Kharif grain sorghum – 2016
Aruna C & Sujay Rakshit coordinating with scientists of SAUs

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Executive summary

Towards improvement of grain sorghum, both basic and applied research aspects were undertaken at ICAR-IIMR and All India Coordinated Sorghum Improvement Project (AICSIP) centers during 2016. Multi-location yield trials with the newly developed varieties and hybrids from the centers of AICSIP and private companies were carried out as part of applied research. Basic and strategic research focused on development of new MS and R lines, breeding for earliness, drought tolerance, cold tolerance, resistance against key insects and diseases etc. Biotechnological tools as well as conventional breeding methodologies were employed towards this direction. Initiatives on inter-institutional hybrid development and testing involving various centers were also taken up.

Multi-location AICSIP trials

Advanced Hybrid Trial
- In this trial 7 hybrids and 4 checks were evaluated across 9 and 19 locations in Zone I and Zone II, respectively. Data were reported from 7 locations in Zone I and 14 locations in Zone II. Of the hybrids tested, three were in the second year of advanced testing and 4 were in the first year of advanced testing.

Zone I
- In Zone I, SPH 1778 performed well for grain yield (5673 kg/ha) with 19% improvement over the best check, CSH 16. Other hybrids, SPH 1820 and SPH 1816 also recorded more than 10% superiority over CSH 16. SPH 1779 was an early maturing hybrid with 29% yield superiority over the early check, CSH 30.

Zone II
- Three hybrids SPH 1778 (3953 kg/ha), SPH 1820 (3911 kg/ha) and SPH 1779 (3896 kg/ha) yielded more than the best check, CSH 25 in terms of grain production (3780 kg/ha). For fodder yield SPH 1813 (147 q/ha) yielded slightly higher than CSH 25 (142 q/ha).

Advanced Variety Trial
- In this trial fourteen varieties along with 4 checks were evaluated across 5 and 10 locations in Zone I and Zone II, respectively. Of the varieties tested, SPV 2293, SPV 2296, SPV 2307 and SPV 2308 are in second year of AVT.

Zone I
- In Zone I, for grain yield seven test varieties out yielded the best check, CSV 17 (2374 kg/ha) with more than 10% improvement in grain yield over the check. None of the varieties could give fodder yield more than the best check CSV 23 (132 q/ha)

Zone II
- In Zone II, the varieties, SPV 2357 (3674 kg/ha), SPV 2307 (3653 kg/ha) yielded better than the best check, CSV 20 (3422 kg/ha) in terms of grain, while for fodder yield SPV 2362 (141 q/ha) was the best.

Initial Hybrid Trial
- In this trial 10 test hybrids along with four checks were evaluated in RCBD for grain yield, fodder yield and other agronomic traits across 10 locations, four in Zone I and six in Zone II.

Zone I
- None of the test hybrids could out yield the checks, CSH 25 (3724 kg/ha) and CSH 30 (3425 kg/ha). For fodder yield also CSH 25 (134 q/ha) recorded high yields, and none of the test hybrids could out yield CSH 25.

Zone II
- In Zone II, only one hybrid SPH 1846 (3816 kg/ha) yielded better than the best check, CSH 25 (3702 kg/ha). For fodder yield, SPH 1855 (138 q/ha) had marginally better yields compared to the check, CSH 25 (135q/ha).
Initial Variety Trial

- In this trial 21 test varieties and 4 checks were evaluated in RCBD for grain yield, fodder yield and other agronomic traits across 10 locations.

Zone I

- Four test varieties yielded better than the best performing check, CSV 20 (3136 kg/ha), SPV 2438, SPV 2424, SPV 2437 and SPV 2442. However, none of them yielded more than 10% over the best check, CSV 20. Of the seven varieties matured in 100 days or less, four varieties SPV 2424, SPV 2442, SPV 2436 and SPV 2440 recorded >10% higher yield over the early check, CSV 17 (2307 kg/ha). Highest fodder yield was recorded in the variety, SPV 2430 (171.6 q/ha), followed by SPV 2425 (170 q/ha). The best check for this trait was CSV 27 (164.7 q/ha).

Zone II

- The test variety, SPV 2423 (4027 kg/ha) recorded >10% grain yield superiority over the best check, CSV 20 (3519 kg/ha).

Coordinated sorghum breeding research

During 2016, two inter-institutional hybrid programmes, one with 17 experimental hybrids along with three checks and another with five hybrids were tested at Coimbatore, Akola, Dharwad, Parbhani and Indore. Best checks was CSH 25 (4398 kg/ha). None of the hybrids could outyield CSH 25 in grain production. IIHT Ak4 with 4206 kg/ha of grain yield was the best among test hybrids followed by IH 16-9 (4028 kg/ha). Sixty nine F2 populations were shared with various centers (Chamarajnagar 15, Indore 8; Udaipur 8; Diggitonk 15; Bapatla 15 and Deesa 8). Number of single plant selections made at these centers is: Indore 156; Udaipur 163; Diggitonk 186 and Deesa 34.

Kharif sorghum breeding at IIMR

The kharif sorghum improvement program at IIMR continues to give emphasis on diversification of genetic base to break the yield plateau, development of parental lines with high combining ability and hybrids with high heterosis, development of high yielding varieties and hybrids with good grain quality suitable for different end uses. Emphasis is also given on breeding for important biotic stresses such as grain molds, shoot fly, stem borer etc. Both conventional and advanced breeding tools are employed to deal with these problems.

In the project on development of kharif sorghum genotypes suitable for different seasons, diverse photosensitive guinea sorghum germplasm from Sudan, Zambia, Malwi, Tanzania and Nigeria were used in the crossing program, and about 400 single plant selections were made from 31 F2 populations. 35 B lines and 60 R line trials were evaluated in RCBD. 300 pairs of A and B lines were advanced. In another set, 43 out of 52 pairs of test crosses planted in BC4 generation during rabi 2015 were selected for further backcrossing in kharif 2016. The grain yield in advanced breeding lines ranged from 1281 to 3844 kg/ha, and IIMR 1625 (3844 kg/ha) and IIMR 1618 (3833 kg/ha) outyielded the best check CSV 27 (3731 kg/ha) marginally.

ICAR XII Plan Consortia Research Platform on Biofortification in selected crops for nutritional security (2012-17)

Grain iron in the popular cultivars ranged from 15-43 ppm and zinc from 13-36 ppm. More than 60 new crosses using the donor sources for grain iron/zinc were made earlier. Segregating generations (F2-F6) (250 SPP) are being advanced and selections are being made in the field based on phenotypic attributes of plant and panicles. Phenotyping of the sorghum association mapping panel comprising of 250 genotypes is in progress for grain iron and zinc content. The genetic diversity analysis of allelic data using 48 SSR loci indicated the presence of excellent genetic diversity, genotyping with more markers is under progress.
**Genetic improvement of kharif sorghum genotypes for higher yield and better grain storability**

During the kharif season 40 F2 populations were evaluated at Hyderabad and currently 834 F3 families are being evaluated and advanced. Besides these, a total of 69 F2 populations were shared with various centers (Chamarajnagar 15, Indore 8; Udaipur 8; Diggitonk 15; Bapatla 15 and Deesa 8). Numbers of single plant selections made at these centers are as follows: Indore 156; Udaipur 163; Diggitonk 186 and Deesa 34. Out of 309 early A/B pairs evaluated 205 have been selected and advanced. Top 10 lines with high oil over two years identified are: IS 30466, IS 30443, IS 1212, IS 30507, IS 29654, IS 30383, IS 30451, IS 30536, IS 603 and IS 31681. Seed hardness data suggest IS 13782, IS 8971, IS 2382, IS 19153 and IS 23521 to be hardest, and IS 29326, IS 2379, IS 25548, IS 30450 and IS 40778 to be softest. Towards genetic diversification 23 polycrosses were attempted.

**Molecular mapping and candidate gene analysis of a new epicuticular wax locus in sorghum (Sorghum bicolor L. Moench)**

A new epicuticular wax (Bloom) gene has been identified and fine-mapped to 207.89 kb genomic region on SBI-01. A putative candidate gene, Sobic.001G269200 annotated as GDSL-like Lipase/Acylhydrolase, involved in bloom synthesis/deposition is proposed as the most probable candidate gene.

**Improvement of sweet and high biomass sorghums for biofuel and forage production**

The hybrid NSS 1008 A X IS 18542 recorded the highest fresh biomass of 101 t/ha and was 17% superior to the check CSH 22SS (86 t/ha). The same hybrid exhibited the highest fresh stalk yield (76 t/ha) and was 19% superior to the check. The hybrid NSS 1008 A X (NSSV 258 X ICSV 93046)-1-3 recorded highest brix (19.5%). Of the 22 varieties evaluated for sweet sorghum productivity traits, NPK 2016-2 recorded the highest biomass yield of 73 t/ha against the check CSV 24SS (51 t/ha) and was superior to the check by 43%. It was also promising for fresh stalk yield (46 t/ha) and was superior to the check by 50%.

**Kharif sorghum breeding at AICSIP centers**

**Akola**

During kharif 2016-17, F0 seed of 19 new crosses were sown and harvested in bulk for F1 generation. Similarly, F1 seed of nine new R x R were planted for further advancement of generation. F2 selections of 12 new crosses were sown and further, individual plants were selected for advancement (F3). Similarly, the F2 generations (IPS) of eight four way crosses were sown. Total 105 IPS were selected in R line development programme, and 27 BC pairs were made. In grain mold resistance breeding programme, total 21 IPS were selected in R line development programme while 16 IPS in B line development. Total 29 BC pairs were made in grain mold resistance breeding programme. In shoot fly resistance breeding programme, 23 BC pairs were made. In order to get new recombinations, the F2 population from four way crosses (Biparental crosses) were sown for advancing.

