

# **ANNUAL RESEARCH REPORT 2014-2015**



**Nimbkar Agricultural Research Institute,  
P.O. Box 44, PHALTAN-415523,  
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**September 2015**

# Nimbkar Agricultural Research Institute (NARI), Phaltan

## ANNUAL RESEARCH REPORT 2014-15

### Report of the President



I am very happy to place the annual research report 2014-15 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.

Some of the highlights of the year were as follows :

1. Dr. Anil K. Rajvanshi received the [distinguished alumnus award](#) from the University of Florida (UF) in Gainesville (USA). It was given on the third of May 2014 during the summer commencement ceremonies. Dr. Rajvanshi also gave a short address at the commencement after receiving the award. Dr. Rajvanshi is the first Indian to be given this award by UF.
2. Shri. Rajesh Aggarwal, Principal Secretary, Department of Information Technology, Maharashtra commissioned the new custom-built buck and ram semen freezing laboratory in the presence of NARI's founder Shri. B. V. Nimbkar and about 100 invitees.
3. Dr. Anil K. Rajvanshi's e-book "[Romance of innovation-A human interest story of doing R&D in rural setting](#)", was released in Pune on 20 October 2014 by Padma Vibhushan Dr. R. A. Mashelkar and Dr. Rajat Moona, Director General of CDAC in a [well-attended function](#). This book has been made freely available on the internet in the fond hope that it may inspire the young researchers to be engaged in rural development.
4. It is heartening to see how sheep rearers are benefiting directly from the sheep breed 'NARI Suwarna' developed by NARI Animal Husbandry Division. For example Shri. Doddaraju from Karnataka who purchased 10 pregnant FecB gene carrier 'NARI Suwarna' ewes from the AHD of NARI in July 2014 became a proud owner of 23 lambs (21 survived) in August.
5. The high-oil safflower variety NARI-57 has been released for commercial cultivation in the safflower growing areas of Maharashtra, Karnataka, Madhya Pradesh, Rajasthan, Punjab, Uttar Pradesh, Jharkhand and West Bengal states of India by the Central Variety

Release Committee in a meeting held in January 2015 at New Delhi. On account of containing more than 36% oil in its seeds it produced 18% higher oil yield than the national check variety A-1 in the coordinated trials over locations and years. It is also highly resistant to *Fusarium* wilt. Marico Industries, the largest producer of refined safflower oil in India has taken up seed multiplication and contract farming of NARI-57 mainly in Vidarbha.

This year also Mr. B. V. Nimbkar gave a generous donation of Rs. 2,50,000 for the purchase of the Kjelo plus automatic nitrogen estimation unit and a microwave oven. Since its purchase this unit is being used practically continuously for the estimation of protein in fodder of *Stylosanthes seabrana*, *Cenchrus ciliaris* and *Leucaena* as well as safflower leaves. I would like to thank Mr. Nimbkar as well as the others who have so kindly given donations to further our various research activities.

Dr. N. Nimbkar  
President

September 16, 2015

## ***SAFFLOWER***

### **All India Coordinated Research Project (AICRP) on Oilseeds (Safflower)**

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

**Scientists :** V. Singh, Ph.D., M. B. Deshpande, M.Sc., G. E. Atre, M.Sc., R. V. Kale, M.Sc.

**Technical staff :** A. M. Shitole, M.Sc., Ms. U. D. Gaikwad, M.Sc., M. R. Jadhav, M.Sc., S. V. Choudhari, B.Sc.

NARI is one of the centers of All India Coordinated Research Project (AICRP) for safflower (*Carthamus tinctorius*) research under limited irrigation since 1980. The programme is monitored by the Indian Institute of Oilseeds Research (IIOR), Hyderabad which is the central agency under ICAR for planning, coordinating and monitoring of AICRP on sunflower, safflower and castor. 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*) along with development of suitable agro-production and crop protection technologies for growing safflower under limited irrigations. Recently development of short duration and single-headed safflower has received high priority owing to their future importance to the changing scenario of safflower production.

**Research Highlights :** The major highlights of safflower programme implemented during 2014-15 are furnished below :

#### **Summer 2014 :**

Summer season was utilized for maintenance of thermosensitive genetic male sterile lines in safflower. During summer 2014, 75 selections of thermosensitive genetic male sterile lines were maintained for their further screening and utilization in hybrid development in safflower.

#### **Post-monsoon (Winter) season 2014-15 :**

##### **Breeding :**

1. **Release and notification of high oil safflower variety NARI-57 for commercial production :** The high oil safflower variety NARI-57 has been notified and released for commercial cultivation in the safflower growing areas of Maharashtra, Karnataka, Madhya Pradesh, Rajasthan, Punjab, Uttar Pradesh, Jharkhand and West Bengal states of



India by the Central Variety Release Committee in a meeting held in January 2015 at New Delhi. The most important characteristic of this variety is that its seeds contain on an average 36.6% oil as compared to 28-32% in other released varieties. NARI-57 gave seed yield on par with that of the national check A-1. However, it

produced 18.36% higher oil yield than A-1 in coordinated trials conducted, over locations and years. NARI-57 is also highly resistant to *Fusarium* wilt. It produces brilliant orange flowers at bloom.

2. **Confirmation of male-sterility maintaining ability of newly identified genotypes for cytoplasmic male sterility in safflower** : The crosses resulting from the sib-mating attempted between male sterile plants and the newly identified male sterility maintainer genotypes last year, were evaluated during winter 2014-15 to confirm the male sterility maintaining ability of the concerned genotypes. The evaluation of the sib-mated pairwise crosses for male sterility during flowering of the crop revealed very high percentage of male sterility ranging from 95 to 100. The lines giving 100% male sterility were further maintained with the corresponding male parents for evaluating them across the locations for stability of male sterility and making crosses with different genotypes. This would be useful to determine the extent of hybrid vigour expressed by them and to know their usefulness in hybrid development in safflower.



3. **Evaluation of progenies of single-headed plants** : The single-headed plants which appeared in a genotype grown during winter 2013-14 were raised during winter 2014-15 in plant to progeny rows to assess the nature of plants arising from them and to identify the progenies giving

maximum number of fully filled seeds. Germination % of the seeds of individual

progenies which were raised varied from 6.3 to 100% thus exhibiting a wide variation and hence scope for improvement in this character. The evaluation of 75 progenies of single-headed plants showed 21 of them giving single-headed plants, while rest gave plants which were either single-headed or had only primary branches. Flower opening in majority of the progenies was found to be satisfactory with each containing sufficient number of flowers in the capitulum. The fertility of the pollen grains was found to be low with the presence of pollen grains of irregular shape and size in the single-headed plants. The number of seeds in the single-headed progenies evaluated ranged from 1 to 47. The capitulum diameter ranged from 1.4 to 3.7 cm. The number of days to maturity of the entries screened ranged from 105 to 110, which was 15 to 25 days earlier than the safflower which branched normally. The number of seeds in the capitulum of single-headed plants needs to be enhanced significantly before they can be commercially exploited.

4. **Crossing programme** : Sixty crosses were made in line X tester fashion during winter 2014-15 using 15 genotypes as males and two CMS and two TGMS lines as females to develop high-yielding hybrids in safflower. Enough seeds of each cross were produced to evaluate them in a replicated trial in winter 2015-16.

5. **Early and advanced generation selections** :

- (a) Three  $F_2$  crosses comprising of single-headed and normally branching genotypes as parents were raised during the season. Segregating populations were screened for normal and single-headed plants to determine the inheritance of single-headed plants in safflower. Single-headed plants were harvested individually to examine them for seed setting and yielding ability.
- (b) Ninety eight  $F_3$  families of two crosses each comprising high oleic genotype as one of the parents were raised during the season. Each family was harvested separately as a bulk to screen them for high oleic acid. The families identified as having oleic acid-rich oil will be further subjected to selection and evaluation in subsequent generations to develop high-oleic acid cultivars in safflower.

- (c) Ninety six F<sub>7</sub> high-oil selections were evaluated for seed yield and its components. This resulted in identification of 20 F<sub>7</sub> entries giving higher seed yield than the best checks.
- (d) One hundred and thirty-eight advanced generation lines which have stabilized were evaluated in winter 2014-15 in five preliminary varietal trials for seed yield and its components. Of these 14 genotypes recorded higher seed yield than the respective checks.
- (e) Twenty two promising F<sub>6</sub> lines having short duration nature were screened along with two standard checks of normal duration for seed yield and its components under light soil conditions. The results showed that none of the short duration entries could outyield the national check A-1. However, three of the short duration entries gave numerically higher seed yield than the check PBNS-12 having normal duration. Among the short duration selections entry D-197-SD-128-3 gave the maximum seed yield of 843 kg/ha as against 616 kg/ha of PBNS-12 thus indicating an increase of 36.85% in seed yield over the check. The genotypes giving higher seed yields than the normal duration genotypes would be further evaluated to confirm their high yielding ability under light soil conditions.
6. **Development of high seed and oil-yielding safflower cultivar** : A promising safflower variety NARI-96 giving high seed and oil yield was evaluated in Initial Varietal Trial during 2013-14. It gave an increase of 10.2% in oil yield over the check PBNS-12 under irrigated conditions. NARI-96 contains 33.1% oil in its seed as compared to 28.5% in the check PBNS-12. In addition, a high oil-containing variety NARI-95 evaluated in Advanced Varietal and Hybrid Trial-1 recorded an average increase of 15.28% in oil yield over the national check A-1 under irrigated conditions.
7. **Coordinated varietal trials** : Among the two coordinated varietal trials, out of the 27 entries in IVT, entry SSF-1305 recorded the maximum seed yield of 2353 kg/ha which was followed by the entries PBNS-129 (2135 kg/ha) and PBNS-138 (2020 kg/ha). In IH & AVHT, entry DSH-252 recorded the highest seed yield of 2575 kg/ha which was followed by the entries DSH-256 (2120 kg/ha) and DSH-249 (2029 kg/ha).

8. **Seed production of safflower varieties and hybrids** : NARI has produced 700 Kg seed of safflower variety NARI-57, 30 kg seed of NARI-NH-1 and 50 kg seed of female parent of NARI-NH-1.

#### **Agronomy :**

1. **Yield maximization in safflower** : To maximize safflower yield, a trial comprising of the thermosensitive genetic male sterility (TGMS)-based hybrid NARI-H-23 was planted with all the recommended cultural practices on 2000 m<sup>2</sup> area on October 24, 2014. The trial was provided with three irrigations i.e. first at the time of sowing for germination of seeds, second at 35 days after sowing and third at 70 days after sowing. Necessary plant protection measures were followed to prevent yield losses due to diseases and pests. The trial was supplied with 100% recommended dose of fertilizers to get the optimum seed yield from the crop. Timely thinning and weeding were carried out in the trial.

The seed yield recorded from the crop was 1004 kg/ha, while gross returns were Rs. 32128/ha, net returns were Rs. 6863 and benefit cost ratio was 1.27. The cost of cultivation was adjusted to reflect practices undertaken by farmers. The yield obtained from the trial was quite low since sowing was done on a leased farm where the time taken for creation of irrigation facility delayed the first irrigation after sowing by about one week. This adversely affected the germination in the trial. Though we carried out gap filling to maintain the plant population, we could not get a satisfactory yield from the crop.

- 2 **Comparative productivity, profitability and resource use of non-spiny safflower to other rainfed rabi crops/systems** : The results of the trial showed that safflower-equivalent yield for non-spiny safflower variety NARI-6 was observed to be the highest at 9473 kg/ha which was followed by non-spiny safflower hybrid NARI-NH-1 (7189 kg/ha), sole chickpea (2897 kg/ha) and sorghum + safflower (2612 kg/ha). The same trend was recorded for gross returns, net returns and benefit cost ratio. When both the seed and the petal are considered, the non-spiny safflower variety NARI-6 gave the highest net returns of Rs. 2,77,866/ha which were followed by the non-spiny safflower hybrid NARI-NH-1 (Rs. 201776/ha).



- 3. Influence of planting time on oil content and oil yield of safflower :** The results of the trial showed that differences due to dates of sowing and varieties were significant for oil content. In general, first date of sowing recorded higher oil content than the remaining two dates of sowing. Among the varieties NARI-57 gave the highest oil content of 36.37% as against 27.97% in A-1 and 31.65% in NARI-6 for the first date of sowing on October 24, 2014. The oil content results at three dates of sowing showed that delayed sowing gave gradual reduction in oil content as compared to the first date of sowing. Oil yield also gave the maximum values for all the safflower entries when sown on October 24, 2014 followed by sowings carried out on November 24, 2014 and December 2, 2014. Therefore, it can be concluded that sowing on October 24, 2014 was the most suitable since it gave the maximum seed yield, oil content and oil yield in all the entries.
- 4. Assessment of suitable plant population for crop diversification :** The results of the trial showed that differences due to different spacings were significant for seed yield and other contributing characters with the increase in the spacing between rows adversely affecting the seed yield in safflower. In general, closer spacings exhibited numerical superiority in seed yield over the wider spacings under irrigated conditions.
- 5. Revised assessment of fertilizer recommendations for safflower (irrigated) :** The results of the trial with safflower variety NARI-38 indicated that differences due to different fertilizer levels were significant for seed yield, biological yield, gross returns, net returns and benefit:cost ratio. The significantly highest seed yield of 1892 Kg/ha was obtained by the application of 90:80:40 Kg/ha of N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O, which was followed by the treatments of 90:40:40 Kg/ha of N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O (1601 Kg/ha), 60:80:40 Kg/ha of N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O (1593 Kg/ha) and 60:40:40 Kg/ha of N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O (1568 Kg/ha). The maximum net returns of Rs. 30572/ha were recorded by the treatment of 90:80:40 Kg/ha of N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O which was followed by the treatment of 30:0:40 Kg/ha of N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O (Rs. 30117/ha). The latter treatment also gave the maximum benefit cost ratio of 2.40.
- 6. Crop residues as a component of INM in safflower-based cropping systems :** The results suggested that with INM the use of chemical fertilizers can be curtailed to 50% without compromising on productivity of the crop as was shown by the treatment of 50% NPK to both soybean and safflower and incorporation of safflower residue and 2.5 t

FYM/ha in soybean and 5 t FYM/ha or soybean residue in safflower. These treatments have not only provided higher seed yields than the control but have also recorded higher net returns (Rs. 38517/ha and 37839/ha respectively) than it.

### **Plant Pathology :**

1. **Survey of safflower diseases :** According to the survey of safflower diseases conducted in Satara and Sangli districts in winter 2014-15, in almost all the fields surveyed the *Alternaria* leaf spot incidence was found to be more than that of *Fusarium* wilt as in winter 2013-14. The *Alternaria* disease grade ranged from 0 to 5 in irrigated crops, while the early sown rainfed crop exhibited disease grade ranging between 1 to 3. None of the farmers in any of the villages applied fungicidal sprays except those of Satewadi in Khatav taluka of Satara district. The incidence of wilt was occasional and of low intensity.
2. **Screening of selected elite material against *Alternaria* leaf spot :** The trial comprised of 41 entries, including 25 of IVT, 14 of IH-AVHT and two checks, viz. Manjira, which is *Alternaria*-susceptible (SC) and HUS-305 which is *Alternaria*-tolerant (TC). The results revealed that all the entries were susceptible to *Alternaria* leaf spot.
3. **Screening of selected elite material against wilt :** The trial comprised of 40 entries including 25 of IVT and 14 of IH-AVHT along with susceptible check Nira. Among these NARI-H-23 recorded the lowest wilting of 13.96% and entries NARI-107, DSH-253, DSH-252, NARI-96 and DSH-250 recorded wilting percentage < 25%. All these have been categorized as tolerant to wilt. However, rest of the entries showed highly susceptible reaction to wilt. The susceptible check Nira exhibited a wilting percentage of 77.68%.
4. **Disease development in relation to weather parameters :** The trial comprised of evaluation of disease (*Alternaria* leaf spot) development in the susceptible variety Manjira as related to the weather parameters. There was weak negative correlation between disease development and the weather parameters during winter 2014-15.
5. **Screening of PVT material against wilt :** Seventy-nine PVT entries along with susceptible check Nira and tolerant check NARI-38 were screened for wilt caused by *Fusarium oxysporum* f.sp. *carthami*. Out of all the entries screened the entries WR-5-22-1, WR-4-13-3, D-150-3-2-2 and D-151-43-7 were found to be moderately resistant to wilt.

6. **Disease incidence in breeding and agronomy experiments :** During winter 2014-15, there was no major disease problem in the research trials on either the Tambmal or the Vinchurni farms. The intensity of *Alternaria* leaf spot was low to moderate in all the trials. In some trials, the wilt caused by *Fusarium oxysporum* f.sp. *carthami* was observed at low intensity.

