dr. Nandini Nimbkar and Mr. Sharad Choudhari and pointed out the problems with the levelling carried out by Mr. Kalyan Kulkarni.
9.	9 May 2012	Mr. Dilip Majgaonkar, Ms. Mrinalini Naniwadekar - Reporters	Rajhans Prakashan, Mumbai, and Sakal, Mumbai respectively.	Get information about the AHD's activities.
10.	12 May 2012	Dr. Suhas G. Shukla, Program Co-ordinator	Agri-based livelihood projects of Suzlon Foundation, Daman	He had a discussion with Shri B.V. Nimbkar about the dissemination of improved goats and sheep in rural areas.
11.	16 May 2012	Mr. Haresh Patel	Harmony Magazine, Mumbai	Photosession for magazine article on Dr. Anil Rajvanshi.
12.	18 May 2012	Mr. Ravichandran, Global head,	Cummins, Pune	See if Lanstove can be spread as a part of

		CSR		Cummins CSR activities.
13.	19 May 2012	Dr. P. R. Somani and Mr. A. Nene	Applied Science Innovations Private Ltd., Pune	Scientific discussion with Dr. Anil Rajvanshi.
14.	23 May 2012	Mr. Amitabh Tripathi + 2 colleagues	Indovision Media, Mumbai	Make a short film on NARI's research activities.
15.	25 May 2012	Nazim Furniturewala	Mumbai	For discussions on gasification.
16.	30 May 2012.	Mr. N. N. Londhe	Superintendent, District Vocational Training Centre, Satara.	Dr. Chanda Nimbkar and Ms. Bharati Pawar gave him information about the training programmes of AHD in sheep and goat rearing that can be organised for women under training programmes of their Vocational Training Centre.
17.	7 June 2012	Mr. N. N. Londhe	-??-	Dr. N. Nimbkar gave him information about the programmes on renewable energy and agriculture where apprentices can be trained.
18.	13 June 2012	Dr. P. S. Minhas (Director), Dr. Jagadish Rane (Head, Division of drought stress management)	National Institute of Abiotic Stress Management (NIASM), Baramati.	See the research facilities and activities of NARI.
19.	14 June 2012	Mr. Anushman	Pashan, Pune	
20.	27 June 2012	Dr. P.S. Minhas, Director	National Institute of Abiotic Stress Management (NIASM), Baramati	Familiarize himself with the activities of AHD.
21.	29 June 2012	Mr. A. V. Rane	Wivre Bk, Tal. Raver, Dist. Jalgaon	Get information about sweet sorghum.
22.	3 July 2012	Mr. N. D. Pharande	Nimbut, Tal. Baramati, Dist. Pune	Get information about sweet sorghum.
23.	20 July 2012	Dr. P.K. Shukla,	Veterinary University, Mathura, U.P.	Get information about the AHD's research and development work in sheep and goats.
24.	20 July 2012	Mr. P. S. Kiran Kumar, Mr. B. Srinivasa Prasad,	Vijayawada, Andhra Pradesh	Get information about sweet sorghum.

		Mr. P. Venkata Subbarao		
25.	28 July 2012	Mr. Dipak Pralhad Chavan, MLA, Phaltan Constituency	Taradgaon, Tal. Phaltan	See sheep and goat farm of AHD.
26.	30 July 2012	Mr. Manoj Sharma	Omnikan, Mumbai	Purchase seed of non-spiny safflower to encourage farmers in Karnataka to cultivate it.
27.	11 August 2012	Mr. Hrishikesh Ahirrao, Mr. Yogesh Ahirrao, Mr. Pralhad Ahirrao	A/P : Dhadane, Tal. Sakri, Dist. Dhule	Get information about sweet sorghum.
28.	17 August 2012	Mr. Ganesh Yadav	A/P : Akluj, Tal. Malshiras	Get information about NARI.
29.	23 August 2012	Mr. N. M. Madhekar	Pune	Give consultancy to NARI on projects.
30.	8 September 2012	Maj. Gen. T. M. M. Gaisale	Pune	Get information about NARI.
31.	20 September 2012	Dr. Aditi Pant, Former Head	Biochemical Sciences, National Chemical Laboratory, Pune, M.S.	Get information about AHD's activities.
32.	25 September 2012	Dr. A. V. Umakanth, Breeder Dr. D. Shivani, Breeder Dr. Ameer Basha, Pathologist	DSR, Hyderabad ARS, Tandur ARS, Palem	Monitoring team to look at AICSIP sorghum research programme of Kharif 2012.
33.	2 October 2012	Dr. Rishendra Verma, Joint Director (Research)	National Dairy Research Institute, Karnal, Haryana	Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi gave him information about the research and development work carried out at AHD.
34.	6 October 2012	Dr. Ratna Kumar Pasala Dr. P. Suresh Kumar	NIASM, Baramati	Take <i>Opuntia</i> pads & sweet sorghum seed.
35.	6 October 2012	Mr. K. Vishnuprakash, Fellow	Tata Institute of Social Sciences, Mumbai (working under the Rural Transformation Fellowship Programme in village Nimbhore in Phaltan Taluka)	Get information about the sheep and goat development activities of AHD.