In university programme total 6 Station Hybrid/Varietal Trials were successfully conducted. Under the programme of enrichment of sorghum for micronutrients (zinc and iron), eighteen F1 cross seed (R x R) were planted and individual plant selections made from F2s. Under the project “Identification of micronutrients dense sorghums for better health in western and central Africa (WCA) and India” funded by Harvest Plus Programme of CGIAR, three trials were conducted successfully. Total 8 AICSIP trials were conducted successfully and data submitted. Similarly under the project CRP on Agro biodiversity, total 1000 kharif germplasm lines were evaluated. One Ph.D. and two M.Sc. students are doing their research work at this unit. Total Nine research papers have been published in the NAAS rated journals. Ten popular articles were also published.
Coimbatore

Grain sorghum breeding program:
In MLT (S) four cultures were tested and the highest grain yield of 4200 kg/ha was noted by TNS 648 with yield increase of 11% over the check, CO 30, and fodder yield of 12981 kg/ha with yield increase of 10%. It also recorded less shoot fly incidence of 11.9%. In MLT (K), TNS 648 recorded highest grain yield (3319 kg/ha), with yield increase of 16.3 and 31.7% increase over the check CO 30 and K12 respectively. The hybrids viz., TNSH 487 and TNSh 488 recorded highest grain yield of 36 and 20% over CO 5. In UVT-I, highest grain yield of 2685 kg/ha noted in APK 1 x M 35-1-2-2-3. The highest fodder yield was a noted in the cross derivative IS 18417 x CO 25-4-3-1-3 (12638 kg/ha) followed by CO 26 x IS 4646-3-1-1-2 (12768 kg/ha.). In UVT-II, 11 entries were tested. Five entries excelled in grain yield performance with highest grain yield in the cross derivatives TNS 636 x TNS 634-5-1-2 (2867 kg/ha) and TNS 633 x TNS 636-2-3-1 (2585kg/ha) with yield increase of 21 and 35% over check. The highest fodder yield was observed in TNS 630 x TNS 634-5-2-2 (12926 kg/ha) followed by TNS 631 x TNS 633-3-2-5 (12400 kg/ha). Fifteen entries were evaluated under NRRYT. The grain yield performance were recorded and it ranged from 648 (CO 26 x EP 60 - 5-1-3-1-1) to 2222 kg/ha (CO 26 x EP 60 - 5-1-3-2-3). For state released variety CO 30, 40 kg of breeder seeds and 700 kg of TFL seeds were produced. A total 39 crosses were evaluated and 54 families were selected for further evaluation. A total of 16 AICSIP trials were conducted.

Forage sorghum breeding program:
Released one Multicut Forage Sorghum variety SPV 2242 F as CSV33MF at national level. PPV & FRA application prepared for SPV 2242 F and submitted to IIMR. In R line development programme, seven F1 crosses evaluated for forage traits. In segregating generations viz., in F2, nine crosses evaluated and 25 families selected. Similarly F3-seven and F5-nine crosses evaluated and seven and 24 families selected, respectively. In total, 13 crosses evaluated and 62 families selected for forage value. MLT forage sorghum (Summer): TNFS 213 recorded highest green fodder yield (29417 kg/ha) which is 38.76% increase over check K11. MLT Sweet sorghum (Summer): TNSS 212 recorded green fodder yield of 31827 kg/ha and 16% increase over check CSV 245S. MLT-Forage Sorghum (Kharif): TNFS 213 (29413 kg/ha) expressed 38 and 48% superior performance over checks CO 27 and K11. RRYT Sweet sorghum: A total of 8 entries were tested and recorded superior performance over check (22-35%). RRYT Forage sorghum: A total of 28 cultures were tested and recorded 20-45% superior performance over check. Breeder seed: A quantity of 200 kg produced. 126 Germplasm lines are characterised with minimum DUS traits. Germplasm were subjected to screening for drought tolerance based on leaf area index, SPAD chlorophyll, relative water content, plant height, proline, stay-green and grain yield. The genotypes IS23399, DRT1030, MS7735, KOS5SS3 and KOS5SS186 are identified as drought tolerant. In AICSIP programme, Forage sorghum (4), sweet sorghum (1), Pathology (3), Entomology (4) and Agronomy (1) trials were successfully conducted and data sheet submitted.

Deesa
In station trials, outstanding performance was observed by entry DS 157, DS 165 and DS 172 in dual and DSF 145, DSF 133 and DSF 158 in forage sorghum. In station trials Entry DS 127, SR 2935, DS 137, SR 2812 and SR 2980 were found superior for grain and dual sorghum. In forage sorghum Entry SRF 353 followed by SRF 332, SRF 370, DSF 153, SRF 347 and DSF 117 found superior for green and dry fodder yields. Under breeding programme total 33 crosses of dual and forage sorghum were successfully made. Under the generation advancement 36 F2s and Single plant progenies of dual and fodder sorghum were evaluated under different stages (F3 to F1) and selections made. A total of 1000 accessions of forage and dual sorghum were characterized under CRP Agro biodiversity and 35 new germplasm collected. Other than station breeding programme, centre conducted 8 coordinated trials and evaluated 69 entries (25 hybrid and 44 varieties) of grain/dual sorghum, 38 entries of single cut forage sorghum, 19 entries of multicut sorghum and 11 entries of high biomass sorghum.
Dharwad
Kharif sorghum improvement is undertaken mainly to develop improved varieties and hybrids with higher productivity coupled with improved tolerance to biotic stresses particularly grain mold and shoot fly pests. Five ICAR trials IVT (GS), IHT(GS), AVT(GS), AHT(GS) & IIHT were conducted & these trials comprised of two varietal (SVD-1130 & SPV-2366) & four hybrid entries (SHD-63, SHD-70, SPH-1816 & SPH-1817) from Dharwad centre. Apart from this, two multilocation (varietal and hybrid trials) and four station trials were also conducted. In the station hybrid trial I, SHD-111 (76.89 q/ha) and SHD-116 (76.12 q/ha) recorded significantly superior grain yield compared to local check hybrid CSH-14 (56.49 q/ha) and some hybrids were superior over recently released hybrids CSH-30 (67.60 q/ha). In station hybrid trial II, SHD-130 (65.93 q/ha), SHD-131 (58.15 q/ha) and SHD-92 (58.52 q/ha) recorded significantly superior grain compared to local check hybrid CSH-14 (41.67 q/ha).

Indore
Five genotypes were contributed in Coordinated Trials and tested i.e. two in AVT (single cut), one in AVT (GS), two in IVT (GS) and seven experimental hybrid in IIHT trial. Four station trials i.e. SVT I(22 entries), SVT II(22 entries), SHT I (58 entries) and SHT II(25 entries) were conducted. 30 Indore bred restorers were evaluated for agronomical traits. Characterization of One thousand exotic germplasm under CRP- Agro biodiversity (27 traits). Notification proposal was submitted for RVJ 1862.

Hisar
Six AICSIP forage sorghum breeding trials including IAVHT-MC, IVHT-SC, AVHT-SC, SML trial, IIFH trial and seed trial were conducted. Entomology trials (sweet sorghum trial, multicut trial, IVHT and AVHT single cut trial and SPN-Kh 2016) were conducted, and a pest survey was also done at farmers field. Three agronomy trials were successfully conducted. One physiology trial on evaluation of sorghum elite lines for salinity tolerance was also conducted. 25 FLDs (0.4 ha each) on forage varieties were conducted as per the guidelines of IIMR. In station trials 110 MS based hybrids was evaluated. In Progeny Row Trial, Small Scale Trial and Large Scale trial 37, 26 and 7 genotypes were tested and promising genotypes were selected. Four research papers, one book chapter and five technical bulletins have been published. Two papers were presented in two international conferences during this period. Under RKVY project entitled “Farmers’ trainings on scientific cultivation of forage crops to ensure quality seed production” 20 training were organized in 20 districts of Haryana to aware farmers about quality seed production of forage sorghum and good cultivation practices of forage crops production including sorghum.

Kovilpatti
Two AICSIP breeding trials viz., AVT GS and AHT GS were conducted at ARS, Kovilpatti. A total of 102 single plants were selected in varietal development programme. F₁ of 15 crosses were evaluated and harvested. Similarly F₂ (36), F₃ (30) crosses were evaluated and a total of 102 families were selected for further evaluation. Midge resistance programme- F₁ (12), F₄ (33), F₅ (10), F₆ (11) crosses were evaluated and 12 single plant were selected with resistance score 1. In drought tolerance programme, F₁ generation of five new crosses was harvested. The high yielding culture TKS 1036 has recorded grain yield of 3647 kg/ha and single cult forage sorghum culture TKFS 11109 has recorded dry fodder yield of 19.75 t/ha under rainfed condition. These two are under second year MLT evaluation. The breeder seed production of K 8 and K 12 was carried out.

Ludhiana
Nine coordinated (including five forage sorghum, one seed yield and three sweet sorghum trials) trials were conducted successfully. In addition, four local trials were conducted including one multilocation trial in which promising fodder sorghum hybrids were evaluated for high fodder yield and quality. In the multilocation trial, PSC 10 and PSC 13 were found promising with good fodder yield and quality. In the station trial 11 new hybrids were evaluated and among these two hybrids
recorded good fodder yield. Four private sector hybrids were also evaluated for single cut performance and Sugargraze recorded highest green fodder yield but its per day productivity is low. About 35 A/B pairs along with 70 restorer lines were maintained. 230 lines of different segregating generations were received from IIMR and single plant selections were made. 16 sweet sorghum lines were also received which were also maintained and involved in crosses. Seed of released sorghum hybrids (PSC 1 and PSC 4) was produced along with their parental lines, and the seed of SL 44 variety was also produced.