## ***SWEET SORGHUM***

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

**Funding Agency :** Indian Council of Agricultural Research (ICAR), New Delhi.

**Scientists :** Radhika Prabhakaran, Ph.D., Ms. M. M. Patil, M. E., Ms. Ketaki Kanbargi, M.Tech.

**Technical staff :** Mr. C. S. Khore, M.Sc., Mr. B. D. Pandit, M.Sc., Ms. U. D. Gaikwad, M.Sc., Ms. A. R. Gholap, Ms. Rima Jadhav

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 Indian Institute of Millets Research (IIMR), 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 through collaborative multi-location testing and facilitate production of genetically pure seeds for the farmers as also improvement of syrup production from sweet sorghum juice.

### **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 grain.
2. Development of high brix CMS lines.
3. Development of shoot-fly 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 post-rainy (winter) season.

### **Research highlights :**

The investigations carried out during the year under this project are described below.

#### **Kharif (Rainy season) 2014 :**

##### **1. Varietal development :**

##### **Evaluation of F<sub>8</sub> progenies**

A total of nine (Group A, five crosses) and 12 (Group B, single cross) progenies were evaluated during Kharif-2014 with their parents along with two varietal checks *viz.*, CSV-19-SS and CSV-24-SS for their performance for sugar yield and its components. Performance of the best entries is given below :

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Juice extraction (%)	Juice yield (t/ha)	Brix of juice (%)	TSI (t/ha)
<b>Group A</b>							
(DC-24)-27-1	71.2	61.3	43.6	33.6	14.7	18.0	2.6
(DC-26)-4	60.3	58.5	35.4	39.7	14.0	12.7	1.7
CSV-24 SS (C)	85.8	61.7	53.3	35.9	18.8	16.7	3.1
CSV-19 SS (C)	62.0	66.5	41.7	32.4	13.6	17.0	2.3
<b>Group B</b>							
D-118)-25-3	80.9	68.9	55.9	32.3	18.5	16.2	2.9
(D-118)-25-7	65.52	64.5	42.1	28.4	12.0	17.8	2.1
CSV-24 SS (C)	76.91	70.6	54.1	35.6	19.4	17.0	3.3
CSV-19 SS (C)	49.6	68.4	34.0	31.4	10.7	17.3	1.8

## 2. R line development :

F<sub>2</sub> populations received from DSR under network breeding programme have been advanced to PVT selection. Thirty four progenies selected from two different crosses were evaluated during Kharif 2014 along with the checks IS-2312, CSV-19-SS and CSV-24-SS. All the progenies were evaluated for phenological characters : plant height, stem diameter, 50% flowering, days to maturity; yield components: biomass, stripped stalk weight, juice yield and sugar components : brix of juice, Reducing Sugar (RS), Total Reducing Sugar (TRS) and sucrose in juice, Total Sugar Index (TSI). The summary of the collected data is given in the table below :

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Juice extraction (%)	Juice yield (t/ha)	Brix of juice (%)	TSI (t/ha)
10R-SS-19-16-5-3	58.7	74.1	43.0	36.7	16.0	16.8	2.68
10R-SS-19-16-5-2	54.9	81.7	44.8	37.4	16.8	16.8	2.83
10R-SS-20-61-5-5	54.5	59.9	33.6	42.4	12.6	20.3	2.55
IS-2312 (C)	57.5	74.7	42.9	34.2	14.8	16.7	2.46
CSV-19-SS (C)	60.8	69.0	42.1	32.1	13.5	17.5	2.38
CSV-24-SS (C)	60.7	64.1	39.4	30.7	12.9	15.7	2.01

### 3. B line development (Network breeding) :

A total of 47 F<sub>8</sub> maintainer lines of sweet sorghum along with two checks *viz.*, 296 B and IS-2312 were assessed for their performance in three different trials (Group A, B and C) for two major characters *viz.*, high biomass and high sugar content along with other characters during Kharif -2014. The important outcomes are summarized in the table below.

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Juice extraction (%)	Juice yield (t/ha)	Brix of juice (%)	TSI (t/ha)	Shoot fly damage @ 28 DAE (%)	Stem borer damage @ 45 DAE (%)
<b>Group A</b>									
10B-AGR-32-55-5-2	59.2	53.9	31.9	43.0	13.6	16.5	1.76	15.4	5.0
10B-AGR-46-45-2-4	52.9	57.3	30.3	51.2	15.7	17.3	2.12	29.4	17.0
296B (C)	44.5	65.0	29.0	34.1	9.7	15.8	1.19	15.8	4.5
IS-2312 (C)	53.7	59.2	31.9	25.7	8.2	15.8	0.93	21.0	11.7
<b>Group B</b>									
10B-AGR-47-71-3-3	52.6	76.4	40.2	29.8	11.4	17.2	1.97	23.1	13.0
10B-AGR-47-87-2-2	49.2	72.1	35.5	31.6	11.1	18.5	2.06	8.6	8.5
296B (C)	28.9	63.2	18.3	33.3	5.9	13.0	0.77	18.7	14.6
IS-2312 (C)	43.5	60.8	26.4	27.3	7.1	16.7	1.19	11.1	8.0
<b>Group C</b>									
10B-AGR-66-3-4-4	51.3	57.5	29.5	33.6	10.0	17.8	1.80	11.0	10.0
296B (C)	43.1	53.9	23.2	32.7	7.6	16.5	1.30	11.3	3.5
IS-2312 (C)	51.9	57.7	29.9	27.0	8.0	16.7	1.30	8.0	6.5

### 4. Preliminary trials (PVT) :

A total of 55 sweet sorghum lines in comparison with two nationally released varietal checks *viz.*, CSV-24-SS and CSV-19-SS were assessed for their performance in four different preliminary varietal trials (PVT) (Groups A, B, C and D) for high biomass, brix of juice and pest tolerance along with some other characters during Kharif- 2014. Only in group D one of the entries was superior to the national check CSV-19-SS as can be seen from the data given in the table below :

Entries	Total biomass (t/ha)	Brix of juice (%)	Shoot fly damage @ 28 DAE (%)	Stem borer damage @ 45 DAE (%)
<b>Group D</b>				
(D-34)-21-3-3	60.09	21.5	12.67	9.29
(D-34)-21-3-10	58.31	20.5	12.67	7.16
CSV-19-SS (C)	58.31	19.5	5.67	1.75
CSV-24-SS (C)	28.12	20.67	11.33	3.36

## 5. CMS line development

In CMS development programme, a total of 33 pair-wise crosses were evaluated along with three parental A/B lines (5A/B, 6A/B, and 11A/B) for all the phenological and biochemical characters as well as pest resistance. Four of the best performing CMS lines for various parameters are given below :

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Juice extraction (%)	Juice yield (t/ha)	Brix of juice (%)	TSI (t/ha)
BC8-3-1-2-1-2-1A	36.69	50.75	18.62	37.29	6.94	24	1.34
BC8-3-1-2-1-2-1B	31.47	49.24	15.5	35.84	5.55	21	0.96
BC7-59-1-2-3-4A	10.86	84.13	9.13	19.81	1.81	22	0.32
BC7-59-1-2-3-4B	18.24	76.81	14.01	17.52	2.45	24	0.49
BC7-80-3-3-2-3A	34	61.5	22.11	29.26	6.47	20	1.12
BC7-80-3-3-2-3B	31.99	64.59	20.66	23.42	4.84	20	0.82
BC8-5-1-1-1-2-5A	18.88	58.53	11.05	37.67	4.16	20	0.66
BC8-5-1-1-1-2-5B	13.82	66.1	9.13	30.89	2.82	18	0.42
NARI-SS-5A	30.45	58.75	17.89	27.85	4.98	18	0.72
NARI-SS-5B	31.86	57.38	18.28	27.71	5.07	18	0.76
NARI-SS-6A	29.68	55.56	16.49	30	4.95	20	0.84
NARI-SS-6B	34.28	51.41	17.62	27.4	4.83	19	0.72
NARI-SS-11A	13.28	26.69	3.54	37.89	1.34	20	0.23
NARI-SS-11B	13.83	21.13	2.92	37.78	1.1	20	0.2

## AICSIP trials :

Three trials were allocated to our AICSIP centre and they were successfully conducted. These trials were :

## 1. IAVHT (Sweet sorghum)

### Best performing entries

Sr. No.	Entry	Biomass (T/ha)	Fresh stalk yield (t/ha)	Brix of juice (%)	Juice yield (t/ha)	Total sugar yield (t/ha)	Bioethanol yield (l/ha)
1.	RSSH-18	<b>50</b>	<b>40.2</b>	16.5	12160	2.2	1145
2.	NARI SS 5 (Phaltan)	<b>52.5</b>	<b>41.1</b>	17.4	<b>15610</b>	<b>2.3</b>	<b>1205</b>
3.	NARI SS 15 (Phaltan)	<b>46.4</b>	<b>39.1</b>	<b>18.2</b>	<b>13606</b>	2.2	1163
4.	ICSV 12007 (ICRISAT)	38.1	28.2	<b>18.5</b>	9863	2.1	1113
5.	R13-MP-9 (DSRAVU)	39.2	29	<b>18.3</b>	10593	<b>2.3</b>	<b>1203</b>
6.	PVKK 902 SS (Parbhani)	46	35.1	17.1	<b>15552</b>	<b>2.3</b>	<b>1210</b>
7.	CSV 19 SS (C)	38.6	27.8	17.2	11444	2.0	1075
8.	CSV 24 SS (C)	42.1	31.3	17.3	10811	1.9	1013
9.	CSV 22 SS (C)	44.9	33.0	16.9	11748	1.9	993

Values in bold are the first three ranks based on all India performance.

2. AHT (Grain sorghum) and 3. AVT (Grain sorghum) were also carried out, but there were no entries from NARI center in these.

## Rabi (Post-rainy season) 2014-15 :

### 1. Varietal development

#### Maintenance of F<sub>7</sub> generation

A total of 107 F<sub>7</sub> individual plants from six different crosses were maintained during Rabi 2014-15 for the purpose of seed increment and evaluation in an unreplicated manner. The objective of the trial was to identify promising entries for high biomass and high sugar yield which were later to be included in the PVT selection.

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Juice extraction (%)	Juice yield (t/ha)	Brix of juice (%)	TSI (t/ha)	Total grain yield (q/ha)	Shoot fly damage @ 28 DAE (%)	Stem borer damage @ 45 DAE (%)
F <sub>7</sub> (DC-124)-27-2-2-1-1	35.1	55.91	19.62	28.13	5.52	17.0	0.94	4.57	16.0	28.0
F <sub>7</sub> (DC-124)-27-8-1-4-2	33.49	67.03	22.45	47.31	10.62	18.0	1.91	16.03	20.93	11.63
CSV-19-SS (C)	37.95	61.68	23.41	31.68	7.42	14.5	1.08	11.54	20.45	6.82
CSV-24-SS (C)	23.4	51.93	12.15	39.48	4.80	14.0	0.67	13.65	14.55	3.64
F <sub>7</sub> (DC-126)-17-4-2-4-1	42.43	60.92	25.85	29.85	7.72	17.5	1.35	12.05	6.45	3.23
F <sub>7</sub> (DC-126)-12-3-3-1	33.4	57.12	19.08	35.85	6.84	18.1	1.24	20.07	7.81	10.94
CSV-19-SS (C)	19.39	72.12	13.99	27.56	3.85	17.5	0.67	6.57	5.88	1.96
CSV-24-SS (C)	21.38	63.53	13.58	27.15	3.69	15.4	0.57	16.27	23.40	12.77



## 2. R line development

### Maintenance of R lines (Network Breeding)

A total of 31 R lines along with the three checks (CSV-19-SS, CSV-24-SS and IS-2312) were maintained in Rabi 2014-15 in an unreplicated manner. The performance of best lines is given in the table below :

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Juice extraction (%)	Juice yield (t/ha)	Brix of juice (%)	TSI (t/ha)	Total grain yield (q/ha)	Shoot fly damage @ 28 DAE (%)	Stem borer damage @ 45 DAE (%)
10R-SS-20-61-5-7	52.41	57.42	30.09	33.08	9.95	21.30	2.12	1.62	7.89	15.79
10R-SS-20-78-3-4	45.47	63.44	28.85	20.08	5.79	23.60	1.37	2.13	10.77	10.77
10R-SS-20-100-4-4	43.36	86.23	37.39	31.64	11.83	20.90	2.47	55.55	3.92	3.92
CSV-19-SS (C)	50.29	54.70	27.51	26.03	7.16	19.10	1.37	18.80	0	1.54
CSV-24-SS (C)	43.78	53.67	23.50	39.19	9.21	12.10	1.11	36.41	6.82	6.82
IS-2312 (C)	27.88	42.82	11.94	7.49	0.89	20.50	0.18	7.70	4.0	0

## 3. B line development (Network breeding)

### Maintenance of B Lines :

A. 13 PVT B lines were evaluated in an un-replicated manner along with the parental lines NARI-SS-5B and NARI-SS-11B during Rabi 2014-15 for various parameters. The data of promising progenies and the parental lines are given below :

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Extraction (%)	Juice wt (t/ha)	Brix of juice (%)	TSI (t/ha)	Total grain yield (q/ha)	Shoot fly damage @ 28 DAE (%)	Stem borer damage @ 45 DAE (%)
BC-3-1-2-1-2B	33.08	29.11	9.63	21.08	2.03	17.90	0.36	18.25	3.45	6.90
BC-5-3-1-1-2B	27.01	31.69	8.56	23.26	1.99	20.30	0.40	16.83	5.0	10.0
BC-5-2-2-1-1B	26.80	39.30	10.54	15.74	1.66	24.60	0.41	3.49	6.0	6.0
NARI-SS-5B	35.35	34.28	12.12	25.00	3.03	15.30	0.46	15.81	6.90	8.62
NARI-SS-11B	8.99	41.92	3.77	49.89	1.88	19.60	0.37	6.17	8.70	8.70

**B.** A total of 50 F<sub>6</sub> progenies (Network breeding) produced from seven different crosses were evaluated in an un-replicated manner during Rabi 2014-15 (Groups A, B and C).

The two checks were 296B and IS-2312 respectively.

The performance of most promising progenies is given below along with that of the checks (C) :

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Extraction (%)	Juice wt (t/ha)	Brix of juice (%)	TSI (t/ha)	Total grain yield (q/ha)	Shoot fly damage @ 28 DAE (%)	Stem borer damage @ 45 DAE (%)
<b>Group A</b>										
IS-2312 (C)	28.52	47.10	13.43	21.26	2.86	20.5	0.59	35.28	0	7.41
10B-AGR-32-63-2-2	35.23	54.39	19.16	27.14	5.20	20.4	1.32	8.92	6.45	9.68
10B-AGR-46-147-2-4	37.94	18.99	7.20	42.32	3.05	16.3	0.50	23.38	4.76	16.67
296B (C)	16.46	28.03	4.61	10.29	0.47	19.4	0.09	4.86	3.13	3.13
<b>Group B</b>										
10B-AGR-47-34-1-1	49.70	52.07	25.88	37.94	9.82	16.9	1.66	4.91	1.92	0
10B-AGR-47-71-3-3	38.57	27.07	10.44	60.50	6.32	16.8	1.06	26.48	8.57	0
296B (C)	22.20	68.0	15.10	43.82	6.62	19.6	1.30	27.91	5.88	1.96
IS-2312 (C)	31.11	37.95	11.81	18.06	2.13	18.7	0.40	6.22	0	10.34
<b>Group C</b>										
10B-AGR-66-1-1-2	40.74	42.55	17.33	27.0	4.68	18.8	0.88	21.89	3.45	6.90
296B (C)	22.42	42.36	9.50	63.95	6.07	15.7	0.95	27.91	5.88	1.96
IS-2312 (C)	22.11	40.97	9.06	16.09	1.46	15.8	0.23	29.61	14.29	14.29

#### 4. Preliminary varietal trials (PVT)

A total of 64 PVT entries were maintained along with two standard checks, CSV-19-SS and CSV-24-SS in Rabi 2014-15 season in an unreplicated manner. The entries were developed with an objective of getting high biomass and high sugar yield with pest resistance. The summary of evaluation of the most promising entries in groups A, B, C and E is given below :

Entry	Total biomass (t/ha)	Stripping (%)	Stripped stalk wt (t/ha)	Extraction (%)	Juice wt (t/ha)	Brix of juice (%)	TSI (t/ha)	Total grain yield (q/ha)	Shoot fly damage @ 28 DAE (%)	Stem borer damage @ 45 DAE (%)
<b>Group A</b>										
(D-118)-69-4	48.88	73.49	35.92	29.94	10.75	19.5	2.10	18.56	3.13	0
CSV-19 SS (C)	37.06	65.72	24.35	34.62	8.43	19.0	1.60	17.40	1.72	3.45
CSV-24 SS (C)	38.16	56.78	21.67	31.03	6.72	16.7	1.12	46.60	13.11	1.64
<b>Group B</b>										
(D-91)-9-2	37.09	69.50	25.78	32.01	8.25	21.3	1.76	17.72	6.35	0
CSV-24 SS (C)	34.43	55.82	19.22	28.57	5.49	20.1	1.10	22.47	7.14	4.76
CSV-19 SS (C)	44.68	67.86	30.32	34.28	10.39	17.8	1.85	22.84	6.06	3.03
<b>Group C</b>										
(D-141)-34	45.81	65.11	29.83	28.17	8.40	18.3	1.54	33.02	9.84	1.64
CSV-19 SS (C)	26.87	72.16	19.39	23.63	4.58	18.7	0.86	30.34	3.33	6.67
CSV-24 SS (C)	28.92	58.85	17.02	28.03	4.77	19.6	0.93	23.87	27.45	7.84
<b>Group E</b>										
(D-34)-21-3-10	24.03	64.97	15.61	34.68	5.41	17.5	0.95	11.72	9.52	0
CSV-19-SS (C)	25.54	63.0	17.0	24.10	4.09	16.2	0.61	10.10	3.10	6.80
CSV-24-SS (C)	9.34	51.37	4.80	25.36	1.22	18.2	0.22	14.72	17.50	10.00

## 5. Number of trait-based crosses made :

Around 52 hybrids were made between various A lines and promising R lines (with high biomass and high sugar yield).