36.	13 October 2012	Mr. Jodhbir Singh	Pune	Get information on electric rickshaws developed at NARI.
37.	16 October 2012	Mr. N. M. Madhekar and Mr. R. M. Datar	Pune and Mumbai	Provide consultation to NARI on projects.
38.	20 October 2012	Dr. C. Renukprasad, Vice Chancellor and Dr. Nadeem Fairoze, Professor and Head	Karnataka Veterinary, Animal and Fisheries Sciences University (KVAFSU), Bidar and Department of Livestock Products Technology, Veterinary College, Hebbal, Karnataka respectively	They had discussions about the collaboration. between KVAFSU and NARI with Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi..
39.	22 October 2012	Mr. K. Vishnuprakash, Fellow	Tata Institute of Social Sciences, Mumbai	He discussed the rural transformation programme he was involved in at village Nimbhore with Dr. Anil Rajvanshi and Dr. Nandini Nimbkar and explored how NARI's work can be used for it.
40.	25-27 October 2012	Dr. P. Kumarasamy together with four colleagues	Professor and Head, Department of Bioinformatics Centre & ARIS Cell, Madras Veterinary College, Chennai, Tamil Nadu	They wanted to purchase <i>FecB</i> homozygous rams under Central Sector Scheme to be implemented at Tamil Nadu Veterinary and Animal Sciences University. They tested the <i>FecB</i> carrier rams available for sale at AHD for Tuberculosis and Johne's Disease (JD). They were shown around the farm and laboratories.
41.	29 October 2012	Mr. Santosh Kumar and Mr. Suhas Nikumbe	Marico Ltd., Bidar and Marico Ltd., Mumbai	Meeting with Dr. Vrijendra Singh to discuss safflower seed production.
42.	29 October 2012	Mr. Santhosh Kumar	Volunteer social worker, Patna, Bihar	He is promoting goat farming among more than 2000 families in Patna and wanted to familiarise himself with the AHD's work in sheep and goat development.
43.	30 October 2012	Mr. Santosh Masal	Basant Agro Seed company	He held discussions with Dr. Vrijendra Singh on seed production of NARI's safflower varieties.