**Palem**

RARS Palem is one of the important AICSIP center working for kharif Sorghum Improvement in Telangana with major emphasis on development of dual purpose sorghum varieties with tolerance to grain mold disease. During Kharif 2016, 5 breeding trials (4 GS + 1 SS) were conducted. In Station level three trials were conducted with total no. of entries (43) which include AVTGS-II (17 entries) in AVTGS-I (17 entries) and in IVTGS (9 entries). 18 progenies were selfed to maintain in F₆ generation for further advancement to station trials. In Yellow pericarp sorghum improvement, 21 promising lines were maintained for future use. In crossing work, 25 new crosses were made utilizing the grain mold tolerance lines and dual purpose lines. Further 76 germplasm lines selected during Germplasm field day at CRS, Solapur were sown during Rabi 2016.

**Pantnagar**

Pantnagar Centre is doing fruitful efforts to cater to the demands of the farmers and dairy men of north-western India. With the mandate of developing high yielding fodder varieties and hybrids of single cut and multicut nature, the centre is functioning as the fore runner in developing multicut forage sorghum hybrids in the country. It has the credit of developing two multicut hybrids viz. CSH 20 MF and CSH 24 MF at the national level, of which CSH 24 MF has become very popular and large scale hybrid seed production of its being taken up under the public-private-partnership (PPP) mode through the concerted efforts of ICAR-IIMR, To meet market demand of multicut hybrids and recent requirement of single cut hybrids, efforts have been mainly focused on development of good high tillering, early flowering and fast regenerating as well as single cut type juicy sweet stemmed restorers/pollen parents. Single cross hybrids viz. SPH 1797 (UTFSH 2) and UTMCH 1317 (New) were under test in AICSIP Trials during Kharif 2016. Efforts are in progress to develop three way cross hybrids and some of them has red grain seed parent thus fulfilling market demand of preference for coloured grain forage sorghum hybrids. Three way cross hybrids of multicut and single cut types viz. SPH 1768 (UTMCH 1313), SPH 1807 (UTMCH 1315), UTMCH 1318 (new), SPH 1822 (UTFSH 3) and UTFSH 4 (new) have been tested in All India Coordinated Trials during Kharif 2016.

Beside maintaining and utilizing a collection of 422 germplasm line and 74 pairs of A/B line for generating genetic variability through inter varietal crossing, large number of generations (from F₁ onwards) of 9198 progenies (single plant progenies as well as bulk progenies) belonging to 183 crosses were planted. Out of these, 1131 progenies of 115 crosses were selected for various forage traits. Work is in progress to develop/improve B lines for fodder yield and quality by making B x B crosses. 78 single plant progenies of 11 B x B crosses are in F₂. Promising genotypes for restorers, potential single cut and multicut elite lines, stable brown midrib genotypes, sweet and juicy stem have been identified for validation tests for yield, quality etc.

**Parbhani**

A total of 13 AICSIP and 04 station trials were conducted. In addition, two Physiology and one State level trial were also successfully evaluated. During rabi 2016-17, 9 AICSIP and 5 station trials are under evaluation. Two state level and two sorghum Physiology trials are also allotted to this research station and are under field evaluation. 13 kharif and 17 rabi entries from this research station were contributed and evaluated in AICSIP and state level trials. 77 single plant selections for R line
improvement, and 85 SPS for B line development programme were made during 2016 kharif. 35 selections from 10 crosses for grain mold improvement and 25 single plant selections from 18 crosses for shoot fly improvement program were also made.

**Phaltan**
In Kharif 2016, three (3) breeding and two (2) physiological AICSIP trials and nine (9) station trials were conducted. Objectives for station trials were to develop and identify high biomass, high juice yield, high brix, shoot fly and stem borer tolerant lines.

**Rahuri**
The AICSIP MPKV, Rahuri is voluntary working on sweet sorghum improvement. During kharif season crop condition of sweet sorghum crop was satisfactory. The cane yield and brix% level in all the experiments was recorded satisfactorily. In general kharif season is favorable to sweet sorghum crop. The sweet sorghum hybrid Phule Vasundhara for ethanol purpose has been notified vide S.O. No. 2238 E dated 29/6/2016.

**Surat**
During kharif 2016, total 11 project trials, four on grain, three on forage sorghum, each one on sweet sorghum and high biomass, were successfully conducted at Surat, while two trials on grain sorghum were conducted at Mangrol. Total four trials of grain sorghum and three of forage sorghum were successfully conducted at 16 locations. In grain sorghum genotypes, SR 2957, SR 2914, SR 2950, SR 2896, SR 2958 and SR 2980 while in forage SRF-347, DS-117, DS-123 and SRF-316 depicted superiority for economic yield over respective better check. Evaluation of F₄ and F₅ generations was also taken up.

**Udaipur**
Thirteen advance generation material from F₆ and F₇ grain generations (grain & dual) were evaluated for grain yield and other attributes under Station Varietal Trial (SVT). 12 promising entries from advanced generation material from F₆ and F₇ were evaluated for their for fodder yield and other forage attributes under Station Fodder Trial (SFT). Evaluation of single cut sorghum genotype SPV2185, for green fodder yielding capacity at Udaipur and ATC Chittorgarh (RVFT). This year a total of 36 new crosses were attempted to get the improved R line using nine parents in half diallel mating design. Selections were made for early, fodder purpose plant types with insect/disease resistance through evaluation of 4 crosses in F₃, 21 crosses in F₄ and 1 cross in F₆ generation. A total of 185 progenies were advanced. Nucleus seed of SPV 245, CSV 15, CSV10, CSV17, PJ1430, CSV23, PC1080, SPV1822, SU45 and SPV1753 and breeder seed of CSV 17, CSV 23, & PC 1080 was produced.

**Publications**
During 2016-17 on grain, forage and sweet sorghum improvement all total 40 research papers, 25 conference papers, 11 popular articles, and 6 book chapters were published.
Introduction
In 2016, both basic and applied research towards improvement of grain sorghum were undertaken. Applied research dealt with multi-location yield trials of finished or near finished products (varieties and hybrids) from the centers of All India Coordinated Sorghum Improvement Project (AICSIP) and private companies. Basic and strategic researches focused on various aspects including new cultivars, MS and R lines development, breeding for earliness, resistance against key insects and diseases etc. Efforts were made to use biotechnological tools as well towards understanding diversity and gene mapping. Efforts were also made to develop inter-institutional hybrids, under which promising MS lines were shared across centers and new experimental hybrids were developed, which were tested under multi-location trials. The progresses made during the kharif 2016 are discussed under the following heads:

I. Multi-location AICSIP trials
II. Coordinated sorghum breeding research
III. Kharif sorghum breeding at IIIMR
IV. Kharif sorghum breeding at AICSIP centers
V. Publications

A. Multi-location AICSIP trials
During kharif 2016 four trials, viz., Advanced Hybrid Trial (AHT), Advanced Variety Trial (AVT), Initial Hybrid Trial (IHT) and Initial Variety Trial (IVT) were conducted across 11 (initial trials) to 21-28 locations (advanced trials).

i) Advanced Hybrid Trial (Tables 1.1 to 1.8, 1A, 1B and 1C)
In this trial 7 hybrids and 4 checks were evaluated across 9 and 19 locations in Zone I and Zone II, respectively. Data were reported from 7 locations in Zone I and 14 locations in Zone II. Trials got vitiated principally due to heavy rains during maturity at some locations. Of the hybrids tested, three were in the second year of advanced testing and 4 were in the first year of advanced testing.

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<td>9</td>
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</tr>
<tr>
<td>10</td>
<td>Lines &gt; best check</td>
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<td>SPH 1778, SPH 1778, 1820, 1779, 1817</td>
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<td>11</td>
<td>Data from locations (no)</td>
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<tr>
<td>12</td>
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Zone I (Table 1A)
- Days to flowering and maturity – Flowering among hybrids ranged from 58 (CSH 30) to 64 days (CSH 25). Among test entries SPH 1779 and SPH 1813 was comparable to early check, CSH 30 with 60 days to flower. CSH 30 was the earliest to mature (97 days), followed by SPH 1779 and SPH 1813, both of which matured in 99 days. CSH 25 took longest time (103 days) to mature.
- Plant height – Plant height ranged from 172 cm (SPH 1820) to 194 cm (CSH 16).
- Grain yield – CSH 16 was the best performing check (4754 kg/ha) and the early maturity check CSH 30 yielded 3965 kg/ha of grain yield. Among the test entries, SPH 1778 performed the best with 19% improvement over the best check, CSH 16. The hybrids, SPH 1820 and SPH 1816 recorded more than 10% superiority over CSH 16. Among the early maturing test hybrids, SPH 1779 recorded 29% yield superiority over the early check, CSH 30.
Table 1A. Performance of hybrids in Advanced Hybrid Trial (AHT) – Zone I during kharif 2016

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Hybrid</th>
<th>Centre</th>
<th>Centre</th>
<th>FY</th>
<th>% ± over CSH 16</th>
<th>% ± over CSH 30</th>
<th>% ± over CSH 25</th>
<th>% ± over CSH 30</th>
<th>DT F</th>
<th>DT M</th>
<th>PH</th>
<th>SW</th>
<th>GM FG</th>
<th>GM TG</th>
<th>SF DH</th>
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<td>5.3</td>
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<td>8</td>
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<td>CV(% )</td>
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Note: R - Ranking; FY - Grain Yield (kg/ha); SF - Fodder Yield (kg/ha); DTF - Days to flowering; DT M - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage at 28 DAE; GM FG - Grain mold field grade (1-9); GM TG - Grain mold threshed grade (1-9)

Zone II (Table 1B)

- Days to flowering and maturity – Flowering among hybrids ranged from 65 (CSH 30) to 72 days (CSH 25). None of the test hybrids were as early as CSH 30. However, SPH 1779 and SPH 1817 were early to flower in 68 days in this zone. CSH 30 was the earliest to mature (105 days) followed by SPH 1779 and SPH 1817 which matured in 107 days. CSH 25 matured in 112 days, while all other hybrids matured earlier to CSH 25.
- Plant height – Plant height ranged from 181 (SPH 1820) to 217 cm (SPH 1813).
- Grain yield – CSH 25 was the best performing check (3750 kg/ha). Three test hybrids, SPH 1778, SPH 1820 and SPH 1779 performed better than CSH 25 with grain yield of 3953 kg/ha, 3911 kg/ha and 3896 kg/ha, respectively.
- Fodder yield – CSH 25 ranked first among the checks in terms of fodder yield (142 q/ha). Among test hybrids only SPH 1813, out yielded this check (147 q/ha).
- Grain size – Grain size ranged from 2.80 g/100 grain (SPH 1813) to 3.02 g/100 grain (SPH 1816).
- Biotic stress – All test hybrids and checks were at par in terms of grain mold and shoot fly response.
- Remarks – None of the hybrids could out yield the check, CSH 25 for both grain and fodder yields in this zone.