**Set I. A Lines :** NARI-SS-5A, NARI-SS-6A, NARI-SS-15A, NARI-SS-34A,  
NARI-SS-296A

**R lines :** NSS-216, RSSV-21-2, (D-94)-74, (D-118)-70-5, (D-102)-12, (D-118)-34

**Set II. A Lines :** BC-3-1-2-1-2-1A, BC-5-1-1-5-1-2A, BC-5-1-1-5-1-3A, BC-5-1-2-1-2-2A,  
BC-5-1-2-1-2-4A

**R Lines :** NARI-SS-216, RSSV-21-2, (D-94)-74, (D-118)-70-5

## 6. Maintenance and seed production :

- 289 germplasm lines
- 135 IS lines
- 250 CMS A/B lines
- 134 land races
- Seed production of CMS-based hybrid NARI-SSRH-20 and two promising selections viz., (D-94)-74, and (D-118)-34 was also undertaken. The selections (D-118)-34 and (D-94)-74 were tested in AICSIP trials during Kharif 2014 and D-118-34 has been promoted for second year of testing in AVT-II. (D-94)-74 has already completed three year's of testing in coordinated trials, but was not released.

**AICSIP trials :**

Two trials were allocated and they were successfully conducted. These trials were :

**1. IAVHT (Sweet sorghum)****Best performing entries**

Sr. No.	Entry	Biomass (t/ha)	Fresh stalk yield (t/ha)	Brix (%)	Juice yield (t/ha)	Total sugar yield (t/ha)	Bioethanol yield (l/ha)
1.	PVKK 902 SS (Parbhani)	<b>47</b>	<b>29</b>	10.4	<b>9426</b>	<b>0.91</b>	<b>483.79</b>
2.	RSSV 350 (Rahuri)	<b>38</b>	21	12.4	4844	0.54	288.92
3.	RSSV 333 (Rahuri)	<b>37</b>	<b>22</b>	11.4	4767	0.51	272.52
4.	RSSV 369 (Rahuri)	36	<b>22</b>	10.6	5860	0.52	278.26
5.	ICSV 12007 (ICRISAT)	35	20	<b>14</b>	<b>8993</b>	<b>1.1</b>	<b>585.65</b>
6.	NARI SS 5 (Phaltan)	35	21	<b>13.1</b>	9477	<b>1.14</b>	<b>605.05</b>
7.	NARI SS 15 (Phaltan)	22	12	<b>13</b>	4279	0.42	224.34
8.	ICSV 12006 (ICRISAT)	29	18	10.3	<b>9337</b>	0.87	464.35
9.	CSV 19 SS (C)	33	19	11.3	5375	0.5	267.35
10.	CSV 24 SS (C)	25	12	8.3	4529	0.32	172.58
11.	CSV 22 SS (C)	30	16	9.5	5187	0.47	248.24

Values in bold are the first three ranks based on all India performance.

**2. IVHT (Rainfed grain sorghum under shallow soil conditions)** was also carried out successfully, but did not contain any entries from NARI AICSIP centre.

## **GRASSLAND DEVELOPMENT AND FODDER PRODUCTION**

**Funded :** internally

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

**Technical staff :** Mr. S. V. Choudhari, Mr. D. B. Kulkarni, Ms. S. A. Khalate, B.Sc.

**Irrigated :**

1. *Stylosanthes seabrana* : Two trials were sown on 16 and 26 August 2014 respectively to assess the effect of cutting interval and cutting height. The cutting intervals being evaluated are 30, 45, 60, 75, 90, 105 and 120 days. These were imposed after the base cut carried out 145 days after sowing. The characteristics being evaluated are fresh weight, dry weight, % leaf, plant height and ash, protein and fat content of the herbage.



The cutting heights chosen were 10, 20 and 30 cm above ground with harvesting carried out every 45 days. The characteristics being evaluated are the same as in the cutting interval trial. Both the trials have been laid out in a randomized complete block design (RBD) with four replications.

2. *Cenchrus ciliaris* : Two trials were sown on 22 November 2014 with *Cenchrus ciliaris* cultivar Laredo. The trials were laid out in RBD with four replications. In the first trial three treatments viz. cutting every 3, 6 and 12 months are being evaluated while in the second trial cutting is being carried out every 60 days at 5, 10 or 15 cm from the ground level.



**Rainfed :**

3. *Cenchrus ciliaris* (buffel grass) and *Stylosanthes seabrana* for grassland development in semi-arid area of Phaltan taluka. A high proportion of grazing lands on the semi-arid Deccan plateau are

severely degraded and have experienced considerable loss of perennial vegetation and soil due to erosion. A typical heavily eroded (average soil depth 23 cm) 1.37 ha area near village Vinchurni was selected to establish a pasture of buffel grass and *S. seabrana*. These two species were selected because *S. seabrana* is a legume and known to establish well on poor and severely eroded soils under dryland conditions, while buffelgrass is a versatile and diverse grass species which is fairly easy to establish and is the most drought-tolerant of the commonly sown grasses.

One kg seed each of four most promising accessions of buffelgrass identified in the nursery evaluation was broadcast into separate plots behind a bullock-drawn harrow in July 2013. The area was fenced to prevent grazing by stray animals. In July 2014 30 kg *S. seabrana* seed was broadcast in the area. The rainfall received from June-December 2013 was 775 mm and that in year 2014 was 425 mm. In December 2014 four areas of 20 m<sup>2</sup> each were harvested from each plot for evaluation. The estimated ground coverage was 25-30% and the best entry 'Lardeo' gave average fresh and dry biomass weights of 3.2 and 1.8 T ha<sup>-1</sup> respectively after 17 months' of grown without any inputs. With full ground coverage we can expect 10-12 T ha<sup>-1</sup> fresh and 5-7 T ha<sup>-1</sup> dry weight in 1.5 years without any fertilizer and water inputs.

## ***RENEWABLE ENERGY***

### **Highlights :**

The high point of the year was the receipt of [distinguished alumnus award](#) from University of Florida by Dr. Anil K. Rajvanshi. It was given on 3 May 2014 during the summer commencement ceremonies. Dr. Rajvanshi also gave a short address at the commencement after receiving the award. Dr. Rajvanshi is the first Indian to be given this award.

Dr. Rajvanshi and Dr. Nimbkar also used this opportunity to visit various universities engaged in precision agriculture. They had detailed discussions with the chairman of agricultural engineering department at Ohio State University in Columbus and a senior professor of robotics at the Carnegie Mellon University in Pittsburgh. The detailed report is [given here](#).

Dr. Anil K. Rajvanshi's e-book "[Romance of Innovation – A human interest story of doing R&D in rural setting](#)", was released in Pune on 20 October 2014 by Padma Vibhushan Dr. R. A. Mashelkar and Dr. Rajat Moona, Director General of CDAC. The well attended function was held on CDAC premises. The details of the book release function are [given here](#).

Dr. Anil K. Rajvanshi was invited to deliver the Second Gemini Ganesan Memorial lecture at Madras Christian College, Chennai. The details of the lecture are [given here](#).

Dr. Anil K. Rajvanshi was also invited to be the Chief Guest in IIT Bombay for their MENGRES 2015 Symposium. The details of his lecture [are given here](#).

### **Projects :**

1. Development of solar-powered water purifier
2. Development of diesel lanstove

### Low-cost solar water purifier for rural households

Safe drinking water is the basic need of human beings. Microbial contamination of drinking water is a major health hazard. According to World Health Organization (WHO) each year diarrheal diseases [claim the lives of approximately 760,000 young children throughout the world](#). There are many types of bacteria, viruses and protozoans responsible for diarrheal diseases with a range of persistence in water, infectious dose and health significance. Coliform bacteria which are present in large quantities in human feces are good indicator organisms for the presence of pathogenic bacteria and are relatively easy to determine by simple methods. For drinking water, WHO recommends that total coliforms must not be detectable in any 100-ml sample.

Researchers world over are developing or have developed low cost water treatment devices for rural households. They include filters, reverse osmosis (RO) and ultraviolet (UV) radiation-based water purifiers, among others. However these devices suffer from problems like filter clogging with a need for their periodic replacement, wastage of water (in case of RO) and unavailability of electricity in rural areas for both RO and UV-based systems.

NARI has developed a unique and low cost solar water purifier (SWP) for rural households which neither requires electricity nor wastes precious water.

SWP consists of four tubular solar water heaters attached to a manifold (Fig. 1). Non-potable water is filled in SWP after filtering through a four-layered cotton cloth and heated in the stagnation mode by solar energy to make it potable.

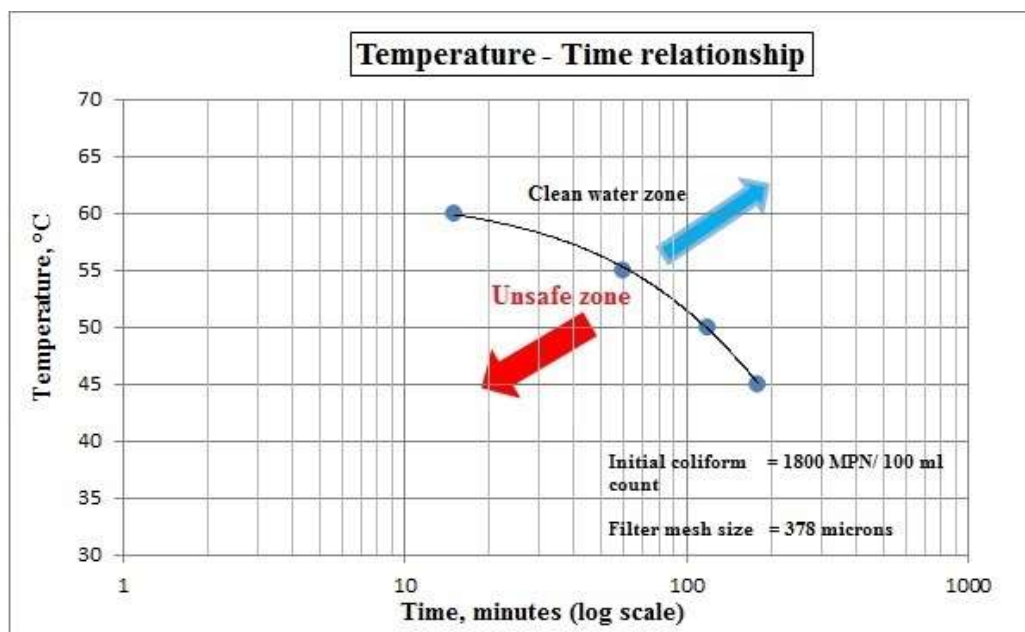
**Fig 1. Four tube SWP**





Tests done by NARI on this SWP for last one year have shown that even on a completely cloudy and rainy day, water is heated to high enough temperatures to make it potable.

NARI developed SWP in two steps. In the first step it developed a protocol for filtering unclean water through a four-layered cotton sari cloth (mesh size less than 378 microns) and then heating it to 60°C for 15 minutes so that all the coliforms are inactivated. Tests done by NARI in its labs showed that such filtered water heated either to 60°C for 15 minutes or 45°C for 3 hours inactivated all the coliforms. The initial count of coliforms was between 1800 to 2400. Thus a temperature-time regime for treatment of filtered water was developed (Fig. 2).



**Fig 2.**

The bacterial colony count was done in the Institute's microbiology lab according to well-known international protocols for such testing. NARI published a paper on this in [Current Science in 2013](#). Washing of the sari cloth every day ensures that fitter clogging will not take place.

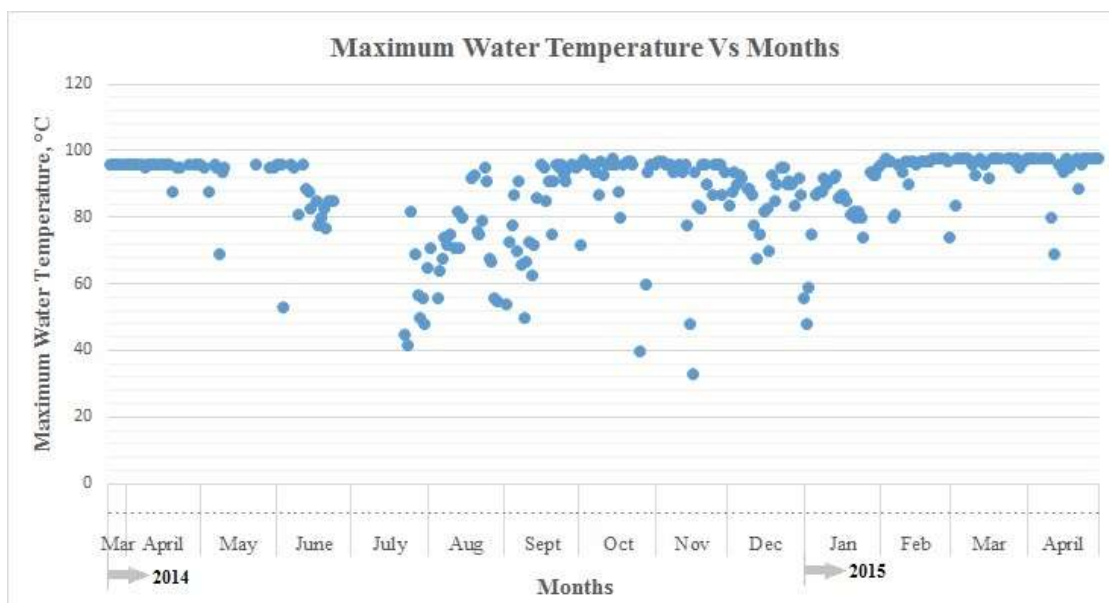
Once the protocol was developed, the next step was to develop an economic method of heating the filtered water in an environmentally friendly manner. Generally in rural areas wood is used for heating bath-water. This produces smoke pollution, is costly and time consuming in terms of wood collection. Hence a better method was to use solar energy and to see whether the temperature-time regime required could be obtained in a simple solar device. The filtered water was therefore heated using the tubular solar collectors in the SWP.

Thus every morning the water was put in the SWP; solar energy heated the water to the desired temperature and the potable water was taken out next morning from the unit before refilling it.

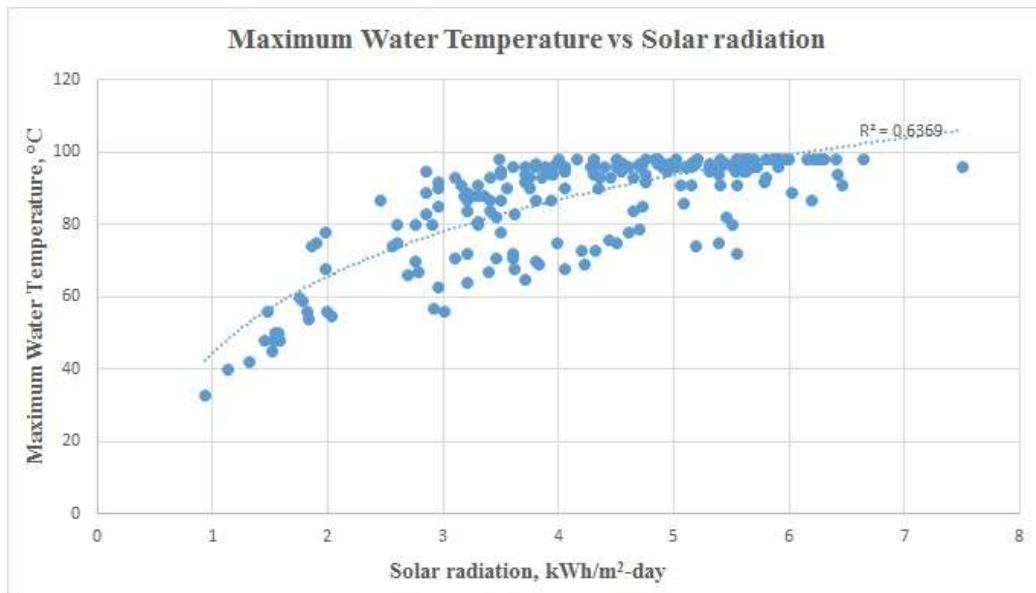
The main criterion in designing the solar water heater was that under completely cloudy conditions the diffused solar radiation should be able to raise the water temperature above  $45^{\circ}\text{C}$  for more than 3 hours. Thus the collectors had to be very efficient. Tubular vacuum-based solar collectors (tube dimensions : 47 mm internal diameter and 1.8 m long; volume of each tube ~ 3 liters) fitted the bill. The tubes were fitted in a stainless steel manifold so that the total volume for 4-tube collector system is ~ 12 liters.