44.	3 November 2012	Mr. Shirish Shah	Laxminagar, Phaltan	Visit to see the NARI activities.
45.	10 November 2012	1. Mr. Madhav Gogate (I.F.S.) Rtd., General Consultant, 2. Dr. Ramesh Rao, Principal Scientist, and 3. Dr. D.R. Bapat, Agricultural Consultant	1. Odisha Forestry Sector Development Project (OFSDP), Bhubaneswar, Orissa, 2. Directorate of Onion and Garlic Research, Rajgurunagar, Pune, M.S. 3. Maharashtra Association for Cultivation of Science, Pune respectively.	Discussions with Mr. B.V. Nimbkar and Dr. N. Nimbkar on the grass/pasture research project. They were shown the <i>Cenchrus</i> germ plasm at NARI and discussions were held on how to proceed in future.
46.	20 November 2012	Mr. Vishwas Kakade	Pune	Get information about sweet sorghum.
47.	27-28 November 2012	Mr. Vaibhav Tidke Mr. Rahul Aware Mr. Ashok Pingle Mr. Tushar Gaware Mr. Dilip Jadhav Mr. Swapnil Kokate	Institute of Chemical Technology (ICT/UDCT), Mumbai	Visit to familiarize themselves with the renewable energy work of NARI.
48.	30 November 2012	Mr. Bharat Karve Mr. Ajit Doddanavar Mr. R. B. Pattanshetti	Belgaum	Get information about the biomass gasifier.
49.	5 December 2012	Mr. Rajendra S. Rite	At Post : Malegaon, Tal. Baramati	Get information about the handicapped rickshaw.
50.	14 December 2012	Mr. Prashant Sarswat	Salt Lake City, USA	Meet Dr. Anil Rajvanshi and get information about his work at NARI.
51.	22 December 2012	Mr. A. V. Deshmukh	A/P : Manegaon, Dist. Solapur	Visit.
52.	24 December 2012	Mr. A. R. Kadam and Mr. V. S. Beldar	Karmayogi Engg. College, Pandharpur	Get information about gasifier.
53.	25 December 2012	Mr. P. S. Shinde	Intel Solar, Pune	Get information about ethanol stove.

54.	1 January 2013	Mr. Ramling Kalel	Geometric Ltd., Pune	Get information about sowing sweet sorghum on his farm at Barshi.
55.	4 January 2013	Mr. V. G. Shenoi, Project Development Consultant (waste management and renewable energy)	Gloucestershire, England	See the research and development work at NARI.
56.	4-5 January 2013	Dr. K.N. Prabhudeva, Director of Extension	Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka	Familiarize himself with the AHD's research and extension work.
57.	7 January 2013	Dr. Sunil Gokhale	Gangotri Eco Technologies Pvt. Ltd., Pune	Discussions on pyrolysis oil.
58.	9 January 2013	Mr. Arvind Bharadwaj, Head Technology & Auto-farm sector	Mahindra & Mahindra, Chennai	Collaboration on precision farming.
59.		Dr. Shivshankar Usturge, Dean together with five colleagues	Veterinary college, Bidar, Karnataka	Dr. Chanda Nimbkar and Dr. Ghalsasi gave information about the AHD's activities and showed them the farm. They had discussions regarding future collaboration between the two institutes.
60.	9 January 2013	Dr. Anand Singh Kushwah, Executive Officer together with four veterinary officers	M.P. Livestock and Poultry Development Corporation, Bhopal, M.P.	See the sheep and goat semen freezing laboratory at AHD. Ms. Padmaja Ghasasi showed them the laboratory.
61.	10 January 2013	Dr. P. S. Srinivas, Entomologist Dr. Jagdish Singh, Breeder Dr. P. C. Uke, Agronomist Dr. D. R. Murumkar, Pathologist	DOR, Hyderabad JNKVV, Ujjain PDKV, Akola Solapur	Monitoring team for evaluation of research in AICRP on safflower.
62.	11 January 2013	Ms. Varsha Kulkarni Mr. Amit Golwalkar Mr. Sunil (Cameraman) Mr. V. Deshpande (Reporter)	Sakal Papers, Pune SAAM Marathi, Pune Phaltan	Visit to get information on Dr. Anil Rajvanshi's work at NARI.