Table 1B. Performance of hybrids in Advanced Hybrid Trial (AHT) – Zone II during kharif 2016

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<tr>
<th>Sl.</th>
<th>Hybrid</th>
<th>Centre</th>
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<th>R</th>
<th>% ± over CSH 25</th>
<th>% ± over CSH 30</th>
<th>FY</th>
<th>R</th>
<th>% ± over CSH 25</th>
<th>% ± over CSH 30</th>
<th>DT F</th>
<th>DT M</th>
<th>PH</th>
<th>SW</th>
<th>GM FG</th>
<th>GM TG</th>
<th>SF DH</th>
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<tbody>
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<td>3953</td>
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<td>71</td>
<td>110</td>
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<td>13.6</td>
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<td>217</td>
<td>2.80</td>
<td>3.3</td>
<td>3.7</td>
<td>71.1</td>
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### Table 1C. Performance of promising hybrids over three years in AICSIP trials (2014-2016)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Entry Center</th>
<th>Grain yield</th>
<th>Fodder yield</th>
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<td>Zone I</td>
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<tr>
<td></td>
<td></td>
<td>2014</td>
<td>2015</td>
</tr>
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<td>4182</td>
<td>4210</td>
</tr>
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<td>2</td>
<td>SPH 1779 Hytech Aur</td>
<td>4790</td>
<td>4050</td>
</tr>
<tr>
<td>3</td>
<td>SPH 1789 IIMR, Hyd</td>
<td>4652</td>
<td>4413</td>
</tr>
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<td>4</td>
<td>CSH 25 Check</td>
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<td>3364</td>
</tr>
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<td>4264</td>
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<td>SPH 1778 Hytech Aur</td>
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<td>5</td>
<td>CSH 30 Check</td>
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<td>4964</td>
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</table>

Three hybrids, SPH 1778, SPH 1779 and SPH 1789 have completed three years of testing in AICRP on sorghum trials. The compiled data over three years (Table 1C) indicates that the hybrids, SPH 1778 and SPH 1779 performed well for grain yield in both the zones.

### ii) Advanced Variety Trial (Tables 2.1 to 2.8, 2A, 2B and 2C)

In this trial fourteen varieties along with 4 checks were evaluated across 5 and 10 locations in Zone I and Zone II, respectively. Of these entries, SPV 2293, SPV 2296, SPV 2307 and SPV 2308 are in second year of advanced testing, while the rest ten entries are in first year of advanced testing.

### Table 2. Summary results of AVT GS

<table>
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<tr>
<th>S. No</th>
<th>Traits</th>
<th>Zone I</th>
<th>Zone II</th>
<th>All India</th>
<th>Zone I</th>
<th>Zone II</th>
<th>All India</th>
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<td>74.7</td>
<td>100.7</td>
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<tr>
<td>9</td>
<td>CV (%)</td>
<td>23.3</td>
<td>14.7</td>
<td>15.8</td>
<td>11.9</td>
<td>10.3</td>
<td>10.5</td>
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</table>
Zone I (Table 2A)

- Days to flowering and maturity – Flowering among varieties ranged from 56 (CSV 17) to 65 days (SPV 2301, CSV 23 and CSV 27). Early check, CSV 17 matured earliest (96 days), and check, CSV 23 took longest time to mature (105 days). Among the test entries, SPV 2358 and SPV 2366 were the earliest with 60 days to flower and 100 days to mature.
- Plant height – Plant height ranged from 140 (CSV 17) to 231 cm (CSV 27).
- Grain yield – Among check varieties CSV 17 recorded highest grain yield (2374 kg/ha) in this zone. Seven varieties, viz., SPV 2301, SPV 2358, SPV 2362, SPV 2363, SPV 2296, SPV 2366 and SPV 2364 out yielded CSV 17 with above 10% superiority.
- Fodder yield – For fodder yield CSV 23 out yielded all the entries and checks with 131.7 q/ha fodder yield. This was followed by CSV 20 and CSV 27 both with 131 q/ha fodder yield.
- Grain size – Grain size ranged from 2.31 g/100 grain (SPV 2363) to 3.19 g/100 grain (SPV 2366).
- Remarks – In Zone I for grain yield seven test varieties out yielded best performing check, CSV 17 (2374 kg/ha) with more than 10% superiority, and none could give fodder yield above CSV 23 (131.7 q/ha).

Table 2A. Performance of varieties in Advanced Variety Trial (AVT) – Zone I during kharif 2016

<table>
<thead>
<tr>
<th>Entry</th>
<th>Center</th>
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<th>R</th>
<th>% ± over CSV 17</th>
<th>% ± over CSV23</th>
<th>FY</th>
<th>R</th>
<th>% ± over CSV 20</th>
<th>% ± over CSV23</th>
<th>DTF</th>
<th>DTM</th>
<th>PH</th>
<th>SW</th>
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Note: R - Ranking; GY - Grain Yield (kg/ha); FY - Fodder Yield (q/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage at 28 DAE; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshold grade (1-9)

Zone II (Table 2B)

- Days to flowering – Flowering among varieties ranged from 66 (CSV 17) to 79 days (CSV 27). Among the test entries, SPV 2373 with 71 days to flower is the earliest. Early check, CSV 17 to mature earliest (107
days), while CSV 27 matured in 117 days. SPV 2373 took 110 days to mature. None of the test varieties were comparable to early check, CSV 17.

- **Plant height** – Plant height ranged from 145 (CSV 17) to 245 cm (CSV 27).
- **Grain yield** – Among checks, CSV 20 recorded highest grain yield (3422 kg/ha). Three test varieties, viz., SPV 2357, SPV 2307 and SPV 2293 recorded higher grain yield than CSV 20 with grain yield of 3674, 3653 and 3474 kg/ha, respectively.
- **Fodder yield** – Four test varieties (SPV 2362, SPV 2357, SPV 2366 and SPV 2307) recorded higher fodder yield than best performing check, CSV 27 (134 q/ha). CSV 20 with 132 q/ha fodder yield was the second among checks in fodder yield.
- **Grain size** – Grain size ranged from 2.34 g/100 grain (SPV 2370) to 3.04 g/100 grain (SPV 2307).
- **Remarks** – In Zone II no test variety could out yield best check, CSV 20 in terms of grain and fodder yield with a margin of 10%.

### Table 2B. Performance of varieties in Advanced Variety Trial (AVT) – Zone II during kharif 2016

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<tr>
<th>Entry</th>
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<th>GY</th>
<th>R</th>
<th>% ± over CSV 20</th>
<th>% ± over CSV 27</th>
<th>FY</th>
<th>R</th>
<th>% ± over CSV 20</th>
<th>% ± over CSV 27</th>
<th>DT</th>
<th>DT</th>
<th>PH</th>
<th>SW</th>
<th>GM FG</th>
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**Table 2C. Performance of promising varieties over three years in AIC SIP trials (2014-2016)**

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Four varieties, SP 2293, SPV 2296, SPV 2307 and SPV 2308 have completed three years of testing in AICRP on sorghum trials. The compiled data over three years (Table 2C) indicates that the variety, SPV 2296 and SPV 2307 have performed well for grain yield in zone I over CSV 20.

iii) Initial Hybrid Trial (Tables 3.1 to 3.8, 3A and 3B)

In this trial 10 test hybrids along with four checks were evaluated in RCBD for grain yield, fodder yield and other agronomic traits across 10 locations, four in Zone I and six in Zone II, respectively.

Table 3. Summary results of IHT GS

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</table>

Zone I (Table 3A)

- **Days to flowering and maturity** – Flowering in hybrids ranged from 56 -63 days. CSH 30 was the earliest check (56 days) with 96 days for maturity, and SPH 1848 took maximum time (63 days) to flower and matured in 101 days.
- **Plant height** – Plant height ranged from 169 cm in SPH 1852 to 201 cm in CSH 16.
- **Grain yield** – Among checks CSH 30 yielded maximum (3725 kg/ha), while medium maturity check CSH 25 recorded grain yield of 3724 kg/ha. None of the test hybrids could out yield the checks CSH 30 and CSH 25.
- **Fodder yield** – Among checks CSH 25 was highest yielder (133.8 q/ha). This was followed by SPH 1848 (132.6 q/ha) and SPV 1853 (125.3 q/ha).
- **Grain size** – Maximum grain size was recorded in SPH 1847 (3.2 g//100 seeds) followed by SPH 1849 (3.05 g/100 seeds), while the check, CSH 25 recorded grain size of 2.76 g/100 seeds.
- **Remarks** – None of the test hybrids could out yield CSH 30 for grain yield.