Data on this system over the last year showed that only for three days in the whole year water temperature was below  $45^{\circ}\text{C}$  and even on some of the cloudiest days when it was raining the tubular solar collectors heated the water to  $45^{\circ}\text{C}$  for 3 hours to make it potable.

Fig. 3 shows the yearly data of maximum water temperature reached in the system during 2014-15 and Fig. 4 shows the correlation between the solar radiation and maximum water temperature. Though this relationship is primarily valid for [Phaltan weather conditions](#), as a first step it can be used in designing the SWP for most places in India.



**Fig 3. Graph of maximum water temperature vs. months**



**Fig 4. Maximum water temperature vs. solar radiation relationship**

The cost of the SWP is around Rs. 2500 – 3000/- (~\$40 - 50) and it is so simple that any small rural workshop can fabricate it. In large scale production it is envisaged that the cost can come down to Rs. 1500/-. Thus a reasonably low-cost and simple water purifier for rural households has been developed. **NARI has not patented this technology since it feels that it should be made freely available for rural population.** The [manual of SWP is available here](#).

We also feel that SWP can be an excellent system for providing clean drinking water in disaster-affected areas. Besides it can also be used in conjunction with rain-water harvesting to provide safe and potable water. Since last one year two such systems at NARI are producing around 30 liters of potable water daily for all its staff members. NARI is now exploring the possibility of scaling up this technology for village-level application so that 30,000-40,000 liters of water can be made potable daily for its residents.

We also feel that the hot water after sterilization, which is at temperatures around 70-80°C, can be used to make ice via an absorption-type refrigeration system. This ice, supplied in properly insulated ice boxes, can provide low cost refrigeration for unelectrified rural huts. Experiments are underway to develop an efficient absorption cooling system for SWP.

### Acknowledgements

Help of A. M. Pawar, S. C. Madane, Asmita D'Souza and Akshay Kumbhar in fabricating the SWP and in doing initial experiments is gratefully acknowledged. Thanks to Dr. N. Nimbkar for editing and suggestions.

News stories on this article appeared in various news lines like [Business Standard](#), [Moneylife](#), [Newsgram](#), [Huffington Post](#), among others. [Better India](#) carried a special story on [it](#).

### Diesel as a household fuel for rural areas

Diesel fuel is normally used in automobiles, tractors and trucks and is considered a dirty fuel since these vehicles emit smoke and particulates. It has not been considered for use as a household fuel primarily because of its cost and also unavailability of cooking and lighting devices running on it. However NARI has shown that it can be an excellent and clean fuel for cooking and lighting in rural households when used in a newly invented device called [Lanstove™](#) (lantern plus stove).

NARI's diesel-powered lanstove simultaneously provides excellent light (equivalent to that from a 200 W electric bulb) and cooks a complete meal (including bread such as *chapatti* and *bhakari*) for a family of five. Besides it can make 10 liters of water potable. Thus one device provides excellent light, clean cooking energy and drinking water.

Diesel lanstove has been tested for the last two months in five unelectrified rural huts in western Maharashtra. It has shown excellent results with users commenting that it does not produce smoke or smell like their existing biomass-powered chulha and gives excellent light when compared to the presently used hurricane lanterns, tin wick lamps and even solar lamps. The carbon monoxide (CO) levels (measure of how good the combustion is) from these lanstoves are less than 3 parts per million (ppm), whereas those from regular chulhas are between 250-400 ppm or 80 to 130 times more than that from the lanstove. Thus lanstove is an extremely clean device equivalent to an LPG stove for cooking.



Diesel lanstove testing in a hut

Previously NARI had developed this [lanstove to run on kerosene](#) and had tested it in 23 unelectrified huts for one year.<sup>1</sup> However unavailability of kerosene for rural poor (it is normally diverted on large scale for adulteration of diesel) hampered its growth. Hence NARI thought it prudent to run it on diesel which is available in plenty and everywhere. Besides diesel has similar fuel properties as kerosene and hence it was easy to modify the kerosene lanstove to run on diesel. Also in terms of energy density, liquid fuels are way ahead of gaseous and solid fuels thereby making the storage of fuel less bulky.

In order to alleviate the problem of availability of kerosene for rural poor, Government of India (GOI) had proposed selling kerosene in open market and not through the Public Distribution System (PDS) shops. But that would have meant setting up new kerosene pumping stations. Diesel is already sold in present petrol stations and hence it is easily available.

Normally kerosene and diesel are considered to be dirty fuels. Hence their use for rural households has not been looked at favorably. Every fuel is dirty. It is the way it is burnt that makes the fuel clean or dirty. Thus liquid petroleum gas (LPG), compressed natural gas (CNG) or ethanol become clean fuels only because of excellent combustion technologies available for them. Lanstove allows diesel to burn very cleanly.

Lanstove has been designed so that diesel is stored in a slightly pressurized ( $4 \text{ kg/cm}^2$ ) 10 liters capacity cylinder from where it flows into the combustor and burns very cleanly. This detachable cylinder can be filled up and pressurized in the diesel pump stations. This filling of diesel in cylinder will be similar to getting an LPG cylinder changed. Our data shows that for a family of five, lanstove will require about 20 liters of diesel per month. Thus one full cylinder will last for 15 days. Our data also shows that on large scale manufacturing, lanstove (including the cooking utensils) will cost around Rs. 4000/- only.

However for diesel lanstove to spread on large scale in rural areas, an enlightened policy by GOI is needed to make diesel available at cheaper rates to poor people. Our data shows that it should be made available to BPL families through their UID (Aadhar) card at the subsidized rate of Rs. 30/liter. The regular users of diesel will pay the open sale price while the BPL families will pay the subsidized price through the Aadhar card. With this diesel subsidy the

lanstove's running cost will be equal to having subsidized LPG for cooking and subsidized electricity for lighting.

According to the latest census figures (2011) there are about 35,000 villages in India which have never been electrified.<sup>2</sup> These villages should be the first to be given the lanstove so as to improve the quality of life of their inhabitants.

With selling price to rural poor of Rs. 30/liter, the total subsidy bill of diesel for 35,000 villages will come to about Rs. 12,600 crores. This is less than one-third the subsidy given presently for LPG (Rs. 40,000 crores/year) which mostly goes to the middle and upper class Indians. With diesel subsidy given to the rural poor, around 2.1 crore rural households (10.5 crore people) will immediately benefit from excellent light and clean cooking technology.

Electricity-based lighting is the most efficient, but it is difficult to see how in near future electricity can be made available throughout rural India. According to 2011 census around 30 crore people are without electricity even after 68 years' of independence.<sup>2</sup> Various NGOs, foreign agencies and even GOI departments are therefore promoting solar-powered light emitting diode (LED) lanterns. These lanterns are costly, produce light equivalent to that from a 40 W incandescent bulb, are difficult to maintain because the lead acid battery in them fails easily and are energy guzzlers in their production (solar cells consume more energy in their manufacture than they will ever produce in their lifetime). Besides solar lanterns cannot cook !

Recently it has also been shown that LED light is harmful to the eyes and produces irreparable damage to retina.<sup>3</sup> On the other hand light from **lanstove has a continuous visible spectrum and is like daylight and hence easy on the eyes.**

The critics of diesel or other fossil fuel-based lanterns contend that it's burning contributes to harmful earth-warming greenhouse gases. However the fact remains that in the last 15 years the average earth-air temperatures have remained constant!<sup>4</sup> Furthermore a recent scientific study suggests that earth-warming is caused mostly by Chlorofluorocarbons (CFCs)

emissions rather than those of carbon dioxide.<sup>5</sup> Thus there is a need for rich nations to put their house in order first.

The poor cannot wait indefinitely for getting cheap renewable energy technologies for lighting and cooking. They need devices now to improve their quality of life and I feel an excellent diesel combustion device like lanstove will go a long way in doing so. The best strategy, therefore, is to rapidly develop technologies which make the existing fuels burn efficiently and in an environmentally safe manner.

There are extensive efforts being made world over to produce diesel and kerosene-like fuels from agricultural residues so as to make them renewable. I hope these efforts are also undertaken in vigorous manner in India which produces huge amounts of agricultural residues and has a very large demand for diesel and kerosene as a household fuel.

### **Acknowledgements**

NARI's team for lanstove development consisted of Akshay Kumbhar, Amol Dalvi and Sikandar Madane. Their help in fabrication and field testing of the lanstove is gratefully acknowledged.

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A syndicated story on diesel lanstove was carried by IANS and published in various news lines like [Yahoo News](#), [MoneyLife](#), [Business Standard](#) among others. An article on this was [published as a blog in Huffington Post](#).

## ***ANIMAL HUSBANDRY DIVISION (AHD) RESEARCH***

### **Highlights**

- The highlight of the year was the commissioning of the new custom-built buck and ram semen freezing laboratory on 8 November 2014 at the hands of Shri. Rajesh Aggarwal, Principal Secretary, Department of Information Technology, Maharashtra and in the presence of NARI's founder Shri. B.V. Nimbkar and about 100 invitees. It was Mr. Nimbkar's idea to have such a function. He also motivated the publication of and wrote the first draft of a booklet 'The pioneering work done by NARI in buck and ram semen freezing and artificial insemination technology' which was released on this occasion.



### **The buck frozen semen laboratory at the AHD built with savings due to customs duty exemption on imported equipment**

At the function, Mr. B. V. Nimbkar made a short speech about the establishment of the ram and buck frozen semen laboratory and the trials and tribulations that the AHD went through to achieve success in this ambitious and pioneering research and development endeavour. Dr. A. D. Karve, the first Director of NARI spoke about the research carried out during his tenure at NARI; Dr. Nandini Nimbkar, the president of NARI elaborated on research in crops and renewable energy and Dr. Chanda Nimbkar, the director of AHD spoke about the important projects undertaken by the AHD since its inception in 1990. Dr. Ghalsasi showed a short video film of the inside layout of the new laboratory as there are restrictions on entry there due to biosecurity norms.





**Shri. Rajesh Aggarwal giving speech as the Chief Guest at the inauguration of the frozen semen laboratory**

- Shri. Doddaraju, a farmer and sheep rearer from Veerapura in Sira Taluka, Tumkur district in Karnataka purchased 10 pregnant FecB gene carrier NARI Suwarna ewes from the AHD of NARI on 11 July 2014. Dr. G. M. Nagaraja, Assistant Director, Animal Husbandry Department, Karnataka government had told him about NARI Suwarna sheep. All ten ewes lambed in August and had 23 lambs in total (four had triplets, five had twins and one had a single lamb). Twenty one of these survived and were reared successfully by him. Shri. Doddaraju says that he would have got less than one lamb each from 10 local ewes but he got more than two lambs per NARI Suwarna ewe. The blood samples of 19 of these lambs were genotyped at NARI's laboratory. Out of these 12 were Homozygous FecB carrier and seven were Heterozygous FecB carrier. It is gratifying to see a sheep rearer benefiting directly from a sheep breed developed by NARI AHD.



**Mr. Doddaraju, his father and other family members with the lambs produced by 10 NARI Suwarna ewes**

- Twenty sheep owners from Tumkur, Chikkaballapura and Chitradurga districts of Karnataka were sponsored by Karnataka Sheep and Wool Development Corporation Limited (KSWDCL) to get training in ‘Sheep and goat management especially NARI Suwarna ewe and ram management’ at AHD in August 2014. This was under their programme ‘introgression of twinning genes into sheep in Karnataka through NARI Suwarna rams’. KSWDCL purchased 20 NARI Suwarna homozygous (FecB<sup>BB</sup>) rams from AHD on 1 October 2014 for distribution among the trained shepherds for introgression of the twinning gene into their flocks.
- The AHD has set up ‘The Late Shri. Ramchandra Keshav Nimbkar Memorial’ in the front room of his old house on Wadjal Farm. R. K. Nimbkar who was a trained Ayurvedic Doctor (Vaidya) migrated to Phaltan from Dahigaon near Phaltan and bought some land and built a house at Wadjal. His son Shri. Vishnu Nimbkar who was a mining engineer and then a well-known industrialist and philanthropist bought more land adjacent to the inherited land. This land and the house were then inherited by his son Shri. B. V. Nimbkar who also bought more land and then donated it all to NARI when he founded it in 1968. The farm has been used for useful agricultural research since then. The brief history of three generations of the Nimbkar family is displayed here with photographs. This memorial was inaugurated by Shri. B. V. Nimbkar on 26 August 2014 on the occasion of the Annual General Meeting of the Maharashtra Goat and Sheep Research and Development Institute.

## Ongoing Projects

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

**Funding :** We are proud to say that this breeding programme is, at present, self-sufficient. The revenue generated from sale of breeding animals can cover the expenditure on sheep maintenance and pasture and fodder cultivation for the sheep.

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

**Technical staff :** Mr. Rupsing Khanvilkar, Mr. Vikram Shedge, Ms. Padmaja Ghalsasi

#### A. Breeding programme

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 2014-15 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. The high conception rate achieved (80 to 85%) indicates the high standard of practices used for the AI programme. Adequate numbers of unrelated breeding rams were used to keep inbreeding under control. Genetic analysis was used to estimate breeding values.

A new strain of Deccani sheep was developed, called 'NARI Suwarna', that gives about 60% higher lamb production due to almost twice the proportion of twinning as in local Deccani sheep. The growth rate, mothering ability and conformation of the new breed were improved by the introduction of the Madgyal breed and continuous selection is being carried out to improve these traits further. The breed has been disseminated to shepherds in Maharashtra, Karnataka and Andhra Pradesh and they are profiting from its use. So far, about 350 breeding rams and 550 breeding ewes have been supplied. Out of these, 66 rams and 164 ewes were supplied during 2014-15. This year, 40 ewes and 4 rams were procured by sheep rearers from Pune district of Maharashtra. This is an encouraging sign as it means they are slowly realizing the profitability of NARI Suwarna.

In our selected nucleus flock, on 31 March 2015, there were 86  $FecB^{BB}$  adult ewes (homozygous for the *FecB* allele), 215  $FecB^{B+}$  adult ewes (heterozygous for the *FecB* allele) and 55 non-carrier adult ewes, making a total of 356 adult ewes. In addition, there were 61 young ewes (25  $FecB^{BB}$  and 36  $FecB^{B+}$ ) that were 4 to 11.5 months old. There were 19 adult, breeding rams, comprising of 10  $FecB^{BB}$ , 7  $FecB^{B+}$  and 2 non-carrier Madgyal rams. Additionally, there were about 50 selected young *FecB* carrier breeding rams for use and dissemination. 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.

**Table 1. Details of AI programs carried out at NARI's Lundy farm, Rajale in February, June and September 2014**

Particulars	Ewe's FecB genotype			Total
	<i>FecB</i> <sup>BB</sup>	<i>FecB</i> <sup>B+</sup>	<i>FecB</i> <sup>++</sup>	
Ewes available for breeding	87	264	63	414
Ewes inseminated artificially (AI)	80	225	58	363
Ewes conceived (first and second AI + NS)	73	191	45	309
Conception rate to first AI (%)	85.0	85.0	80.0	84.5
Pregnant ewes died	0	3	0	3
Ewes aborted	2	2	1	5
Ewes lambled with at least one live lamb	60	166	44	270
Ewes lambled with all lambs stillborn or died soon	4	10	0	14
Total live lambs born	93	271	48	412
Live lambs born per ewe lambled with at least one live lamb	1.55	1.63	1.09	1.53
Live lambs born per ewe lambled or aborted or with all lambs stillborn	1.41	1.52	1.07	1.43
Live lambs born per ewe conceived	1.27	1.42	1.07	1.33
Live lambs born per ewe available for breeding	1.07	1.03	0.76	0.995

Thus *FecB* homozygous and heterozygous ewes produced 41% and 35% more live lambs per ewe available for breeding than non-carrier ewes. This has been a consistent finding over the last several years and proves the higher productivity of *FecB* carrier ewes. This year the performance of homozygous ewes was found to be better than that of heterozygous ewes as they had fewer stillbirths.