63.	17-18 January 2013	Prof. Pankaj Sood, Associate Professor	Veterinary Gynaecology and Obstetrics, DGCN College of Veterinary and Animal Sciences, Palampur, H.P.	Obtain information about semen collection, processing, storage, A.I. in goats and laboratory infrastructure. He was directed by the Secretary, Animal Husbandry, New Delhi to visit AHD. Dr. Pradip Ghalsasi showed him the semen freezing laboratory and provided him the required information.
64.	28 January 2013	Mr. Arvind Apte and Mr. Anand Patil	Vasundhara Panlot Vikas Yantrana, Pune and AFARM, Pune, Maharashtra	Get information of AHD's goat and sheep development work.
65.	29 January 2013	Mr. Chris Bakwin	Bozeman, Montana, USA	Visit to see NARI activities.
66.	7 February 2013	Mr. Nilesh Pawar Mr. Sagar Patil Mr. Shridhar Gaikwad	Nashik	See the institute.
67.	7 February 2013	Mr. Bhupendra Nirja	Phaltan	See the institute.
68.	13 February 2013	Mr. C. R. Kumar	Geetha Drugs Pvt. Ltd., Vijayawada, A.P.	See the institute.
69.	16 February 2013	Mr. M. Y. Shukla, Asst. Professor, Electronics and Communication Engineering Mr. Ashutosh Shinde Mr. Vikramsingh Kadam	Symbiosis Institute of Technology, Pune	Research discussion on the removal of weeds by machine in small land holdings through image processing detection.
70.	18 February 2013	Mr. Ashok Suryavanshi Ms. Shubhangi Suryavanshi	Pen, Dist. Raigad	See the institute.
71.	1 March 2013	Mr. L. le Roex Managing Director, Biomass Energy Enterprises C.C. and Mr. C. Cambray	South Africa	Research collaboration in the field of small farmer development growing sweet sorghum as a feedstock for bioethanol production.
72.	5 March 2013	Mr. Sagar Band and Mr. Shashank Tanksale	Satara	See the institute.
73.	7 March 2013	Dr. Babasaheb Desai + 2	Pune	NARI research information.

74.	18 March 2013	Mr. Sarvesh Kumar, Sr. Manager, Corporate strategy & Business Development + 1	Cummins India Ltd.	Visit regarding CSR activities.
75.	21 March 2013	Dr. S.N. Singh, Technical Director, together with his colleagues	Intervet India Pvt. Ltd., Pune	Discuss about the trials of JD vaccine produced by their company with Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi.
76.	29 March to 5 April 2013	Prof. Stephen Walkden-Brown, University of New England, Armidale, Australia	Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia	Do a post-project adoption study of the ACIAR-funded project “Improved productivity, profitability and sustainability of sheep production through genetically enhanced prolificacy, growth and parasite resistance” implemented by NARI, AHD in India from 2003 to 2008.

## 2. Visits by groups during the year to see research and development activities of NARI

Sr. No.	Date	No. of persons	Type of group	Organized by
1.	29 May 2012	32	Farmers	Office of District Joint Director of Agriculture, Bagalkot, Karnataka and Two Agricultural Officers accompanied them.
2.	22 September 2012	15	Trainees of Agri Clinic and Agri Business Training	Krishi Vigyan Kendra, Babhalewshwar, Dist. Ahmednagar, M.S.
3.	15 October 2012	28	First year BSW degree Students	Yashwantrao Chavan School of Social Work, Satara, M.S.
4.	27 October 2012	11	Students	Symbiosis School for Liberal Arts, Pune, M.S.
5.	6 November 2012 and 14 February 2013	41	Trainees of Agri Clinic and Agri Business Training	Krishi Vigyan Kendra, Babhalewshwar, Dist. Ahmednagar, M.S.
6.	7 December 2012	10	Third year BA degree students	Mudhoji College, Phaltan, M.S.
7.	15 December 2012	10	Farmers	Datta Krupa Krishi Vigyan Mandal, Bharwade, Tal. Shirpur, Dist. Dhule