Table 3A. Performance of hybrids in Initial Hybrid Trial (IHT) – Zone I during kharif 2016

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Entry</th>
<th>Center</th>
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<th>% ± over CSH 25</th>
<th>% ± over CSH 30</th>
<th>R</th>
<th>% ± over CSH 25</th>
<th>% ± over CSH 30</th>
<th>FY</th>
<th>% ± over CSH 25</th>
<th>% ± over CSH 30</th>
<th>DTF</th>
<th>DTM</th>
<th>PH</th>
<th>SW</th>
<th>GM FG</th>
<th>GM TG</th>
<th>SF DH</th>
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Table 3B. Performance of hybrids in Initial Hybrid Trial (IHT) – Zone II during kharif 2016

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<th>% ± over CSH 30</th>
<th>FY</th>
<th>R</th>
<th>% ± over CSH 25</th>
<th>% ± over CSH 30</th>
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<th>DTM</th>
<th>PH</th>
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<th>GM FG</th>
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Note: R - Ranking; GY - Grain Yield (kg/ha); FY - Fodder Yield (q/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage at 28 DAE; GMFG - Grain mold field grade (1-9); GMTG - Grain mold thresbed grade (1-9)

Zone II (Table 3B)

- Days to flowering and maturity – Flowering in hybrids ranged from 65 (CSH 30) to 73 days (CSH 25). CSH 30 matured earliest (103 days). SPH 1846 and SPH 1854 matured in 106 days.
- Plant height – Plant height ranged from 164 cm in SPH 1851 to 214 cm in SPH 1855.
- Grain yield – Among checks, CSH 25 was highest yielder (3702.4 kg/ha), while among entries SPH 1846 (3815.5 kg/ha) yielded more than the best check. However, none of them recorded >10% grain yield advantage.
- Fodder yield – Best fodder yielding check was CSH 25 (135.2 q/ha). One test hybrid, SPH 1855 (138.3 q/ha) yielded better than CSH 25.
- Grain size – Maximum grain size was recorded in CSH 16 (2.97 g/100 seeds) and lowest in SPH 1852 (2.64 g/100 seeds).
- Remarks – In Zone II None of the hybrids out yielded the best check by over 10%.
iv) Initial Variety Trial (Tables 4.1 to 4.8, 4A and 4B)

In this trial 21 test varieties and 4 checks were evaluated in RCBD for grain yield, fodder yield and other agronomic traits across 10 locations.

Table 4. Summary results of IVT GS

<table>
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<tr>
<th>S. No</th>
<th>Traits</th>
<th>Zone I</th>
<th>Zone II</th>
<th>All India</th>
<th>Zone I</th>
<th>Zone II</th>
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6. Min.

7. Max.

8. CD (0.05)

9. CV (%)

10. Lines sig. > check

11. Lines > best check

12. Data from locations (no)

13. Loc. for national av. (no)

Zone I (Table 4A)

- Days to flowering and maturity – Flowering dates ranged from 51-72 days. CSV 17 was earliest to flower with 90 days to mature, and SPV 2423 took maximum time to flower (72) as well as to mature (109 days). The test variety, SPV 2432 was the earliest to flower in 60 days and maturing in 97 days.

- Plant height – Plant height ranged from 136 cm in CSV 17 to 269 cm in SPV 2424.

- Grain yield – Among the checks CSV 20 recorded highest grain yield (3136 kg/ha), followed by CSV 23 (2736.6 kg/ha). Four test varieties yielded better than the best performing check, CSV 20, SPV 2438, SPV 2424, SPV 2437 and SPV 2442. However, none of them yielded more than 10% over the best check, CSV 20.

- Fodder yield – Highest fodder yield was recorded by the test variety, SPV 2430 (171.6 q/ha), followed by SPV 2425 (170 q/ha), SPV 2434 (168.3 q/ha) and others. The best check for this trait was CSV 27 with 164.7 q/ha of fodder yield.

- Grain size – Maximum grain size was recorded in SPV 2435 (3.06 g/100 seeds) and lowest in SPV 2430 (3.50 g/100 seeds).

- Remarks – Though the test varieties, SPV 2438, SPV 2424 and SPV 2437 yielded better than the best check, CSV 20, none of them could record 10% superiority over the check. The varieties, SPV 2430, SPV 2425, SPV 2434 and SPV 2439 recorded higher fodder yields compared to the best check, CSV 27.

Table 4A. Performance of varieties in Initial Variety Trial (IVT) – Zone I during kharif 2016

<table>
<thead>
<tr>
<th>SL</th>
<th>Entry</th>
<th>Center</th>
<th>FY</th>
<th>R</th>
<th>% ± over CSV 20</th>
<th>% ± over CSV 27</th>
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<th>DTW</th>
<th>PH</th>
<th>SW</th>
<th>GM FG</th>
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</table>
Zone II (Table 4B)

- Days to flowering and maturity – Flowering in varieties ranged from 62-84 days. CSV 17 was the earliest to flower (62 days) with 101 days for maturity. None of the test varieties were comparable to early check. Among test varieties, SPV 2442 was the earliest to flower (71 days) and to mature (110 days), while SPV 2426 took maximum days (84 days) to flower and mature (124 days).
- Plant height – Plant height ranged from 151 cm in CSV 17 to 256 cm in SPV 2423.
- Grain yield – Among checks CSV 20 was highest yielder (3518.7 kg/ha) followed by CSV 23 (3436.8 kg/ha). Four test varieties recorded yield higher than CSV 20. Among these only one, SPV 2423 (4026.7 kg/ha) recorded >10% yield superiority than the best check.
- Fodder yield – CSV 23 was highest fodder yielder (153 q/ha) among the checks. None of the test varieties out yielded CSV 23 for fodder yield.
- Grain size – Maximum grain size was recorded in SPV 2435 (2.96 g/100 seeds) and lowest in SPV 2430 (2.29 g/100 seeds).
- Remarks – Only one test variety, SPV 2426 (4026.7 kg/ha) recorded >10% grain yield superiority over the best check, CSV 20.

Table 4B. Performance of varieties in Initial Variety Trial (IVT) – Zone II during kharif 2016

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Entry</th>
<th>Center</th>
<th>FY</th>
<th>GM</th>
<th>SV</th>
<th>SW</th>
<th>SF</th>
<th>GM</th>
<th>SF</th>
<th>CD</th>
<th>CD (%)</th>
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During 2015, an inter-institutional hybrid development programme was organized at different centres involving the parental lines contributed by different centers. CMS lines from various centers were shared among centers towards development of new experimental hybrids. Two inter-institutional hybrid trials were organized with the hybrids developed.

### ii) IIHT

During kharif 2016, 17 experimental hybrids (2 from Parbhani, 6 from Akola, 7 from Indore and 2 from IIMR) along with three checks were tested at Coimbatore, Akola, Dharwad, Parbhani Hyderabad and Indore. The trial at IIMR was vitiated due to heavy rains at sowing affecting the plant stand. The results from other centres are presented.

- **Days to flowering and maturity** – Flowering dates ranged from 65-77 days. CSH 30 was earliest (65 days) and none of the test hybrids were as early as CSH 30. IH Pbn2 with 71 days to flower was the earliest among test hybrids.
- **Plant height** – Plant height ranged from 178 cm in IIHT-Ak2 to 236 cm in IIHT-Pbn 1.
- **Grain yield** – Best checks was CSH 25 (4398 kg/ha). None of the hybrids could outyield CSH 25 in grain production. IIHT Ak4 with 4206 kg/ha of grain yield was the best among test hybrids followed by IH 16-9 (4028 kg/ha).
- **Fodder yield** – Among checks maximum fodder yield was recorded in CSH 25 (121 q/ha). Thirteen test hybrids recorded higher fodder yield than CSH 25. IH 16-4 (129 q/ha) was the highest fodder yielder followed by IH 16-7 (128 q/ha) and IH 16-9.
- **Grain size** – Maximum grain size was recorded in IIHT-Ak 3 (3.22 g/100 seeds) and lowest in IIHT-Ak1 (2.41 g/100 seeds). The best check, CSH 16 recorded 3.02 g/100 seeds
- **Remarks** – None of the hybrids could out yield CSH 25.

### Table 5. Summary of experimental hybrids in Inter-institutional Hybrid Nursery

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<th>Treatment</th>
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<th>Center</th>
<th>GY Mean</th>
<th>GY Rank</th>
<th>FY Mean</th>
<th>FY Rank</th>
<th>DF Mean</th>
<th>DF Rank</th>
<th>DM Mean</th>
<th>DM Rank</th>
<th>PH Mean</th>
<th>PH Rank</th>
<th>GW Mean</th>
<th>GW Rank</th>
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</table>
Towards development of new experimental hybrids 9 CMS lines were collated. Four CMS lines were provided by Indore and two each by Akola and Parbhani, and one by IIMR. CMS lines were distributed to Akola, IIMR and Parbhani to develop new hybrids.

ii) IIHT II

Another inter-institutional hybrid trial with four entries from Akola was also conducted across three locations, Akola, Parbhani and Coimbatore.