#### B. Genotyping of sheep DNA at the *FecB* locus :

**Table 2. *FecB* genotypes of sheep belonging to NARI tested at the AHD laboratory during 2014-15**

Breed	Number of animals genotyped	<i>FecB</i> <sup>BB</sup>	<i>FecB</i> <sup>B+</sup>	<i>FecB</i> <sup>++</sup>
Garole and crosses	21	18	3	0
Crossbred NARI Suwarna lambs	421	150	206	65
Confirmation of genotypes initially determined on pedigree	43	28	15	0
Re-genotyping of parents on obtaining doubtful genotype of the progeny and found them to be incorrect	2	0	1	1
Re-genotyping of parents on obtaining doubtful genotype of the progeny and found them to be correct	4	1	1	2
<b>Total</b>	<b>491</b>	<b>197</b>	<b>226</b>	<b>68</b>

**Table 3. *FecB* genotypes of blood samples received from outside NARI**

Source of samples	Breed	Number of animals genotyped	<i>FecB<sup>BB</sup></i>	<i>FecB<sup>B+</sup></i>	<i>FecB<sup>++</sup></i>
King Saud University, Saudi Arabia	Merino X Najdi and Awassi X Najdi	266 out of 423 samples received	3	96	167
Mr. Doddaraju's flock, Tumkur, Dist. Karnataka	NARI Suwarna lambs born to pregnant ewes purchased from NARI AHD	19	12	7	0

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

**Funding agency :** Indian Council of Agricultural Research (ICAR), Government of India, New Delhi, administered through the Central Institute for Research on Goats, Makhdoom, via Mathura, U.P.

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

**Technical staff :** Mr. Kanhaiya Chavan, Mr. Navnath Patange, Ms. Bharati Pawar, Ms. Archana Nimbalkar (up to 31 Aug. 2014), Mr. Sachin Kakade, Mr. Haribhau Thombare (in Kamone, Dist. Solapur), Ms. Surekha Murumkar (in Sakat, Dist. Ahmednagar)

### 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 production performance of goats in farmers' flocks is now being assessed in four villages in three districts in western Maharashtra viz. Satara, Solapur and Ahmednagar districts.
2. The work of **refining and fine-tuning our MS Access database of the Osmanabadi field unit and putting it on the SQL platform for ease of data entry and data retrieval is almost finished.**
3. **Six hundred and five adult does** (125, 195 and 285 adult female goats in Satara, Solapur and Ahmednagar districts respectively) are being recorded. These belong to 188 goat keepers, making the average number of goats per household 3.22. 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.
4. 1176 kids were born in 698 kiddings during the year April 2014 – March 2015, giving a combined average litter size of 1.68 for all four villages. This was slightly lower than the overall average litter size of 1.72 recorded for 2013-14.
5. The least squares mean three month weight of single-born kids (463 records) was  $12.0 \pm 0.1$  kg and that of twin-born kids (1312 records) was  $10.0 \pm 0.1$  kg. Thus **does giving birth to twin kids produced almost 67% more kid weight at three months' age** 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 by the 'Network Project on Osmanabadi Goats', MPKV, Rahuri (1995-99).



**A participating goat keeper in Borla village in Jamkhed taluka, Ahmednagar district**

6. The number of observations of 6-months and 9-months weights was lower (592 and 211 records respectively) since most of the kids are sold between the ages of 3 and 6 months. **The overall least squares mean weight of goat kids at 6 and 9 months age was  $15.7 \pm 0.6$  kg and  $22.7 \pm 1.9$  kg respectively.**
7. 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 3 months and 51.3, 58.4 and 57.0 cm at 6 months. Male kids were bigger than female kids by 1.4 to 3 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.



HaribhauThombare weighing a goat kid belonging to a participating goat keeper in Kamone village in Karmala taluka, Solapur district

8. The least squares means of the test day milk yield of does suckling one, two, three and four kids were 0.621 kg (2154 records), 1.007 kg (3090 records), 1.358 kg (468 records) and 1.750 kg (28 records) respectively. The 100-day milk yield of does that had given birth to single, twin, triplet and quadruplet kids was 64.0 kg (371 records), 97.8 kg (609 records), 131.4 kg (92 records) and 132.1 kg (5 records) respectively. There was large variation in kid weight and milk yield, indicating a potential for selection. Goats from Kamone in Karmala taluka had 30% higher least-squares mean 100-day milk yield than those in Phaltan taluka. We have been able to identify good milk producing does in the villages. 19 does (1.7%) out of 1077 does whose 100-day lactation milk yields were analyzed over six years, were found to yield 200 litres and above and one doe had a 100-day lactation yield of 330 litres. Four of these lactations occurred in 2014-15. Thirty five does (3.2%) had a lactation yield of 150 to 175 kg while 67 does (6.2%) had a lactation yield of 175 to 200 kg. 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.
9. Mortality across all age groups and sexes in all villages was 3.9%. The overall mortality in different age groups was 0–10% in Satara district, 0–8.6% in Solapur district and 0–7.3% in Ahmednagar district. Pyrexia and anorexia appears to be the major cause of mortality with 26% of deaths, while poor nutrition and management were responsible for 11% mortality. Predator attacks caused about 5% of the mortality which was much less than the previous year.
10. NARI purchased 37 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. Seventeen bucks have been culled due to various reasons over the last five years.

11. NARI has disseminated 35 Osmanabadi breeding bucks in different villages for varying periods of time of which four were in the project villages on 31 March 2015, 2 in Karmala taluka and two in Jamkhed taluka.



**The goat keepers from Sakat in Jamkhed taluka came to NARI AHD to select and take home Osmanabadi breeding bucks**

12. About 8,130 straws (0.25 ml French mini straws) of frozen semen of 30 Osmanabadi bucks have been produced so far; 4,000 of these were given to the Government of Maharashtra and were supplied by the government to five district AI centres – Solapur, Ahmednagar, Aurangabad, Buldhana and Osmanabad, 153 straws were used for inseminating village goats around Phaltan that were brought to NARI's farm for artificial insemination, 2453 straws were given to field technicians in Satara, Solapur, Ahmednagar, Pune and Nashik districts and 100 straws were taken by veterinarians in Bangalore district in Karnataka. Printed notebooks were supplied to them by NARI for keeping records of inseminations carried out and results obtained. From their records, they achieved a conception rate of 45-50%. Each dose contains 100 million spermatozoa and the post-thaw progressive motility of the frozen semen is >60%. We have thus started disseminating superior Osmanabadi buck semen outside the project areas also. There are about 25 AI technicians who take Osmanabadi buck frozen semen straws from NARI. NARI now has about 1200 Osmanabadi buck frozen semen straws in storage and 500 Osmanabadi buck frozen semen straws are at the semen bank at NBAGR for the purpose of breed conservation.

The Unit has thus refined, validated and implemented AI in the field. **One of the important objectives of the AICRP on Goat Improvement is “to promote goat farmers to produce breed type superior goats for further breeding support to non-adopted areas”. We have disseminated semen of selected superior bucks to 11 districts of Maharashtra and in Karnataka State, towards the achievement of this objective.**

- Objective 2.** To evaluate the socio-economic status of goat breeders and the economics of goat production in farmers' flocks
13. Goat keeping was a supplementary occupation to crop farming for the majority of the goat keepers under the project. Up to 85% of goat keepers from all project villages owned some land. About half the goat keepers from all project villages were young to middle-aged (in the 31-50 years age group), but one third to half the goat keepers in each centre were illiterate.
14. 28 to 52% of the goat keepers under the project in all talukas kept only one adult doe each. Another 32 to 50% kept two to five adult does each. About half the does in the



project in Karmala and Jamkhed talukas were with families owning less than five does each while half were with families owning 6-20 does.

15. The main source of income from Osmanabadi goat rearing is sale of kids below one year of age. During 2014-15, 35% of the 801 male kids and 22% of the 814 female kids in the 3-6 months age group were sold while 65% of the 399 male kids and 44% of the 562 female kids in the 6-12 months age group were sold by project goat keepers.
16. The average kidding interval was 9.1 months, implying each goat had 1.3 kiddings per year. With the average litter size of 1.69 kids, this means 2.2 kids born per doe per year. With an average 8% mortality in the 0 to 6 months age group, this means two saleable kids per doe per year. For an average sale weight of 15 kg and average sale price of Rs.190 per kg, this works out to a gross income of Rs.5,700 per doe per year.

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

17. Five **information booklets in simple Marathi language** have been produced to educate participating and other goat keepers in better goat management. Second editions of these booklets have now been produced as all 500 copies of the first edition were distributed.

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.

18. Since 2013-14, fodder seed of the legume *Desmanthus virgatus* and of the multi-cut fodder sorghum variety COFS-29 developed by the Tamil Nadu Agricultural University are being supplied. This year, they were given to 12 participating goat keepers in Wadgaon and Sakat. Three plants each of psyllid-resistant *Leucaena collinsii* subabul were also supplied to six goat keepers from Wadgaon.
19. Four self-help groups (SHG) of women (61 members in total) were established in Wadgaon, Borla and Kamone. These are operating smoothly with regular meetings and micro-finance benefits to all members.
20. Decrease in sudden mass mortality and improvement in health of animals due to vaccination and treatments: All goats and kids in project villages are vaccinated against E.T., H.S. and P.P.R. and dewormed and sprayed against ecto-parasites as required. This has reduced the mortality among kids substantially.

**We intend to discontinue the Borla centre in Jamkhed taluka as no goat keepers are willing to maintain breeding bucks from the project; the goats are in different hamlets with quite a long distance between hamlets and several goat keepers do not allow us to put ear tags on their animals. Instead, we have identified a centre in Kavthemahankal taluka in southern Maharashtra where 200-300 excellent Osmanabadi goats are available in one village. This is a drought-prone area so goat keeping is more important than farming. We will do the preliminary survey and recording during 2015-16.**

**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, Dr. Chanda Nimbkar

**Technical Staff :** Mr. Kanhaiya Chavan, Mr. Rupsing Khanvilkar, Ms. Padmaja Ghalsasi, Ms. Rupali Bandgar, Mr. Dattatray Mulik

**Funding agency (only for equipment and buck purchase) :** Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Government of India, New Delhi.

**Total amount :** Rs.199.73 lakh

**Date of sanction :** 24 November 2010

The total amount of the third and fourth instalment of Rs. 50 lakhs received by NARI on 23 August 2013 was utilized mainly for the civil construction of a new custom-built buck semen freezing laboratory. Additionally, NARI purchased 20 Osmanabadi and 5 Boer bucks in March 2014 as per the provision made in the A.I. Centre budget.

Some equipment still has to be purchased for full functioning of the frozen semen laboratory. Necessary laboratory fixtures and furniture also have to be purchased to keep the delicate equipment and set up this laboratory as per biosecurity norms. It is of utmost importance to get the remaining funding of Rs.49.73 lakhs for this project in order to complete the laboratory set-up work for its optimum functioning. However, the Department of Animal Husbandry (DADF) of the Government of India has now transferred this project from the scheme ‘Integrated small ruminant development’ to ‘National Livestock Mission’ with complicated procedures and the necessity of each document such as a utilization certificate or progress report being routed through the District Deputy Commissioner, Satara, the Commissioner, Animal Husbandry, Pune and the Secretary, Animal Husbandry, Mantralaya, Mumbai. Additionally, the DADF has declared that unless they receive the utilization certificates of all funds provided by them to the Government of Maharashtra, they would not release the next instalment of funds for NARI AHD’s buck semen freezing centre.

NARI has established a standard protocol for freezing of buck semen. More than 23,000 frozen semen straws were produced up to 31 March 2014. Total 14,500 doses were supplied to the government and private AI practitioners and 4,300 were in storage. Last year 2603 straws were taken by private practitioners while during 2014-15, this doubled to 5224 straws. Out of these, 1357 were of Osmanabadi bucks, 2361 of Boer bucks, 940 or Damascus crossbred bucks and 566 of Alpine X Beetal bucks. The demand for AI is increasing because farmers cannot afford to purchase bucks of improved breeds such as the Boer and cannot afford to maintain a breeding buck for the small number of does they keep.

**Table. Conception rates of farmers’ goats artificially inseminated on institute farms when they were brought in natural oestrus**

<b>Breed of buck</b>	<b>Number inseminated</b>	<b>Number followed up</b>	<b>Number kidded</b>	<b>Conception rate</b>
Boer	213	196	74	38%
Osmanabadi	46	36	14	39%

Conception rates were lower than the previous year. We are ensuring that our inseminators follow the protocols strictly to improve conception rates. Many times farmers bring goats too

late for AI which is one of the causes of a lower conception rate. AHD has prepared a two-page leaflet that gives the steps to be followed while doing AI and this is given to all the technicians who buy frozen semen.

The new custom-built buck and ram semen freezing laboratory was commissioned by Shri. Rajesh Aggarwal, IAS, Principal Secretary, Department of Information Technology, Maharashtra on 8 November 2014.

#### **Project IV. Assessing the performance of *Leucaena collinsii* and comparing its growth and yield with NARI Nirbeeja(KX2)**

##### **Introduction :**

A trial was conducted on using the tree species *Leucaena collinsii* for high quality fodder as an alternative to KX2 which is an outstanding hybrid of *Leucaena leucocephala* and *Leucaena pallida*. KX2 is completely psyllid-resistant but has to be propagated vegetatively while *Leucaena collinsii* can be propagated with seeds although the seed production is low and the pods have a long maturation period which also makes it a tree with lower weed risk. *L. collinsii* is also reported to have negligible concentrations of condensed tannins (0.1% of DM) and low concentrations of mimosine (< 2%).

##### **Materials and Methods :**

###### **Site**

The study was conducted at Wadjal farm of AHD on plot no 5. The soil was tested in the laboratory of Krishi Vigyan Kendra, Baramati and was found to have an alkaline pH of 7.32 within the normal range of 6 to 8.5 and electrical conductivity of 0.19 within the normal range of 0 to 1.0. The soil was thus favourable for the plantation of *Leucaena* species.

###### **Experimental procedure**

The seeds of *L. collinsii* were procured from the Bijapur centre of the University of Agricultural Sciences, Dharwad, Karnataka in June 2013. The seeds were sown in plastic bags containing a soil and manure mixture. The seeds were soaked in water of 80°C temperature for 15 minutes and then in normal tap water for 4 hours and then covered in a wet gunny sack overnight before sowing the next morning. The germination obtained was 50%. The initial growth was slow. When the plants were 4-5 months old and the stems were lignified, they were considered ready to plant in the field.

NARI Nirbeeja (KX2) plants were produced by rooting cuttings. In a shade-net house, high humidity tunnels were erected using polythene sheets. Juvenile cuttings of NARI Nirbeeja, 15 cm long and 8-10 mm diameter and having two axillary nodes were selected. The terminal leaves and two pinnae on the upper leaves were retained to promote rooting. The bases of cuttings were dipped into two rooting hormones – 1% Indole Butyric Acid (IBA) and 0.5% Naphthalene Acetic Acid (NAA) and were then inserted into trays of root trainers containing cocopeat medium. Misting with water was carried out two to four times a day to prevent the wilting or drying of leaves. About 70-75% humidity and 30-33°C temperature were maintained in the tunnels with manual manipulation of the polythene covers. After about four weeks the cuttings which developed strong adventitious root systems were transplanted in polybags containing a soil and manure mixture and were kept in humidity chambers for

further acclimatization and hardening. In this chamber there was gradual decrease of humidity to avoid shock and administration of liquid fertilizer containing NPK. After two to three weeks of hardening the plants were ready to be planted out in the field. The plants were maintained in the shade-net house until further lignification of the stalk so that they will be ready for plantation in the field.

Table : Time of producing seedlings and rooted cuttings

<i>Leucaena</i> variety	Activity	Month	Month of planting in the field
<i>L. collinsii</i>	Sowing of seeds	Jun-Jul 2013	Nov 2013
KX2	Insertion of cuttings	Sep-Oct 2013	Nov 2013

### Plantation :

22 plants each of *L. collinsii* and NARI Nirbeeja were transplanted in one row each in the plot on 20 November 2013. There were nine rows in the plot. *L. collinsii* was planted in the seventh row and NARI *Nirbeeja* in the eighth row. The spacing was 2m X 1.5m and depth of pit was 0.6m. A handful of manure was applied in each pit before plantation. Flood irrigation was given at planting and at intervals of 10-15 days thereafter except in Dec-Jan and Feb-Mar when the interval between irrigations was 28 days. 200 g single super phosphate was applied per tree on 25 February 2015 at a depth of about 0.5 m and a distance of about 0.5 m from the stem.

Eight months after planting, the trees were first cut at a height of 1 m from the base and the edible biomass weighed with electronic weighing scales. Thereafter the trees were cut and the edible biomass weighed every 12 weeks. A pooled sample of 100 g was taken at each cutting and the dry matter and crude protein percentage were estimated.

### Results

The total weight of fresh edible biomass from four cuttings was 76 kg for NARI Nirbeeja (KX2) and 69 kg for *L. collinsii*. A t-test showed that the difference was not significant. The dry matter percentage of NARI Nirbeeja ranged from 35.5 to 45.3% while that of *L. collinsii* was 36.7 to 40% and the difference between the two varieties was not significant. The crude protein percentage of NARI Nirbeeja was, however, higher at 23 to 28% compared to *L. collinsii* at 21 to 26.3% and the difference approached significance.