8.	15 December 2012	30	Training participants	Ecological Society, Pune, M.S.
9.	20 December 2012	22	Staff members	Maharashtra Institute of Technology Transfer for Rural Areas, Nandurbar, M.S. (under Rural Development Program promoted by BAIF)
10.	21 December 2012	20	Self Help Group members	Yerala Projects Society, Sangli, M.S.
11.	29 December 2012	11	Leaders of Self Help Groups and Mr. K. Kamaraj, Founder, VIDIYAL	VIDIYAL (a federation of women's self help groups), Rasingapuram, Tamil Nadu. They shared their experience about educating women in all aspects of goat rearing using mobile phones.
12.	3 January 2013	20	Students	Agricultural Tech. School, Shardanagar, Tal. Baramati, Dist. Pune
13.	5 January 2013	30	Agricultural students	College of Agriculture, Shardanagar, Baramati
14.	18 January 2013	25	First year agricultural diploma students	Padmashri Appasaheb Pawar Krishi Tantra Niketan, Sharadanagar, Baramati, M.S. They were given information on sweet sorghum and safflower seed production and sheep and goat research.
15.	30 January 2013	30	Farmers	Animal Husbandry, Veterinary Mini Polyclinic, Mehkar, Dist. Buldhana, M.S. (under Maharashtra Agricultural Competitiveness Project). Dr. D.S. More, Assistant Commissioner accompanied them.
16.	7 February 2013	10	High school students	They were accompanied by their teacher Ms. Mukta Ventak, Pune
17.	11 February 2013	10	Farmers	From two villages of Shrirampur Taluka, M.S.
18.	18 February 2013	70	B.Sc.-I year students of Botany and Zoology departments	Vidnyan Mahavidyalaya, Sangola, Dist. Solapur. They were accompanied by their professor.
19.	23 February 2013	12	Trainees of Agri Clinic and Agri Business Training	Agri Clinic and Agri Business Training Centre, Wadala, Dist. Solapur, M.S.
20.	25 February 2013	11	Farmers	Sanyukta Dayitwa Shetkari Mandal, Lonarwadi, Dist. Pune, M.S.
21.	1 March 2013	25	B.Sc. (Ag.) students	Agricultural College, Kolhapur. Accompanied by their professor Mr. D. T. Gaikwad
22.	1 March 2013	35	9 <sup>th</sup> Std. Students	Shrimati Premalatai Chavan High School and Junior

				College, Phaltan, M.S.
23.	1 March 2013	25	Final year B.Sc. (Agri.) students	College of Agriculture, Kolhapur
24.	2 March 2013	25	Students	Baramati Agril. College, Shardanagar, Tal. Baramati, Dist. Pune. Accompanied by their professor.
25.	7, 14 and 21 March 2013	75	Livestock officers (3 batches of 25 each)	State Level Training Centre of Animal Husbandry, Maharashtra State (under Maharashtra Agricultural Competitiveness Project)
26.	11 March 2013	7	BVSc girl students	Bombay Veterinary College, Mumbai, M.S. Dr. Devendra Jadhav, Assistant Commissioner and Dr. Azad Kadarbhai, LDO, Veterinary Dispensary, Satara accompanied them.
27.	13 and 27 March 2013	40	Departmental fodder officers of Government of Orissa (2 batches of 20 each)	BAIF Development Research Foundation, Uruli Kanchan, Dist. Pune, M.S.
28.	15 March 2013	30	BSc - III year students	Krushna Krishi Mahavidyalaya, Rethare, Dist. Satara, M.S.
29.	19 March 2013	8	Staff members	Avani Sanstha, Kolhapur, M.S. (Working in the field of rehabilitation of out of school, child labour, poor and supportless children.) Dr. Gorakhnath Kamble, Dept. of Adult Education and Extension work of Shivaji University Kolhapur accompanied them.
30.	21 March 2013	9	Farmers	Kamdhenu Dattak Gram Yojana of District Animal Husbandry Department, Yawatmal, M.S. (Dr. D.E. Potey, Livestock Development Officer, Lohi accompanied them.)