- **Days to flowering and maturity** – Flowering dates ranged from 68-78 days. CSH 30 was earliest (68 days).
- **Plant height** – Plant height ranged from 137 cm to 289 cm.
- **Grain yield** – Best checks were CSH 25 (4535 kg/ha) followed by CSH 16 (3754 kg/ha). The test hybrid, RSH-15-01 recorded grain yield 3877 kg/ha. The early test hybrid RSH 15-03 recorded 3387 kg/ha of grain yield while the early check yielded 3642 kg/ha.
- **Fodder yield** – Among checks maximum fodder yield was recorded in CSH 25 (136 q/ha). None of the test hybrids yielded more than CSH 25 for fodder.
- **Grain size** – Maximum grain size was recorded in CSH 25 (2.97 g/100 seeds) and lowest in RSH 15-04 (2.51 g/100 seeds).
- **Remarks** – None were promising compared to CSH 25

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Pedigree</th>
<th>GY</th>
<th>FY</th>
<th>DF</th>
<th>DM</th>
<th>PH</th>
<th>Grain weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSH-15-01</td>
<td>IIMR 3003 A x AKR 456</td>
<td>3876.8</td>
<td>2</td>
<td>119.5</td>
<td>2</td>
<td>72</td>
<td>5</td>
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<tr>
<td>RSH-15-02</td>
<td>IIMR 3011 A x AKR 492</td>
<td>3152.8</td>
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<td>103.1</td>
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<tr>
<td>RSH-15-03</td>
<td>IIMR 3013 A x AKR 492</td>
<td>3186.9</td>
<td>6</td>
<td>96.1</td>
<td>7</td>
<td>68</td>
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<tr>
<td>RSH-15-04</td>
<td>IIMR 3007 A x AKR 456</td>
<td>3386.5</td>
<td>5</td>
<td>101.5</td>
<td>6</td>
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<tr>
<td>CSH 16</td>
<td></td>
<td>3754.4</td>
<td>3</td>
<td>115.3</td>
<td>4</td>
<td>73</td>
<td>6</td>
</tr>
<tr>
<td>RSH 15</td>
<td></td>
<td>4534.9</td>
<td>1</td>
<td>135.9</td>
<td>1</td>
<td>78</td>
<td>7</td>
</tr>
<tr>
<td>CSH 30</td>
<td></td>
<td>3642.2</td>
<td>4</td>
<td>118.3</td>
<td>3</td>
<td>68</td>
<td>2</td>
</tr>
<tr>
<td>General Mean</td>
<td></td>
<td>3664.6</td>
<td>113.4</td>
<td>71</td>
<td>105</td>
<td>156.5</td>
<td>2.72</td>
</tr>
<tr>
<td>CV(%)</td>
<td></td>
<td>10.61</td>
<td>8.92</td>
<td>2.32</td>
<td>1.56</td>
<td>5.10</td>
<td>9.09</td>
</tr>
<tr>
<td>P-Value</td>
<td></td>
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<td>0.05</td>
<td>0.09</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>CD(%)</td>
<td></td>
<td>716.9</td>
<td>24.4</td>
<td>4.58</td>
<td>3.25</td>
<td>16.8</td>
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<tr>
<td>CD(1%)</td>
<td></td>
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<td>34.2</td>
<td>6.42</td>
<td>4.56</td>
<td>23.5</td>
<td>0.62</td>
</tr>
</tbody>
</table>

iii) BLT and RLT trials

23 B lines and 11 R lines (including the checks) from Indore were evaluated in two locations (Parbhani and Akola) to observe the performance of the lines. There are some B and R lines which performed better than the elite checks. But the lines were not very uniform. The breeder at Indore is advised to make the lines uniform by resorting to single plant selections.

Table: Performance of B and R lines over two locations

<table>
<thead>
<tr>
<th>Entry</th>
<th>GY</th>
<th>R</th>
<th>DRY</th>
<th>R</th>
<th>DF</th>
<th>DM</th>
<th>PH</th>
<th>GW</th>
<th>SI</th>
<th>Entry</th>
<th>GY</th>
<th>R</th>
<th>DRY</th>
<th>R</th>
<th>DF</th>
<th>DM</th>
<th>PH</th>
<th>GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMS 15B</td>
<td>2629</td>
<td>8</td>
<td>91.2</td>
<td>4</td>
<td>80</td>
<td>122</td>
<td>159</td>
<td>2.65</td>
<td>1</td>
<td>132</td>
<td>2519</td>
<td>5</td>
<td>76.5</td>
<td>7</td>
<td>80</td>
<td>122</td>
<td>138</td>
<td>2.56</td>
</tr>
<tr>
<td>IMS 16B</td>
<td>2657</td>
<td>16</td>
<td>76.6</td>
<td>19</td>
<td>79</td>
<td>123</td>
<td>136</td>
<td>2.73</td>
<td>2</td>
<td>134</td>
<td>2713</td>
<td>4</td>
<td>77.8</td>
<td>6</td>
<td>78</td>
<td>120</td>
<td>144</td>
<td>2.51</td>
</tr>
<tr>
<td>IMS 17B</td>
<td>2690</td>
<td>12</td>
<td>86.2</td>
<td>10</td>
<td>82</td>
<td>123</td>
<td>148</td>
<td>2.56</td>
<td>3</td>
<td>136</td>
<td>3032</td>
<td>1</td>
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<td>79</td>
<td>106</td>
<td>130</td>
<td>2.31</td>
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<tr>
<td>IMS 18B</td>
<td>2940</td>
<td>3</td>
<td>78.2</td>
<td>16</td>
<td>76</td>
<td>119</td>
<td>149</td>
<td>2.67</td>
<td>4</td>
<td>138</td>
<td>2032</td>
<td>10</td>
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<td>1</td>
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<td>126</td>
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<td>2.51</td>
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<tr>
<td>IMS 19B</td>
<td>2689</td>
<td>5</td>
<td>96.2</td>
<td>1</td>
<td>80</td>
<td>121</td>
<td>154</td>
<td>2.49</td>
<td>5</td>
<td>15-2</td>
<td>2333</td>
<td>8</td>
<td>79.1</td>
<td>4</td>
<td>78</td>
<td>121</td>
<td>152</td>
<td>2.40</td>
</tr>
</tbody>
</table>
Further ninety five experimental hybrids based on new experimental ms and R lines were evaluated during kharif 300 pairs of A and B lines were advanced. Reliable yield data could not be produced. B line and R line trials with 35 and 60 entries was conducted in RCBD. Nigeria. All these germplasm were highly photosensitive and did not flower during kharif season, however the guinea and interraces with guinea germplasm used here belonged to Sudan, Zambia, Malawi, Tanzania and based on crosses between elite and photosensitive guinea sorghum germplasm were planted. Most of the sensitivity. A total of 409 single selections were made from 31 populations and they were raised during rabi Crosses were made during rabi. Even in F2 population, majority of the plants did not flower showing photosensitivity. A total of 409 single selections were made from 31 populations and they were raised during rabi 2016-17. Further, some of the same F2 populations were raised during rabi also to make selections and advance.

Further, ninety five experimental hybrids based on new experimental ms and R lines were evaluated during kharif 2016 in RCBD with three replications along with the checks, CSV16, CSV25, CSV30 and CSV14. Data was recorded on days to flower, plant height, grain yield, 100 seed weight and grain mould score. But due to heavy reliable yield data could not be produced. B line and R line trials with 35 and 60 entries was conducted in RCBD. 300 pairs of A and B lines were advanced.

**b. Kharif sorghum improvement (K Hariprasanna)**

New male sterile line development: New male sterile line development in the genetic background of superior maintainer lines was taken up to broaden the genetic base of parental lines used in hybrid development. During rabi 2015-16, 43 out of 52 pairs of test crosses planted in BC4 generation were selected for further backcrossing. These 43 pairs in BC5 were planted during kharif 2016 for further backcrossing with the respective maintainer lines for advancement. Due to grain mold development and poor quality of seeds set in the male sterile lines selections were not made, and the BC5 generation is being again advanced during the current rabi season. In another set, 19 new male sterile lines in the genetic background of promising maintainer × maintainer derivatives were maintained and are being used in hybrid development.

**Performance of advance breeding lines:** Superior and genetically uniform advance breeding lines derived from restorer × restorer crosses were evaluated in yield evaluation trials along with appropriate checks for testing the performance per se and further utilization as parental lines or OPVs. During rabi season, IIMR 1470 recorded more than 10% advantage over CSV 27 while 10 breeding lines out yielded CSV 216R by more than 10%.

**C. Kharif sorghum breeding at IIMR**

**a. Development kharif sorghum genotypes suitable for different seasons**

(C Aruna, IK Das, Deepika, Sujay Rakshit, Hariprasanna, Visarada, SS Rao, Padmaja, Ravikumar & Venkateswarlu)

**Single plant selections from F2s based on guinea sorghum germplasm:** During kharif 2016, 31 F2 populations based on crosses between elite and photosensitive guinea sorghum germplasm were planted. Most of the guinea and interraces with guinea germplasm used here belonged to Sudan, Zambia, Malawi, Tanzania and Nigeria. All these germplasm were highly photosensitive and did not flower during kharif season, however the panicles were observed to be very heavy during rabi suggesting that they may have the genes for high yields. Crosses were made during rabi. Even in F2 population, majority of the plants did not flower showing photosensitivity. A total of 409 single selections were made from 31 populations and they were raised during rabi 2016-17. Further, some of the same F2 populations were raised during rabi also to make selections and advance.

Further fifty experimental hybrids based on new experimental ms and R lines were evaluated during kharif 2016 in RCBD with three replications along with the checks, CSV16, CSV25, CSV30 and CSV14. Data was recorded on days to flower, plant height, grain yield, 100 seed weight and grain mould score. But due to heavy reliable yield data could not be produced. B line and R line trials with 35 and 60 entries was conducted in RCBD. 300 pairs of A and B lines were advanced.