Most NARI Nirbeeja trees suffered from severe Gummosis after establishment while *L. collinsii* trees were free from it. Copper oxychloride was sprayed and also poured at the base, but some NARI Nirbeeja trees died and had to be replaced with new ones. Therefore at the first two cuttings, while yields from 22 *L. collinsii* trees were available, there were yields available from only 18 and 19 NARI Nirbeeja trees respectively. At the third and fourth cutting, the newly planted NARI Nirbeeja trees were very young. At the third cutting in January 2015, *L. collinsii* trees suffered from a psyllid attack while NARI Nirbeeja trees did not have any psyllid damage.

The trial will be continued for another year. Indications are that NARI Nirbeeja KX2 yields will surpass *L. collinsii* yields.

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

**Funded :** internally

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

**Technical staff :** Ms. Padmaja Ghalsasi, Ms. Rupali Bandagar, Mr. Kanhaiya Chavan, Mr. Rupsing Khanvilkar, Mr. Vikram Shedje, Mr. Dattatraya Mulik, Mr. Anil Chavan

During 2014-15, the gastro-intestinal (GI) worm burdens due to natural infection of NARI's sheep and goats and of goat keepers' goats participating in NARI's projects were monitored and animals were dewormed either *en masse* or individually depending on the severity of the worm burden.

This year we started using the FAMACHA chart developed by the Central Sheep and Wool Research Institute (CSWRI) for sheep breeds in Rajasthan. This chart has photographs of conjunctiva of sheep with five different levels of haemoglobin due to varying GI infections. These photos can be compared with the conjunctiva of sheep to identify those that are unable to cope with infection by the blood-sucking worm *Haemonchus contortus*. The chart is similar to the FAMACHA<sup>®</sup> chart developed by a South African scientist but the conjunctiva colours match better with local sheep as they are of Indian sheep breeds. The animals which have a score of 3 and above, are considered anaemic and need to be dewormed, while animals in category 1 and 2 are safe and need not be drenched. However, the Packed Cell Volume (PCV) ranges standardized for the corresponding colours presented in the CSWRI chart are higher than the South African chart. This could mean that Indian sheep breeds get anaemic even at higher PCV values than South African breeds. e.g. PCV below 27% is considered anaemic in the CSWRI chart while it is below 22% in the South African chart. PCV indicates quantitatively whether the animal is anaemic or not. We found the South African FAMACHA<sup>®</sup> chart more useful to identify anaemia in Indian goats. The conjunctiva of goats appear different from those of sheep as they have fewer categories of pink shades. The South African FAMACHA<sup>®</sup> chart although prepared for sheep can be effectively used for goats.

### **Report of training received by Ms. Padmaja Ghalsasi**

AHD deputed Ms. Padmaja Ghalsasi to undertake training in Parasitology at CSWRI, Avikanagar from 9 to 15 Sept. 2014. She was trained by the renowned parasitologists Dr. Dharendra Singh, Head and Principal Scientist, Veterinary Parasitology and Dr. C.P. Swarnkar, Scientist (SG), Veterinary Parasitology, Division of Animal Health. The **objectives** of the training were :

1. To update the knowledge in parasitology.
2. To learn new techniques in parasitology with a view to implement them at NARI
3. To learn how to conduct parasitology work in a large number of farmers' flocks

During the training, routine tasks that are carried out in the AHD flocks were carried out; e.g. faecal sample evaluation for number of worm eggs and larval species identification. Ms. Ghalsasi's work was checked and confirmed with the CSWRI parasitologists which boosted her confidence. She also got to learn about the following aspects of parasitology.

- i) CSWRI has developed Bioclimatographs through which one can predict the prevalence of *Haemonchus contortus* on the pasture and consequently the worm burden in the animals which indicates when to deworm the flocks. The prevalence of *H. contortus* larvae on the pasture is highly influenced by the climate. Warmth and moisture are the required conditions for parasite survival. The graphs are plotted considering the average monthly rainfall and maximum temperature. It is a rational attempt to use climatic observations to explain the epidemiology of the parasites. According to the graphs developed for Rajasthan, mass treatment is required only once or twice a year during the monsoon.
- ii) Hypobiosis – This is the phenomenon of a temporary pause in the development of gastro-intestinal nematodes in the abomasum of domestic animals in the early (L4) stage of development. Hypobiotic larvae remain metabolically inactive in the abomasum without causing any clinical symptoms. That means the infectious larvae picked up by the animal in the dry season, remain in the stomach until the environmental conditions become favourable. When there are signals indicating it is time for them to resume development, they develop into normal egg-laying adults in the host. Hence, a rise in FEC is seen at the onset of monsoon.
- iii) Targeted Selective Treatment (TST) - Generally in a flock all animals do not have a high faecal worm egg count (FEC). About 25 to 30% animals are more affected. So mass treatment should be avoided and the animal with high FEC (>2000 eggs per gram of faeces (epg) or FAMACHA score  $\geq 3$  should be treated. This will not only limit the expenditure on anthelmintic but will allow the susceptible worm population to remain on the pasture (*refugia*) and delay the process of anthelmintic resistance.
- iv) Maintaining the animals on a good plane of nutrition is important in worm management. The animal whose nutritional requirement is fulfilled, will be able to cope with the worm burden and will reduce the establishment of the worms.
- v) It is important to screen for all the possible parasites in the faecal sample such as nematodes, trematodes (liver fluke and amphistomes), cestodes (tapeworm) and coccidia species prevailing. This epidemiology record might be useful during an epidemic.

Overall the training was useful and directly applicable.

Some new tests were also learnt, such as :

- i) Culturing faecal samples to identify *Eimeria* species (coccidia gut protozoa)

- ii) Egg hatch assay – A reliable and quick method to detect Benzimidazole (an anthelmintic class) resistance in the flock by processing faecal samples. Calculating the efficacy of the drug by using PROBIT analysis.

### **Observations and findings in the NARI flocks in 2014-15**

1. FAMACHA score is directly proportional to the *Haemonchus contortus* infection the animal is carrying. The FEC were high in those animals which had higher scores e.g. lambed ewes assessed for FEC in Nov. 2014 had FAMACHA scores of 3 to 4 and high FEC >10000 epg. On the other hand, about 80% of the weaned lambs of 4-5 months' age and maiden ewes that were measured for FEC in August 2014 had FAMACHA score of 1 to 2 when their FEC was accordingly low at 0-200 epg.
2. This year the rainfall was delayed, comparatively less and irregular. During periods of rain and when the pastures were irrigated, the worm infection on pastures was higher. The long acting anthelmintic Closantel which is effective against all blood-sucking parasites such as *Haemonchus contortus* was administered to all animals. The effectiveness of Closantel was similar to the previous year. It protected the animals from re-infection for at least 30 days and FEC did not build up for at least 55 days post-drench.
3. Pregnant ewes usually do not get infected with worms due to the pregnancy hormone Progesterone secreted by them. However, in August 2014 a representative sample of a pregnant flock was measured. These ewes had high FEC (Mean 1017 epg and range 0-3800 epg). About 20% of the flock had FEC >2000 epg. The reason could be that it was monsoon season where the chances of pasture contamination were more. These pregnant ewes were dewormed with Inj. Levamisole as it boosts their immunity also. When this group lambed in November, again they built up an extremely high FEC. The mean FEC was 5822 epg and the range was 600 to 20,000 epg. This could be attributed to the peri-parturient relaxation of immunity (PPRI), nutritional stress due to suckling by one or more lambs, and re-infection from contaminated pastures.
4. Probable hypobiosis in *Haemonchus contortus* in the dry season in naturally infected, grazing and later stall-fed Osmanabadi male goats was observed. As a part of project activities of AICRP's Goat improvement project, these bucks were sent to villages for breeding with village goat keepers' does. These were brought to Institute's farm in April 2014 and their FEC was evaluated which was found to be low. Their average FEC, however, increased from a mean of 117 epg in April 2014 to 3216 epg in August 2014 in the absence of any exposure to worms. It therefore appears that there were L4 stage hypobiotic *H. contortus* larvae in these bucks in April, which came out of dormancy due to the higher humidity and rainfall from May onwards, and started producing eggs. Their FEC details were as follows:

## FEC of Osmanabadi bucks in April and August 2014

<b>Tag number</b>	<b>FEC (epg) April 2014</b>	<b>FEC (epg) August 2014</b>
K288	100	7000
K310	100	3100
A687	0	1000
OB890	100	2600
OB891	300	1000
1126	100	4600

5. Goats cannot tolerate worm infection to the extent that sheep do. Past experience has shown that at Dhuldeo farm the goats get highly infected even if rotational grazing is practised. Therefore, this year all the goats were strictly stall-fed from April 2014 after mass drenching with oral Ivermectin. On periodic testing, no worm infection was seen up to November 2014. But in November, the mean FEC of all 49 goats was 898 epg with a range of 0-3100 epg. Eighteen goats had FEC >1000 epg of which eight were recently kidded, seven late pregnant and three goats were empty. Although goats were stall-fed, there was obviously a source of contamination which led to infection in goats. It was found that the infection probably came from a flock of sheep on that farm which was grazing outside and was housed in an adjacent pen in the evening. Later on the sources of faecal contamination in the goats were avoided as far as possible, which was reflected in the low FEC in goats in February and March 2015.
6. About 20-30% of crossbred lambs, Garole lambs and 2-4 months' old kids were found infected with tapeworm. These were effectively treated using 'Fentasplus' medicine. Two of the crossbred lambs which had tapeworm infection also had mild GI nematode infection. However, on post-drench testing no worm eggs were seen as this medicine contains Fenbendazole which is an anthelmintic. The proglottids (segments of the tapeworm) are voided through the faeces and these are visible.
7. Culture of faecal samples for sporulation of coccidia (protozoa) was performed to identify the *Eimeria* species in the sheep and goats from October 2014. Coccidia infection leads to diarrhoea in lambs and kids. The adults do not have symptoms but may act as carrier. The oocysts are shed through the faeces which contaminates feed and water. The sporulated oocysts are thus ingested by the animal and lead to the animal getting infected. Some *Eimeria* species are pathogenic, while others are not. Even if the infecting species is not markedly pathogenic, heavy infection destroys the intestinal cell lining, causing water and nutrients to be poorly absorbed. Therefore, identifying and treating sheep or goats for coccidial infection is important. Coccidia infection can be identified while screening FEC for worm infection by McMaster method. On measuring the FEC routinely, it was found that three adult sheep from Lundy farm on different occasions, one kid from Dhuldeo farm and one village goat from Wadgaon were heavily infected with coccidia. The faeces of the affected animals was collected again and cultured for sporulation. The species which were identified in sheep were *E. pallida*, *E. granulosa* and *E. parva*. (Soulsby



1982). These have a low pathogenicity. However, one sheep was found to be affected with *E. ninakohlyakimovae* which has a high pathogenicity. The Dhuldeo kid was found to be infected with *E. pallida* species which has low pathogenicity. The village goat was infected with mixed species identified as *E. pallida* and *E. arlongi* of which *E. arlongi* has high pathogenicity. All the affected animals were effectively treated with drugs such as Sulfonamides or Nitrofurazone.

8. Pooled faecal samples of sheep and goats of all the three farms were collected to detect occurrence of trematode eggs i.e fluke and amphistomes. None of the flocks were found infected.

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

### **Publications :**

1. Nimbkar, C., Ghalsasi, P. M. 2014. Management of FecB mutation carrier prolific NARI Suwarna sheep for maximizing profit. Proceedings of the National Seminar on “Revisiting Management Policies and Practices for indigenous Livestock and Poultry Breeds as Eco-friendly Economic Producers” held at Vanbandhu College of Veterinary Science & A.H., Navsari, Gujarat on 9-11 October 2014. pp. 144-150.
2. Singh V., Chavan, A., Burungale, S. V., Deshpande M. B. and Nimbkar N. 2014. Heterosis for yield and its components in thermosensitive-genetic male sterility-based hybrids in safflower. J. Agric. Res. Technol., 39 : 320-323.
3. Singh, V., Shitole, A. M., Deshpande, M. B. and Nimbkar N. 2015. New ideotypes for increasing scope and sustainability of safflower. Proceedings of the National Seminar on “Strategic interventions to enhance oilseeds production in India” held at ICAR-Directorate of Rapeseed and Mustard Research, Bharatpur, Rajasthan on 19-21 February 2015. pp. 101-103.

### **Popular articles in Marathi**

1. Dissemination of NARI Suwarna ewes in Karnataka state. (karnatakrajyat juli kokare denarya nari suwarna mendhicha prasar). LokParth. (Local newspaper). 3 September 2014.
2. Shepherds from Karnataka purchased Nari Suwarna sheep. (karnatakatil mendhpalankadun nari suwarna mendhyanchi kharedi). Daily Aikya. 10 September 2014.

### **Books :**

1. [Romance of Innovation – A human interest story of doing R&D in rural setting](#). Anil K. Rajvanshi. October 2014. e-book.
2. Details of the work done in NARI on buck and ram semen freezing and artificial insemination technology. (nimbkar krushi sanshodhansansthechi bokad va balingyanche virya gothawane va krutrim retantanradnyan kshetratil vatchal). Bonbehari Nimbkar, Founder, Nimbkar Agricultural Research Institute. November 2014. P.12.

### **Reports :**

1. Nandeshwar, B. and Patil, M. May 2014. Annual Progress Report of Sorghum research under the All India Coordinated Sorghum Improvement Project (AICSIP) of the Indian Council of Agricultural Research for the period 1 May 2013 to 30 April 2014. Submitted to the Directorate of Sorghum Research, Hyderabad.
2. Nimbkar, C. May 2014. Annual Report of ‘Osmanabadi Goat Field Unit at NARI’ from 1 April 2013 to 31 March 2014 under the All India Coordinated Research Project

(AICRP) on Goat Improvement of the Indian Council of Agricultural Research (ICAR). Submitted to the Director, Central Institute for Research on Goats, Makhdoom, U.P.

3. Singh, V. August 2014. Annual Progress Report of Safflower Research under the All India Coordinated Research Project (AICRP) on Oilseeds of the Indian Council of Agricultural Research for the period 1 August 2013 to 31 July 2014. Submitted to the Directorate of Oilseeds Research, Hyderabad. 100 pp.
4. Singh, V. August 2014. Annual Progress Report of Frontline Demonstrations in Safflower. Submitted to the Directorate of Oilseeds Research, Hyderabad. 44 pp.

### **Blogs of Dr. Anil K Rajvanshi in Huffington Post**

1. Gandhiji, I profess to know. 15 December 2014.
2. Where is the time ? 2 January 2015.
3. Switch off phones for mental peace. 16 January 2015.
4. Your fate is in your hands, Not in your palm. 4 February 2015.
5. How village restaurants could change the lives of rural areas. 7 March 2015.
6. Precision agriculture could start a Green revolution in India. 30 March 2015.

### **Articles of Dr. Anil K. Rajvanshi published in Newspapers**

1. Sleep well sleep tight. Economic Times. 10 October 2014.
2. My small attempt at Swachh Bharat Abhiyan. Blog in Speaking Tree, 24 October, 2014.
3. Nirvana via Stomach. Economic Times. 5 January, 2015.
4. Tech-way to Happiness. Editorial in Speaking Tree. 17 January 2015.
5. Knowledge for common benefit drives evolution; Editorial in Speaking Tree. March 14 2015.

### **NARI in Press (work of NARI published in mass media)**

1. A digital book titled "[Romance of Innovation](#)" published by NARI and authored by Dr. Anil Rajvanshi was put on the net on 1 August 2014. It is available free of cost. The news of this release was syndicated and published all over the world in newlines like [India West](#), [Business Standard](#), etc.
2. The digital book "[Romance of Innovation](#)" was released in Pune by Dr. R. A. Mashelkar on 20th October 2014. The news of the function was covered in [Golden Sparrow](#).
3. A story on NARI's kerosene lantern appeared in [Better India website on 24 November 2014](#).

4. A story on NARI Suvarna sheep which produces twins came in [HINDU newspaper on 14 December 2014](#).
5. A story on NARI's electric rickshaw work appeared on [Better India website](#) on 18 December 2014.
6. A story on NARI's work on sweet sorghum appeared on [Better India website](#) on 12 January 2015.
7. A news story on Dr. Anil Rajvanshi's book "[Romance of Innovation](#)" came in [Daily Mail – a UK based news-line on 2 February 2015](#).

### **Accolades**

1. NARI received a [Certificate of Recognition](#) for its Kerosene Lanstove work from Indian Merchants Chamber (IMC), Mumbai. This recognition was part of IMC Inclusive Innovation Awards 2014 given on 20 December in Mumbai.
2. Dr. Chanda Nimbkar was honoured by the Rotary Club of Pune, Katraj by giving 'Rotary Business Excellence Award' in a function organised at Pune, Maharashtra on 17 May 2014.