### **VIII. VISITS BY STAFF**

1. Shri. B. V. Nimbkar and Dr. Nandini Nimbkar visited the National Institute of Abiotic Stress Management, (NIASM), Baramati, Dist. Pune, M.S. on 8 September 2012. They had discussions with the Director, Dr. P. S. Minhas about various issues concerning agriculture.
2. Dr. Chanda Nimbkar visited the Madras Red Sheep Unit under the Network Project on Sheep Improvement of ICAR at Kattupakkam, Tamil Nadu on 8 September 2012.
3. Dr. Chanda Nimbkar had a meeting with Shri Giriraj Singh, Hon. Minister, Animal and Fisheries Resources Department, Government of Bihar, Patna on 21 September 2012 when she attended the ICAR Regional Committee meeting held at A. N. Sinha Institute of Social Studies, Patna, Bihar on 22 September 2012.
4. Dr. Chanda Nimbkar, Dr. Nandini Nimbkar and Dr. Anand Karve visited M/s. J. K. Paper Ltd. at Fort Songadh in Gujarat on 8-9 October 2012. This was a consultancy visit. NARI has formulated and submitted a research project proposal to J. K. Paper with the objective to identify a superior wood-yielding *Leucaena* hybrid. Dr. Nandini Nimbkar gave advice on the herbicide to control grasses and weeds in *Leucaena*. Dr. Anand Karve gave advice on vegetative multiplication of subabul, setting up a tissue culture laboratory and also suggested testing of several other plants for making paper.
5. Dr. Pradip Ghalsasi visited Y. N. Antoniadis and Sons Ltd. (breeders and exporters of Damascus (Shami) goats) at Limassol, Cyprus on 25 February to 1 March 2013 to see their Frozen Semen Laboratory and to check the quality of frozen semen of Damascus bucks. Nimbkar Seeds Pvt. Ltd. is purchasing 200 doses of frozen semen of Cyprus Shami goats and wanted to examine the semen before placing an order. Dr. Ghalsasi found the quality of the buck semen frozen in Cyprus to be unsatisfactory.
6. Prof. Stephen Walkden-Brown from the University of New England, Armidale, Australia and Dr. Chanda Nimbkar visited the Krishi Vigyan Kendra (KVK) at Namakkal, Tamil Nadu on 25 March 2013 to see the *FecB* carrier rams supplied by NARI. They also saw the *FecB* carrier flocks at KVK, Namakkal and the farmers who have *FecB* carrier 'NARI Composite X Mecheri' sheep in their flocks. They also visited the Tamil Nadu Veterinary and Animal Sciences University, Chennai and Post Graduate Research Institute in Animal Sciences, Kattupakkam on 26 and 27 March 2013. They had a discussion about the *FecB* scheme with Dr. R. Prabakaran, Vice Chancellor, Dr. P. Kumarasamy, Principal Investigator, *FecB* Scheme and other concerned scientists.

### **IX. OTHER ACTIVITIES**

1. Dr. Nandini Nimbkar and Dr. Chanda Nimbkar attended the Scientific Advisory Committee meeting of KVK Baramati on 31 May 2012. Both of them visited NIASM at Malegaon afterwards and discussed possible collaboration between NARI and NIASM with director Dr. P. S. Minhas and NIASM staff.
2. Shri. B. V. Nimbkar, Dr. Nandini Nimbkar and Dr. Chanda Nimbkar attended a function on 12 November 2012 organized by the Agricultural Development Trust at



Sharadanagar, Baramati as a retrospective of the work done by the trust in rural areas of Maharashtra. Hon. Union Minister for Agriculture and President of the Trust Shri Sharadrao Pawar was honoured by the hands of Shri Nimbkar in this function.

3. Shri. B. V. Nimbkar was honoured in the opening ceremony of the 47<sup>th</sup> All India Marathi Vidnyan Parishad Adhiveshan held on 7 December 2012 at Baramati for his work in the field of science for the benefit of farmers. Dr. Nandini Nimbkar and Dr. Pradip Ghalsasi attended the function.
4. Article entitled “Screening of elite material against major diseases of safflower in field condition” was reviewed for the African Journal of Agricultural Research.

#### **X. STAFF APPOINTMENTS TO PRESTIGIOUS POSITIONS**

1. Dr. Nandini Nimbkar was nominated as a member of the Research Advisory Council of the National Institute of Abiotic Stress Management (NIASM) by Secretary, DARE and DG, ICAR from 10.10.2012 to 18.02.2014.
2. Dr. Chanda Nimbkar was nominated as a member of the ‘Committee for revision and modification of the technical programme of the Mega sheep seed project’ under the Network Project on Sheep Improvement constituted by the Deputy Director General (Animal Science), ICAR, New Delhi for 2012-13.
3. Dr. Chanda Nimbkar was re-nominated by the President, ICAR, New Delhi as a member of the Board of Management of the National Dairy Research Institute, Karnal, Haryana for a term of two years from 16 January 2013.
4. Dr. Chanda Nimbkar was recognized from 19 January 2013 by the Karnatka Veterinary, Animal Science and Fisheries Science University (KVAFSU) as a member of the post-graduate students’ advisory committee in the discipline of ‘Animal Genetics and Breeding’.
5. Dr. Chanda Nimbkar was nominated as a member of the reconstituted Research Advisory Committee of the Project Directorate on Foot and Mouth Disease, Mukteshwar by the ICAR Society, New Delhi on 13 March 2013.

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