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**Performance of advance breeding lines:** Superior and genetically uniform advance breeding lines derived from restorer × restorer crosses were evaluated in yield evaluation trials along with appropriate checks for testing the performance per se and further utilization as parental lines or OPVs. During rabi season, IIMR 1470 recorded more than 10% advantage over CSV 27 while 10 breeding lines out yielded CSV 216R by more than 10%.
During kharif 2016, the advance breeding lines were evaluated along with varietal (CSV 20 and CSV 27) and restorer (C 43) checks. The grain yield ranged from 1281 to 3844 kg/ha, and IIMR 1625 (3844 kg/ha) and IIMR 1618 (3833 kg/ha) out yielded the best check CSV 27 (3731 kg/ha) marginally. Three advance breeding lines were on a par with C 43, which can be further evaluated for combining ability. Four promising advance breeding lines (IIMR 5573, IIMR 5574, IIMR 5695 and IIMR 5714) identified based on grain yield advantage are being multiplied for seed enhancement and multi-location evaluation.

**Breeding nursery:** Segregating generations (249 SPP in F₄-F₇) were advanced and 88 selections in F₄, 70 in F₆ and seven in F₇ were made based on phenotypic superiority for grain yield and related traits during rabi 2015-16. During kharif 2016 these selections were advanced further and 56 selections in F₅ and 43 in F₇ were made for further advancement and evaluation.

**Entries under AICRP-S testing:** Advance breeding line SPV 2296 (DSR 1145) has been tested under AVT II, and SPV 2362 (DSR 1151-1) and SPV 2363 (IIMR 1463) have been tested under AVT I-Grain sorghum during kharif 2016. Hybrid SPH 1813 (IIMR SH-1) with light red colour grains has been tested under AHT I-GS during kharif 2016. New entries proposed for testing were IIMR 1510 (IVT-GS) and hybrid IIMR SH-2 (27A × IIMR 1463) (IHT-GS). Seeds of all the entries are being multiplied during rabi 2016-17.

c. **Consortia research platform on bio-fortification in selected crops for nutritional security**

*Hariprasanna K, P Rajendrakumar, CV Ratnavathi, R Venkateswarlu and B Dayakar Rao*

**Grain micronutrient assessment:** Analysis for grain iron and zinc content was undertaken in popular cultivars and parental lines to identify existing cultivars with high iron and zinc contents. Grain iron ranged from 15-43 ppm and zinc from 13-36 ppm.

**Creation of new variability:** Donor sources for grain iron/zinc have been acquired from ICRISAT and used for effecting new crosses (IS 3283, IS 3760, IS 1222, IS 12750, IS 27054, IS 20962, IS 9150, ICSR 14001). More than 60 new crosses have been effect. Segregating generations (F₂-F₅) (250 SPP) are being advanced and selections are being made in the field based on phenotypic attributes of plant and panicles. The advanced generation material needs to be assessed for grain micronutrient status.

**Association mapping:** A sorghum association mapping panel, comprising of 250 genotypes (including landraces, germplasm lines, popular cultivars and parental lines) representing substantial genetic diversity has been constituted for association studies and evaluated in the field. Phenotyping for grain iron and zinc is in progress. Second year field trial for phenotyping was taken up at three locations. The crop has to be harvested and replicated grain samples have to be collected for grain iron and zinc estimation. Population structure of the association mapping panel was analysed using a set of 48 SSR loci. The genetic diversity analysis of allelic data indicated the presence of excellent genetic diversity. Minimum number of clusters (two) obtained from the structure analysis reveals a low level of genetic structure of the population indicating its suitability for association mapping. Genotyping of association mapping panel has been completed with 130 SSR markers distributed across 10 chromosomes of sorghum, and the allelic data have been compiled. Genotyping with more number of markers is under progress.

**Development and standardization of fortified products:** Development and evaluation of iron-fortified and zinc-fortified sorghum food products using natural sources of iron and zinc like Garden cress seed and Gingelly seed with multi-grain/ready-to-cook suitable for mid-day meal was taken up. Micronutrient assessment in the developed fortified-products indicated marginal enhancement, which needs further standardization and evaluation.

**Mapping population development:** For the development of RILs for anti-nutritional factors like polyphenols and phytate that affect the bioavailability of Fe and Zn, F₇ generation of two crosses (SPV 1758 × EA 10, IS 8525 × POP 52) were advanced to F₉ during rabi 2015-16 following SSD method. The F₉ is being further advanced during current rabi season for seed enhancement.

d. **Genetic improvement of kharif sorghum genotypes for higher yield and better grain storability**

*Sujay Rakshit, C Aruna, CV Ratnavathi and PG Padmaja*
During the kharif season 40 F2 populations were evaluated at Hyderabad and currently 834 F3 families are being evaluated and advanced. Besides these a total of 69 F2 populations were shared with various centers (Chamarajnagar 15, Indore 8; Udaipur 8; Diggitonk 15; Bapatla 15 and Deesa 8). Number of single plant selections made at these centers are as follows: Indore 156; Udaipur 163; Diggitonk 1860 and Deesa 34. Bapatla and Chamarajnagar has not reported yet the selections made by them. Out of 309 early A/B pairs evaluated 205 have been selected and advanced. During the period oil percentage and seed hardness of 256 lines were tested. Top 10 lines with high oil over two years identified are: IS 30466, IS 30443, IS 1212, IS 30507, IS 29654, IS 30383, IS 30451, IS 30536, IS 603 and IS 31681. Seed hardness data suggest IS 13782, IS 8971, IS 2382, IS 19153 and IS 23521 to be hardest, and IS 29326, IS 2379, IS 25548, IS 30450 and IS 40778 to be softest. The following experiments were conducted during kharif season, which got spoiled due to persistent rain during grain filling:

i. Station variety trial I with 30 accessions and 7 checks in RBD with two replications
ii. Station variety trial II with 12 entries and 7 check in RBD with two replications
iii. Evaluation of B lines I with 40 entries and 5 checks in RBD with two replications
iv. Evaluation of B lines II with 79 entries and 5 checks in RBD with two replications
v. Evaluation of new R lines I 79 entries and 8 checks in RBD with two replications
vi. Evaluation of new R lines I 71 entries and 8 checks in RBD with two replications
vii. Evaluation of germplasm and red sorghum lines: 362

During rabi season following experiments are being conducted in field:

i. Multiplication and evaluation of MS lines: 24 A1 pairs and 32 A2 pairs
ii. Multiplication and evaluation of R lines: 61 for A1 and 62 for A2 cytoplasm
iii. Multiplication of advanced lines: 31 R lines; 12 B and 205 Early lines
iv. Derivation of new lines: 834 F3 families from 15 crosses
v. Evaluation of diverse oil lines: 21 lines in RBD with 3 replications
vi. Crossing block for new MS line development: 39 double crosses in A1 and 19 double crosses in A2
vii. Crossing block for new R line development: 32 double crosses in A1 and 39 double crosses in A2
viii. Crossing block using Guinea races: 16 single crosses for back crossing to established R lines
ix. Development of experimental hybrids have three programmes (inter-institutional hybrid development, red sorghum hybrid development and early hybrid development)

High diurnal temperature differences have affected the crop growth significantly. Towards genetic diversification a total of 23 polycrosses have been attempted.

e. Molecular mapping and candidate gene analysis of a new epicuticular wax locus in sorghum (R Madhusudhana)

Key message

A new epicuticular wax (Bloom) gene has been identified and fine-mapped to 207.89 kb genomic region on SBI-01. A putative candidate gene, Sobic.001G269200 annotated as GDSL-like Lipase/Acylhydrolase, involved in bloom synthesis/deposition is proposed as the most probable candidate gene. Deposition of epicuticular wax on plant aerial surface is one strategy that plants adapts to reduce non-transpiration water loss. Epicuticular wax (Bloom) less mutants in sorghum with their glossy phenotypes exhibit changes in the accumulation of epicuticular waxes. We report a new sorghum locus, Bloomless Mutant (BM) involved in profuse deposition of epicuticular wax on sorghum leaf and on culm surface. Inheritance studies indicated single gene difference between bloom and bloomless parents for bloom deposition. Bloomless was recessive to bloom deposition. Genetic mapping involving F2 and F7; mapping populations in diverse genetic backgrounds identified and validated map location of BM to a region of 207.89kb region on chromosome 1. Sblm13 and Sblm16 flanked the BM locus to a map interval of 0.3 centimorgans (cM) on either side. Nine candidate genes were identified, of which Sobic.001G269200 annotated for GDSL-like Lipase/Acylhydrolase is the most likely gene associated with epicuticular wax deposition. Gene expression analysis and wax load estimates in parents, isogenic lines (ILs) and sets of near isogenic lines (NILs) also confirmed the role of candidate gene in bloom deposition. The study opens up possibilities for a detailed molecular analysis of the gene, its role in epicuticular wax synthesis and deposition, and may help to understand its function in moisture stress tolerance in sorghum.
f. Improvement of sweet and high biomass sorghums for biofuel and forage production
(AV Umakanth)

Evaluation of experimental sweet sorghum hybrids for brix, stalk yield and other characters (Hybrid trial):

During Kharif 2016, 27 sweet sorghum hybrids including the check CSH 22SS were evaluated in a replicated trial. Observations on days to flower, days to maturity, plant height, stem girth, total biomass, fresh stalk yield, brix (%), juice yield, total sugars and computed ethanol yields were recorded. The hybrid NSS 1008 A X IS 18542 recorded the highest fresh biomass of 101 t/ha and was 17% superior to the check CSH 22SS (86 t/ha). The same hybrid exhibited the highest fresh stalk yield of 76 t/ha and was 19% superior to the check. The hybrid NSS 1008 A X (NSSV 258 X ICSV 93046)-1-3 recorded highest brix content of 19.5% and was 21% superior to the check hybrid CSH 22SS (16.1%). None of the hybrids were promising for juice and ethanol yields. NSS 1008 A X IS 18542 was promising for stalk traits, brix content and an ethanol yield which was equivalent to the check CSH 22SS.