### **II. INVITED TALKS/LECTURES**

1. Dr. Pradip Ghalsasi gave a lecture on 'Sheep and goat improvement initiatives at NARI- particularly the FecB gene introgression and crossbreeding with Boer goat' to 70 Deputy Directors and Assistant Directors of KSWDCL on 23 April 2014 in the office of KSWDCL at Bangalore, Karnataka.
2. Dr. Anil K. Rajvanshi gave a lecture "Rocket science for Bottom of Pyramid – Challenges for Engineers", in Agricultural Engineering Department, University of Florida, Gainesville, Fla, USA on 2 May 2014.
3. Dr. Chanda Nimbkar gave a presentation on 'Sheep and Goat Improvement Initiatives at the NARI AHD' at the Department of Animal Science of the University of Western Australia, Perth, Australia on 9 July 2014. The lecture was organized by Prof. Phil Vercoe.
4. Dr. Anil K. Rajvanshi gave a lecture on 'Romance of Innovation' to about 100+ scientists and engineers at CDAC, Pune on 30 September 2014.
5. Dr. Anil K. Rajvanshi gave an invited talk on 'Romance of Rural Innovation' at Tech Mahindra, Chennai on 2 October 2014.
6. Dr. Chanda Nimbkar presented a lead paper 'Management of FecB mutation carrier prolific NARI Suvarna sheep for maximizing profit' at the National Seminar on

“Revisiting Management Policies and Practices for indigenous Livestock and Poultry Breeds as Eco-friendly Economic Producers” held at Vanbandhu College of Veterinary Science & A.H., Navsari, Gujarat on 9-11 October 2014.

7. Dr. Anil K. Rajvanshi delivered the [2<sup>nd</sup> Gemini Ganesan Memorial lecture](#) on ‘Romance of Innovation – Promise of Solar Energy’ at Madras Christian College, Chennai on 3 March 2015.
8. Dr. Anil K. Rajvanshi gave a talk to 45 engineering students from Phaltan, Baramati and Pune on ‘Roadmap for rural India’, at Bajaj Centre for Sustainable Development in NARI, in March 2015.
9. Dr. Anil K. Rajvanshi was the chief guest at the Mechanical Engineering graduate research symposium (MEGRES) 2015 at IIT Bombay and delivered the keynote address [‘Romance of Innovation – R & D for forgotten Indians’](#) on 21 March 2015.

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

1. Dr. Pradip Ghalsasi attended the ‘Global Animal Nutrition Conference - Climate Resilient Livestock Feeding Systems for Global Food Security’ organised by the Animal Nutrition Society of India in association with the Compound Livestock Feed Manufacturers Association of India (CLFMA) and VIV India on 20-22 April 2014 at Bangalore, Karnataka.
2. Dr. Chanda Nimbkar, as a member of the ‘Steering and Monitoring Committee’ for the ‘Maharashtra Gene Bank Programme’ funded by the Rajeev Gandhi Science and Technology Commission of the Government of Maharashtra attended the first meeting of the committee held at the Indian Institute of Science Education and Research, Pune on 22 April 2014.
3. Dr. Bhupesh Nandeshwar and Ms. M. M. Patil attended the 44<sup>th</sup> Annual Group Meeting of the All India Coordinated Sorghum Improvement Project (AICSIP) organized by the Directorate of Sorghum Research (DSR), Hyderabad at the Tamil Nadu Agricultural University, Coimbatore on 28-30 April 2014 and presented the annual progress of NARI center.
4. Dr. Chanda Nimbkar, a member of the ‘Task Force on Animal Biotechnology-1’ of the Department of Biotechnology, Ministry of Science and Technology, Government of India, attended the first meeting of the Task Force held at New Delhi on 9-10 June 2014.
5. Dr. Chanda Nimbkar, a member of the ‘Animal Breeding Training committee’ established by the Indian Council of Agricultural Research, attended the first meeting held at the National Bureau of Animal Genetic Resources in Karnal, Haryana on 11 June 2014.
6. Shri. Haribhau Thombare, field worker of NARI’s Osmanabadi Goat Field Unit under the All India Coordinated Research Project on Goat Improvement, gave a lecture on ‘Goat breeding with Osmanabadi, Boer, and Damascus goats’ during a training

programme under ATMA organised by the Taluka Agricultural Office at Karmala, Dist. Solapur on 21 August 2014.

7. Dr. Vrijendra Singh and Mr. M. B. Deshpande attended the annual group meeting of safflower and linseed organized by the Directorate of Oilseeds Research (DOR), Hyderabad at the University of Agricultural Sciences, Raichur, Karnataka on 24-26 August 2014 and presented the annual progress of NARI center.
8. Dr. Chanda Nimbkar attended the Annual Review Meeting of the All India Coordinated Research Project (AICRP) on Goat Improvement organised by the Central Institute for Research on Goats (CIRG), Makhdoom, U.P. at the Livestock Research Station, Navsari Agricultural University, Navsari, Gujarat on 29-30 September 2014 and presented the annual progress report of the Osmanabadi Field Unit of NARI.
9. Dr. Chanda Nimbkar attended the 'Bakra Palak Shibir (Gujarat VikasVarsh)' organised by the Livestock Research Station, Navsari Agricultural University, Gujarat at village Sukhesh, District Valsad on 30 September 2014 and addressed the participants.

A competition for the 'Outstanding bucks' was held in this Shibir and the prizes were distributed by the hands of Dr. Nimbkar along with Dr. S.K. Singh, PI and Incharge, AICRP on Goat Improvement, CIRG.

10. Dr. Chanda Nimbkar attended the Silver Jubilee Convention and National Seminar on 'Revisiting management policies and practices for indigenous livestock and poultry breeds as eco-friendly economic producers' organised by Indian Society of Animal Production and Management in collaboration with Department of Livestock Production Management, Vanbhandhu College of Veterinary Sciences and Animal Husbandry, Navsari, Gujarat on 9-11 October 2014. She presented a paper "Management of FecB mutation carrier prolific NARI Suwarna sheep for maximizing profit".
11. Dr. Vrijendra Singh attended the National Seminar on strategic interventions to enhance oilseeds production in India at ICAR-Directorate of Rapeseed Mustard Research at Bharatpur, Rajasthan on 19-21 February, 2015 and presented a paper entitled "New ideotypes for increasing scope and sustainability of safflower".
12. Dr. Chanda Nimbkar, as a member of the ICAR's Regional Committee attended two meetings held during April to June 2014.

#### **IV. TRAINING AND EXTENSION ACTIVITIES**

##### **1. Training :**

A. In June 2011 The Goat Trust, Lucknow requested NARI-AHD to provide technical support to establish an A.I. Centre for goats at Lucknow for their goat improvement programme in Madhya Pradesh, Jharkhand and Rajasthan states. Dr. Pradip Ghalsasi carried out the programme with the help of Shri. Kanhaiya Chavan on 10 to 16 June 2014 as follows.

1. Established field level semen collection and A.I. centre.

2. Carried out oestrus synchronization and artificial insemination programme in 14 goats.
3. Trained five bucks (1 Beetal and 4 Sirohi) for semen collection.
4. Froze 442 semen doses of those five bucks.
5. Trained staff members of the Trust for semen testing and dilution.
6. Gave training to 10 candidates in artificial insemination in goats.

All necessary items required for custom semen freezing, such as semen diluents and sterilized glassware were taken to The Goat Trust from AHD.

In spite of several problems like non-availability of fridge and electricity failures semen was frozen successfully in straws with 50-60% post-thaw motility.



Buck semen freezing (left) and training (right) at The Goat Trust, Lucknow by Dr. Pradip Ghalsasi and Shri. K. M. Chavan



## 2. Courses conducted :

Sr. No.	Date	Subject	Participants
1.	24-25 July 2014	Artificial insemination and improved management in goats.	Four veterinarians from Afghanistan; 1. Dr. Mohammad Hakim Niazmand Asst. Professor, Veterinary College Herat University 2. Dr. Khaled Obaidi, Lab Technician / Coordinator, Cashmere Project Herat 3. Dr. Ahmad Fawad Sharifi Farm Manager / Coordinator Cashmere Project, Herat 4. Dr. Nasir Ahmad Hady, Technical Manager (AI), DAIL, Herat This program was sponsored by the Colorado State University, USA under their 'Cashmere Goat Development' project.
2.	24-26 June 2014	Improved management and artificial insemination in goats.	Six women goat owners from Taluka Man, Dist. Satara sponsored by NARI and two participants from Mumbai and one from Pune.
3.	5-7 August 2014	Modern sheep and goat	Twenty sheep owners in two batches from

	and 12-14 August 2014	husbandry and NARI Suwarna ewe and ram management.	Tumkur, Chitradurga and Chikkaballapura districts of Karnataka sponsored by Karnataka Sheep and Wool Development Corporation Ltd., Hebbal, Karnataka.
4.	11-15 November 2014	Artificial insemination in goats.	Three Scientists, one Technical Officer and one Technician from four goat breeding farms deputed by Animal Breeding Division, Nepal Agricultural Research Council, Khumaltar, Lalitpur, Nepal.



**Trainees from Mann Deshi Foundation learning to do artificial insemination in a goat**

### **3. Internship training**

- Mr. Prashant Rajendra Salgude, an M.Sc. (Botany) Student of Postgraduate Research Centre in Botany at the Tuljaram Chaturchand College, Baramati affiliated to the Savitribai Phule University and his summer training at NARI from 24 June to 5 July 2014. It was entitled 'Study of syrup production and estimation of reducing and total reducing sugars from sweet sorghum and was necessary for fulfilling his degree requirements.
- Mr. K. B. Deshmukh of Phaltan was trained in microbial analysis of water from 25 to 27 June 2014.
- Two B.B.M. (Agriculture) students, Mr. Shinde Abhijeet Prataprao and Mr. Ghodke Vijay Umrao of Padmashree Dr. D. Y. Patil College of Agriculture Business Management,



Pune worked on the farms of AHD and studied management aspects of goat rearing as per their placement during the period 1 July to 15 September 2014.

#### 4. Extension activities :

**A. 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.	8 April 2014	Mr. Aditya Reddy, Sree Lakshmi Sheep and Goat Farms, Ravulapalem, Andhra Pradesh	4	7	6	11
2.	30 April 2014	Mr. Melwin Lewis, Harohalli, Bangalore, Karnataka	3	1	7	18
3.	11 July 2014	Mr. Doddaraju S/o Sannappa, Veerapura, Dist. Tumkur, Karnataka	0	0	5	5
4.	24 July 2014	Mr. Y. Srinivas, Sankaranagaram, Dist. Nellore, Andhra Pradesh	0	2	5	3
5.	15 September 2014	Mr. Ashawath Reddy and Mr. Chickavankat Reddy, Sujjanahalli, Dist. Chikkaballapur, Karnataka	0	2	6	1
6.	1 October 2014	Karnataka Sheep and Wool Development Corporation Ltd., Hebbal, Bangalore, Karnataka	20	0	0	0
7.	1 October 2014	Veterinary Hospital, Government of Karnataka, Sira, Dist. Tumkur, Karnataka	0	0	11	14
8.	1 October 2014	Dr. Sanathkumar, C/o Shiva Clinic, Bheemasamudra, Tal. and Dist. Chitradurga, Karnataka	0	2	0	0
9.	17 November 2014	Senior Farm Superintendent, Zonal Agricultural Research Station, VC farm, Mandya, Karnataka	2	5	0	6
10.	19 November 2014	Mr. Byregowda M., Sethakallu, Urdigre Hobli, Dist. Tumkur, Karnataka	1	2	17	10
Total			30	21	57	68

*FecB<sup>BB</sup>* = homozygous, *FecB<sup>B+</sup>* = heterozygous

**B.** As per mutual understanding with Mann Deshi Foundation, in December 2013 NARI-AHD carried out an oestus synchronization and artificial insemination program in 25 goats belonging to women goat owners in Jambhulni and Pulkoti villages of Mann Taluka. Out of these eight goats conceived and gave birth to 11 kids.

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

The following products were disseminated to farmers and for research purposes during the last year.

Sr. No.	Safflower seed	Quantity (Kg)
1.	NARI-57	248
2.	NARI-6	39.5
3.	MMS White (Parent)	33
4.	NARI-NH-1	17.5
5.	TMS-3-1-9-1 (Parent)	12.0
6.	NARI-H-23	9.5
7.	NARI-38	8.4
8.	C 2829-5-3a-6 (Parent)	5.0
9.	D 152-12 (Parent)	4.0
10.	NARI-H-15	2.0
11.	Experimental varieties	4.25
	<b>Total</b>	<b>383.2</b>

Sr. No.	Sweet sorghum seed	Quantity (Kg)
1.	Madhura	85.75
2.	Experimental varieties, hybrids and their parents	20.45
	<b>Total</b>	<b>106.20</b>

	Safflower petal herbal tea	6.8 Kg
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	Madhura sweet sorghum syrup	203.6 Kg
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	Pads of <i>Nopalea cochinellifera</i>	300 Kg
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#### **V. TRAINING RECEIVED BY NARI STAFF**

1. Ms. Padmaja Ghalsasi, Technical Officer of AHD visited Central Sheep and Wool Research Institute (CSWRI) for training in ‘Parasitological techniques in sheep and goats’ at Avikanagar in Rajasthan on 9 to 15 September 2014. The training was given by renowned parasitologists, Dr. Dharendra Singh, Head, Division of Animal Health and Principal Scientist (Veterinary Parasitology) and Dr. C.P. Swarnkar, Scientist (SG), Veterinary Parasitology, Division of Animal Health, CSWRI.
2. Smt. Ghalsasi studied epidemiological tools for worm management in a sheep flock, formulation of worm management programme, targeted selective treatment, forecasting bioclimatographs / mathematical modeling and detection of anthelmintic resistance. The training was found useful. The new techniques learnt will be implemented in NARI’s sheep and goat flocks for worm management. This training will also help in preparing the data base to be able to keep all the records.
3. Mr. Suhas J. Nikam was sent to “WSD Exposure Dialogue Programme in the Context of CCA” held at the Father Hermann Bacher Learning Centre, Darewadi from 27 to 30

August 2014. This programme was organized by the Watershed Organization Trust (WOTR), Ahmednagar.

## VI. VISITORS TO THE INSTITUTE

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

Sr. No.	Date	Visitor's name	Visitor's organization or place	Purpose of visit
1.	14 April 2014	Mr. S. B. Yadav and his three colleagues	Satara	Information about safflower
2.	15 April 2014	Mr. Rajat Gupta	Thergaon, Dist. Pune	Volunteering work
3.	26 April 2014	Mr. D. B. Balarajan Mr. K. V. R. Reddy	SMS (Plant Protection), KVK, Kurnool, A.P. SMS (Hort.) KVK, Kurnool, A.P.	Information about safflower and sweet sorghum
4.	26 April 2014	Mr. A. K. Reddy, Subject Matter Specialist (Animal Husbandry)	KVK, Yagantipalle, Andhra Pradesh	To see and get information about NARI Suwarna sheep breed.
5.	2 May, 18 August, 10 October and 29 December 2014; 2 January and 5 February 2015	Dr. S. M. Shaikh	Nimbkar Seeds Pvt. Ltd. Phaltan	Ph.D. work
6.	12 May 2014	Mr. O. P. Shukla, Chief General Manager (RM) and his two colleagues	J. K. Paper Ltd., Fort Songadh, Gujarat	They had discussions with Shri. B.V. Nimbkar and Dr. Chanda Nimbkar about propagation of seedless and psyllid-resistant leucaena for the paper factory of J K. Paper Ltd.
7.	20 May 2014	Mr. Ganpat Gaikwad	MLA, Kalyan, Mumbai	To get information about establishment of a new goat farm with improved breeds.
8.	21 May 2014	Mr. Chiranjeev Prasad, IPS, Dy. Inspector of Police	CRPF Bihar Sector, Patna	To get information about goat and sheep improvement programmes of AHD. He had discussions with Dr. Chanda Nimbkar about goat and sheep husbandry.

9.	30 May 2014	Mr. Amol Kasodekar	Jr. Research Fellow, National Chemical Laboratory, Pashan, Pune	He had discussions with Dr. Anil Rajvanshi regarding collaboration.
10.	11 June 2014	Mr. Tushar Deshpande	Res. Engineer, Pune	Visit the Institute
11.	12 June 2014	Mr. Dinesh Gargate	Navi Mumbai	Visit the Institute
12.	13 June 2014	Dr. C. S. Patil, Asst. Prof. and Poultry Manager	Department of Animal Genetics and Breeding, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar, Haryana	Dr. Patil had discussions with Dr. Chanda Nimbkar about increasing growth rate of Beetal goats by crossbreeding with Boer and increasing litter size and milk production of Munjal sheep by cross-breeding with Awassi. Department of Animal Genetics and Breeding, LUVAS also want to train their staff in goat and sheep production technology, artificial insemination in goats and semen freezing technology. Ms. Bharati Pawar showed him improved breeds of sheep and goats at AHD and gave information about these breeds. Ms. Padmaja Ghalsasi showed him laboratories.
13.	23 June 2014	Mr. Suneet S. Tembare	Barad, Tal. Phaltan, Dist. Satara	He wanted to find out about volunteering opportunities at NARI
14.	4 July 2014	Mr. V. B. Lande and Mr. V. G. Ghate	At : Sonai, Tal. Newasa, Dist. Ahmednagar	Information about sweet sorghum
15.	10 July 2014	Ms. Ashwini R. Bhise	At Post : Baramati, Dist. Pune	Information about weather data recording
16.	10 July 2014	Ms. Jyoti Deepak Sutar	At Post : Ajara	Information about seed production plots
17.	11 July 2014	Mr. Ramesh D. Jagadale	At Post : Jaysingpur, Dist. Kolhapur	Madhura sweet sorghum and safflower seed
18.	11 July 2014	Mr. Binod Anand	Vanarai, Pune	Visit the institute
19.	18 July 2014	Mr. Vijay Jadhav, Sr. Manager, Maintenance, Fleetguard Filters Pvt. Ltd.	Village Nandur, Tal. Daund, Dist. Pune	Lanstove testing
20.	21 July 2014	Sagar Pawar	At Post : Gunaware, Tal. Phaltan	Information about Institute

21.	28 July 2014	Niranjan Taradmal	Karjat, Tal. Karjat, Dist. Ahmednagar	Information about Institute
22.	30 July 2014	Ms. Pranita Kolte Ms. Supriya Borhade	Phaltan	Information about Institute
23.	5 August 2014	Dr. Vivek Patil, Assistant Professor with three colleagues	Dept. of Livestock Production Management, Veterinary College Bidar, Karnataka	To get information about advanced management practices for NARI Suwarna sheep and Boer goats and research and development activities of AHD.
24.	11 August 2014	Mr. Rajendra Dhamane, Deputy Inspector General with his two colleagues	Western Region Jail, Yerawada, Pune	To see possibilities of goat rearing as an activity for open jail prisoners. They had discussion with Shri. B.V. Nimbkar and Dr. Chanda Nimbkar.
25.	12 August 2014	Mr. Madhusudan R. Kulthe, Loksatta Reporter	Amrawati	To know about NARI's work in goat and sheep development.
26.	16 August 2014	Dr. N. S. Bhikane	Pune	To see the institute and discuss about activities
27.	18 August 2014	Mr. Abhijit Banerjee, Secretary and programme director and Mr. Kailas Sawant	Finish (Financial inclusion improves sanitation and health) Society, Lucknow	To visit Institute and discuss about activities
		Mr. Anslem Rosario	WWM&CS (Waste Wise Management & Consulting Services Pvt. Ltd.), Bangalore	
28.	18 August 2014	Mr. Rajendra Pawar + 1	KVK, Baramati	To take 2 Kg seed of NARI-57 variety safflower for yearround planting for vegetable purposes
29.	19 August 2014	Mr. Anand and Mr. Shivprakash	Synthite Industries Ltd., Kochi	To discuss regarding safflower petal availability
30.	25 August 2014	Mr. P. R. Bhorde	College of Agriculture, Pune	Information about NARI for Rural Agricultural Work Experience (RAWE)
31.	1 September 2014	Mr. Prafull Kadam	Setalor : Babhul Study and Management Institute At Post : Sangola, Dist. Solapur	He had stood for M.P. election from Madha constituency and wanted information about the projects underway at NARI

32.	1 September 2014	1. Dr. B. S. Rajput 2. Dr. Arvind Rajpurohit Programme Coordinators	1. Krishi Vigyan Kendra, Narayangao, Dist. Pune 2. Krishi Vigyan Kendra, Dahigaon, Dist. Ahmadabad	To get information about sheep and goat development activities of AHD in order to see possibilities of collaboration with NARI in training, fodder development and breed improvement programmes in their regions.
33.	2 September 2014	Dr. Ravindra Wakade	Nature Care Center, Sangli	Program of Nature care centre
34.	9 September, 7 October, 7 November and 4 December 2014; 6 February, 7 and 17 March 2015	Ms. Supriya Vishnu Shinde	At : Songaon, Post : Kshetramahuli, Tal./Dist. Satara	Information on safflower production technology, F.L.Ds etc. for her B.Sc. project for Yashvantrao Chavan Open University
35.	12 September 2014	Mr. Robin Varghese  Mr. Suresh Shah	Special Advisor. Govt. of Madagascar Businessman, Mumbai	They wanted 2 million pieces of ethanol stove for exporting to Madagascar
36.	19 September 2014	A. B. Shinde	KVK, Baramati	For safflower seed
37.	20 September 2014	Mr. P. G. Deshmukh	Basant Agro Tech (I) Ltd., Akola	-??-
38.	24, 26 September 2014	Mr. M. N. M. Fiyas	Muruthawala, Mawanella, Sri Lanka	A trainee of goat management training held at Nimbkar Seeds Pvt. Ltd. He visited AHD to get more information about goat and sheep rearing and the head office to purchase safflower seed and get instructions about its cultivation
39.	26 September 2014	Mr. Amol Karmalkar Mr. Christopher Guta	Praj Industries Ltd., Pune PressCane Ltd., Malawi	To get information about the ethanol stove as they have a distillery in Malawai
40.	6 October 2014	1. Mr. Varthur Prakash, MLA and former Textile Minister, Karntaka 2. Mr. C.V. Lokesh Gowda, Proprietor	1. Sidlaghatta, Karnataka 2. Lokee Sheep N Goat Farm, Ramalingapura, Chikkaballapura Dist., Karnataka	To get information about NARI Suwarna sheep and Boer goats. They had discussions with Dr. Chanda Nimbkar about dissemination of new breeds of goat and sheep. She showed them around the farm and laboratories.
41.	8 October 2014	Dr. P. M. Choudhari with his	Central Sugarcane Research	Visit the Institute

		three colleagues	Station, Padegaon	
42.	8 October 2014	Dr. Vilas Tonapi, Principal Scientist (Seed Technology) Dr. Sunil Gomashe, Scientist (Plant Breeding) Dr. Prabhakar Principal Scientist (Genetics and Plant Breeding)	Indian Institute of Millets Research (IIMR), Hyderabad Solapur	Field visit of kharif season 2014 (monitoring team)
43.	21 October 2014	Mr. Roshan Y. Darade Mr. Prashant Y. Darade	At Post : Yeola, Tal. Yeola, Dist. Nashik	Information about sweet sorghum. Wanted to know whether they can do a project on sweet sorghum syrup utilization in different products for value-addition
44.	30 October 2014	Rajsingh Nimbalkar	Pune	Information about sorghum syrup and goat rearing
45.	11 November 2014	Dr. Pankaj, Dr. Girish Arabale	Acuitas Tech. Conn. NCL Innovation Center, Pune	To visit the institute
46.	1 December 2014	Mr. Rahul A. Kengare Ms. Snehal V. Wankhede	Pune Pune	Information about safflower project
47.	10 December 2014	Mr. Ranjit Prakash Suryawanshi Mr. Akshay Sunil Borkar	KY's Trinity Academy of Engineering, A/P : Baramati, Dist. Pune	Rickshaw project information
48.	26 December 2014	Mr. Sanjay Lokhande	At Post : Nimblak, Tal. Phaltan, Dist. Satara	Visit institute and get safflower information
49.	30 October, 30 and 31 December 2014, 1 and 2 January 2015	Dr. M. K. Galande	At Post : Karjat	Safflower work
50.	1 January 2015	Ms. Sayali D. Jadhav	Phaltan, Dist. Satara	Enquiry about 15 days training programme
51.	5 January 2015	Dr. D. R. Bapat	Agricultural Consultant, Pune	Visit and provide consultation to AICSIP on sweet sorghum
52.	8 January 2015	Mr. Nilesh Dobhada	Walchandnagar	To see cycle rickshaw



		Mr. Sagar V. Doshi	Phaltan	
53.	10 January 2015	Dr. K. Siva Prasad Rao, Hon'ble Speaker of A.P. Legislative Assembly	Hyderabad	To see the work being done at NARI
		Sri P. Pulla Rao, Hon'ble Minister of Agriculture, Animal Husbandry and Dairy Development, Govt. of A.P.	Hyderabad	
		Dr. Manmohan Singh, I.A.S. Principal Secretary, Govt. of A.P.	Hyderabad	
		Dr. P. D. Kondala Rao, Head of the Department and CEO, APLDA	Hyderabad	
		Sri M. Ramaiah, Officer on Special Duty to Hon'ble Minister of Agriculture, Animal Husbandry and Dairy Development, Govt. of A.P.	Hyderabad	
		Sri K. Gurumurthy, Officer on Special Duty to Hon'ble Speaker of A.P. Legislative Assembly	Hyderabad	
		Sri D. Narendra, Hon'ble MLA, Ponnur Constituency, Guntur District	Guntur, A.P.	
		Sri K. Sridhar, Hon'ble MLA, Peddakurapadu Constituency, Guntur District	Guntur, A.P.	
54.	18/19 January 2015	Dr. Shyam Nigam, Former Programme Leader (Groundnut), ICRISAT	Hyderabad	Quinquennial review of safflower research programme at NARI

		Dr. L. G. K. Naidu, Former Head, NBSSLUP	Bengaluru	
55.	21 January 2015	Dr. S. V. Ghuge, Breeder	VNMKV, Parbhani	Monitoring team – for safflower AICRP programme
		Dr. D. Indi, Junior Pathologist, ZARS	MPKV, Solapur	
		Dr. A. K. Verma, Junior Agronomist	IGKVV, Raipur	
		Dr. P. Satya Srinivas, Principal Scientist, Agricultural Entomology	IIR, Hyderabad	
56.	31 January 2015	Dr. S. Rakshit, Principal Scientist, (Plant Breeding)	Indian Institute of Millets Research, Hyderabad	Monitoring team of AICSIP trials
		Dr. U. M. Alse, Jr. Agronomist	VNMKV, Parbhani	
		Dr. Y. D. Narayana, Sr. Scientist (Pathology)	UAS, Dharwad	
		Dr. V. S. Sonalkar, Junior Entomologist	PDKV, Akola	
57.	7 February 2015	Mr. Parag Chaware with three students	Cummins College of Engineering, Pune	Meeting with Dr. Rajvanshi to discuss gasifier stove design developed by them
58.	11 February 2015	Mr. S. M. Salunkhe	College of Agriculture, Phaltan	Placement of students for learning safflower emasculation
59.	12 February 2015	Somabhai H. Patel	Ahmedabad	Training for safflower hybrid seed production
60.	18 February 2015	Shekhar Wankhede Rajesh Dongre	Siddhivinayak Sanstha, Nagpur	For exploring the possibility of growing sweet sorghum in Vidarbha as an alternative to cotton and soybean
61.	21 February 2015	Dr. Paresh Dhepe + Dr. Nandini Devi	National Chemical Laboratory, Pune	To discuss regarding collaborative projects
62.	25 February 2015	Paul Twine  Mr. Jagdale	Vice President of Business Development, Asia Pacific, Nexsteppe, Singapore KVK, Baramati	To get information about sweet sorghum programme at NARI

## 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.	17 May 2014	45	Trainees of a 'Goat Rearing' training course.	Sakal International Learning Centre (SILC), Pune.
2.	26 May 2014	15	Farmers with one officer - study tour under 'Sugarcane development scheme'.	Taluka Agricultural Officer, Chandgad, Dist. Kolhapur.
3.	28 June 2014	20	Farmers with two officers under ATMA's study tour.	Dept. of Animal Husbandry and Veterinary Sciences, Gulberga, Karnataka.
4.	29 July 2014	25	Trainees of a 'Goat Rearing' training with Program Coordinator.	Maharashtra Centre for Entrepreneurship Development, Pune.
5	9 September 2014	44	SHG members and farmers under Livelihood Development program.	BOSCO GraminVikas Kendra, Kedgaon, Dist. Ahmednagar.
6.	15 September 2014	6	Girl students under 'RAWE' program.	College of Agriculture, Phaltan.
7.	16 September 2014	10	Osmanabadi goat rearers from Borla village, Tal. Jamkhed, Dist. Ahmednagar under AICRP on Osmanabadi goat.	Nimbkar Agricultural Research Institute, Animal Husbandry Division.
8.	16 September 2014	20	Farmers with Programme Coordinator.	Appropriate Rural Technology Institute, Phaltan.
9.	16 September 2014	18	Trainees of a 'Goat Rearing' training course.	Krishi Vigyan Kendra, Shardanagar, Baramati.
10.	30 September 2014	49	BSW first year students and one faculty	Yashwantrao Chavan School of Social Work, Jakatwadi, Satara. Maharashtra.
11.	2 October 2014	31	30 fourth year students of B.Sc. (Agri.) with their professor Shradha Katkar under RAWE	College of Agriculture, Pune
12.	16 October 2014	5	Students of engineering	Rajarambapu Institute of Technology, Sakharale, Islampur.
13.	30 October 2014	52	Farmers with two Taluka Agricultural Supervisors.	Taluka Agricultural Office, Deola, Dist. Nashik
14.	15 November 2014	13	Farmers with Taluka Agricultural Officer.	Taluka Agricultural Office, Murbad, Dist. Thane

15.	23 January 2015	11	A scientist from the University of Agricultural Sciences with 10 farmers	UAS, Dharwad, Karnataka.
16.	31 January 2015	42	Two teachers with 40 engineering students of different branches	The Institute of Engineers (Kolhapur Chapter).
17.	12 February 2015	70	Students of B.Sc. (Agri.) course	College of Agriculture, Malegaon.
18.	27 February 2015	26	A teacher with 25 students	Dr. Sukhatme Institute of Agriculture and Research, Phaltan

## **VII. VISITS BY STAFF TO OTHER INSTITUTES**

1. Dr. Pradip Ghalsasi visited following Institutes in Karnataka on 22 April 2014;
  - Veterinary College, Hebbal to see NARI Suwarna rams purchased from AHD by the college under RKVY project. He gave advice to the project staff on oestrus synchronization and management of rams with regard to the *FecB* gene introgression in shepherds' flocks.
  - Institute of Animal Health and Veterinary Biologicals, Bangalore to hand over pre and post Bluetongue vaccinated serum samples of 24 Boer goats of Maharashtra Goat and Sheep Research and Development Institute to test efficacy of the vaccine.
  
2. Dr. Chanda Nimbkar and Smt. Varsha Mehta from Delhi visited Mann Deshi Foundation at Mhaswad on 26 April 2014 to give advice on implementing a goat improvement project in Mann taluka and proper utilization of the data of goat owners which was collected by the Mann Deshi Foundation. They had a talk with beneficiary women goat owners from Pulkoti and Jambhulni villages in Mann taluka.
 

Smt. Mehta works with rural communities and government and non-government organisations towards the objective of poverty alleviation through improved governance and strengthening rural livelihoods, with an emphasis on sustainable and participatory management of natural resources, particularly forests, land and water.
  
3. Dr. Pradip Ghalsasi visited Nepal on 17 to 22 May 2014. During his tour he visited the following institutes.
  - Pokhara Semen Freezing Laboratory, where cattle semen is frozen. Dr. Ghalsasi gave advice to the Laboratory staff on semen freezing of bucks and information about characteristics of pure Boer bucks.
  - Bagmati Goat Breeder Farm—Dr. Ghalsasi gave demonstration of artificial insemination in goats to five goat entrepreneurs.
  - Agricultural Research Station (Goat), Bandipur – Examined kids born to goats inseminated with frozen semen of Boer bucks purchased from Nimbkar Seeds Pvt. Ltd. Dr. Ghalsasi gave advice on how to improve the 30% conception rate of AI in goats achieved by them. Discussions were held regarding training their staff in goat AI at NARI
  
4. Shri. B. V. Nimbkar and Dr. Pradip Ghalsasi visited Mann Deshi Foundation at Mhaswad, Dist. Satara on 5 July 2014. They had a meeting with Smt. Vanita Shinde, Chief Administrative Officer and Smt. Sunita Tarlekar, Business School CEO of Mann Deshi Foundation regarding goat improvement program to be carried out by artificial insemination in local goats in Man taluka.

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

1. Dr. Chanda Nimbkar was nominated as a member of the reconstituted Task Force on Animal Biotechnology-1 of the Department of Biotechnology, Ministry of Science and Technology, Government of India for three years from 16 April 2014.
2. Dr. Chanda Nimbkar was nominated as a member of the Board of Management of Indian Agricultural Research Institute by Hon. Union Minister of Agriculture and President, ICAR Society from 25 February 2014 to 24 February 2016.
3. Dr. Chanda Nimbkar was nominated as a member of the Institute Management Committee of ICAR's National Institute of High Security Animal Diseases, Bhopal from September 2014.
4. Dr. Chanda Nimbkar was appointed as a consultant (member of a committee of four) for evaluation of their work in Genetic Resources by the Food and Agriculture Organization (FAO) of the United Nations, Rome, Italy on 16 October 2014.