Evaluation of sweet sorghum varieties (Varietal Trial): During Kharif 2016, 22 varieties along with the checks CSV 19SS and CSV 24SS were evaluated for sweet sorghum productivity traits. For total fresh biomass, NPK 2016-2 recorded the highest biomass yield of 73 t/ha against the check CSV 24SS (51 t/ha) and was superior to the check by 43%. It was also promising for fresh stalk yield (46 t/ha) and was superior to the check by 50% for this trait. NPK 2016-3, [SSV 84 X (SPV 462 X IS 21891)-3-1-1]-3-1-1, [(RSCN 2103 X SSV 84)-2-1-3]-1-1 and NP (BMR)K 2016-4 were the other promising varieties for stalk traits, juice yields and computed ethanol yields. NPK 2016-3, [SSV 84 X (SPV 462 X IS 21891)-3-1-1]-3-1-1, [(RSCN 2103 X SSV 84)-2-1-3]-1-1 and NP (BMR)K 2016-4 which were promising for stalk yields also exhibited superiority for juice and ethanol yields and can be tested multilocationally to ascertain their performance.

D. Kharif sorghum breeding at AICSIP centers

a) AKOLA

1. R line development programme

New Crosses

- Following F₀ seed of 19 new crosses were sown in kharif 2016-17 and advanced to F₁ and harvested in bulk during kharif 2016-17.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Cross</th>
<th>Sr. No.</th>
<th>Name of Cross</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Akola-265 x AKSV-161</td>
<td>11</td>
<td>IC 286441 x AKSV-267</td>
</tr>
<tr>
<td>2</td>
<td>Akola-206-3 x AKSV-304</td>
<td>12</td>
<td>IC 286596 x AKSV-182-3</td>
</tr>
<tr>
<td>3</td>
<td>IC 286441 x AKSV-182-3</td>
<td>13</td>
<td>IC 286542 x AKSV-304</td>
</tr>
</tbody>
</table>
During Kharif 2016, following F1 seed of nine R x R crosses were planted and from which following individual plants have been advanced to succeeding generation.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Cross</th>
<th>No. of families/single plant planted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AKSV-314 X AKSV-313</td>
<td>105</td>
</tr>
<tr>
<td>2</td>
<td>IC 286314 x AKSV-267</td>
<td>105</td>
</tr>
<tr>
<td>3</td>
<td>IC 285945 x AKSV-314</td>
<td>105</td>
</tr>
<tr>
<td>4</td>
<td>669 X 70 B X AKSV-314</td>
<td>105</td>
</tr>
<tr>
<td>5</td>
<td>82002 X (AKR 314 x AKSV-267)</td>
<td>105</td>
</tr>
<tr>
<td>6</td>
<td>82008 X (AKR 314 x AKSV-267)</td>
<td>105</td>
</tr>
<tr>
<td>7</td>
<td>265 x AKSV-314</td>
<td>105</td>
</tr>
<tr>
<td>8</td>
<td>265 x AKSV-314</td>
<td>105</td>
</tr>
<tr>
<td>9</td>
<td>2010 X (AKR 314 x AKSV-267)</td>
<td>105</td>
</tr>
<tr>
<td>10</td>
<td>2013 X (AKR 314 x AKSV-267)</td>
<td>105</td>
</tr>
</tbody>
</table>

Following F2 selections (IPS) were planted during kharif 2016 and single plant selections made during Kharif 2016-17 in F3 are as below.

Under F2 selections from following eight four way crosses were sown in kharif 2016-17 and from which following individual plants have been selected for advance generation.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Cross</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(PVK-809 X 70 B) X (CSV-20 X SPV-669)</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>(PVK-809 X 70 B) X (CSV-20 X SPV-669)</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>(PVK-809 X 70 B) X (CSV-20 X SPV-669)</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>(PVK-809 X 70 B) X (CSV-20 X SPV-669)</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>(PVK-809 X 70 B) X (CSV-20 X SPV-669)</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>(PVK-809 X 70 B) X (CSV-20 X SPV-669)</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>(PVK-809 X 70 B) X (CSV-20 X SPV-669)</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>(PVK-809 X 70 B) X (CSV-20 X SPV-669)</td>
<td>16</td>
<td>6</td>
</tr>
</tbody>
</table>

Total 105 selections were made in 11 crosses in different generations (Table-1)

Table-1

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1 (RxR)</td>
<td>6</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>F2 (RxR)</td>
<td>5</td>
<td>63</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>11</td>
<td>105</td>
</tr>
</tbody>
</table>

2. B line development programme

For development of new male sterile lines, following backcrosses were evaluated under different back cross generations and after confirming sterility material have been advanced to succeeding generation.

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F4 (BxB)</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>F10 (BxB)</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>9</td>
<td>24</td>
</tr>
</tbody>
</table>
Total 24 selections were made in 09 different BxB and BxR crosses in different generations (Table-2)

3. **MS Conversion programme**

Table-3

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Generation</th>
<th>No. of families/single plant selected(Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BC-I</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>BC-II</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>BC-III</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>BC-IV</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>BC-V</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>BC-VI</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>BC-VII</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>

Total 27 BC pairs were made during Kh-2016 (Table-3)

**Development of lines resistant to various stresses**

Trait 1 – Grain Mold Resistance Breeding Programme

1. **R line development programme - Table-4**

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;10&lt;/sub&gt;(RxR)</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>8</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

Eight crosses in involving grain mold resistance sources like SVD-9601, STR-93, GMPR-65 and GM-9219 were evaluated and 21 single plant selections showing low Field Grain Mold Rating (FGMR) and good grain hardness (above 9) were selected. (Table-4)

2. **B line development programme**

Table-5

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;11&lt;/sub&gt; (BxR)</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>8</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

Eight crosses in F<sub>11</sub> generation involving grain mold resistant B line i.e. B-58586 and th line MS-296 were handled and 16 selections showing low Field Grain Mold Rating (FGMR) and good grain hardness (above 9) were selected (Table-5)

3. **MS Conversion programme - Table-6**

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Generation</th>
<th>No. of families/single plant selected(Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BC-I</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>BC-II</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>BC-III</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>BC-IV</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>BC-V</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>BC-VI</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>BC-VII</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>BC-VIII</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>29</strong></td>
</tr>
</tbody>
</table>

In MS line development programme total 29 BC pairs under different back cross generations involving the crosses having grain mold resistant lines were made during Kh-2016 (Table-6)

Trait 2 – Shoot Fly Resistance Breeding Programme

3. **MS Conversion programme - Table-9**

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BC-I</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>BC-II</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>BC-III</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>BC-IV</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
In MS line development programme total 23 BC pairs under different back cross generations involving the 17 crosses and showing shoot fly resistance were selected during Kh-2016 (Table-9).

**New Crosses:** During kharif 2016, the following selections from F₂ population were planted during Kharif 2016-17 and following selections made under F₃ generation.

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Name of Cross</th>
<th>No of crosses evaluated</th>
<th>No of single plant Planted</th>
<th>IP selections made</th>
<th>S. no.</th>
<th>Name of Cross</th>
<th>No of crosses evaluated</th>
<th>No of single plant selected</th>
<th>IP selections made</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CSV-20 X IS-2205) X (14 B X IS-2312)</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>(14 B X IS-2312) X (CSV -20 X IS-2205)</td>
<td>18</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(CSV-20 X IS-2312 ) X (PVK-809 X IS-2205)</td>
<td>24</td>
<td>3</td>
<td>8</td>
<td>(CSV-27 X IS-2205) X (14 B X IS-2312)</td>
<td>29</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(CSV-20 X IS-2205) X (IS-2312 X IS-2205)</td>
<td>28</td>
<td>2</td>
<td>9</td>
<td>(CSV-27 X IS-2312) X (IS-2312 X IS-2205)</td>
<td>21</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(PVK-809 X IS-2312) X (CSV-23 X IS-2205)</td>
<td>24</td>
<td>6</td>
<td>1</td>
<td>(CSV-20 X IS-2205) X (CSV-23 X IS-2312)</td>
<td>32</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>(CSV-23 X IS-2312) X (CSV-20 X IS-2205)</td>
<td>27</td>
<td>3</td>
<td>1</td>
<td>(PVK-809 X IS-2312) X (CSV-27 X IS-2205)</td>
<td>22</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>(14 B X IS-2312 X (CSV-23 X IS-2312)</td>
<td>27</td>
<td>5</td>
<td>1</td>
<td>(CSV-27 X IS-2312) X (CSV-27 X IS-2205)</td>
<td>20</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Trait 3 – Drought Tolerance Breeding Programme**

1. **R line development programme - Table-10**

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁₀⁻¹₁ (RₓR)</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

Total seven selections were made in two RxR crosses in F₁₀⁻¹₁ generation received from the Project under group efforts on sharing of breeding material. Selections were made for earliness and stay green traits. (Table-10)

**Trait 4 – Enrichment of sorghum for micronutrients**

Under the programme of enrichment of sorghum for micronutrients (zinc and iron), eighteen F₁ seed (R x R) were planted during Kharif 2016-17 and further, individual plant selections have been harvested for advanced generation.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Cross</th>
<th>No of single plants selected</th>
<th>S.No.</th>
<th>Name of Cross</th>
<th>No of single plants selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ICSR-113 x ICSR-135</td>
<td>28</td>
<td>10</td>
<td>ICSR-34 x ICSR-113</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>ICSR-113 x ICSR-40</td>
<td>23</td>
<td>11</td>
<td>ICSR-28 x ICSR-1401</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>ICSR-34 x ICSR-135</td>
<td>18</td>
<td>12</td>
<td>ICSR-69 x ICSR-72</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>ICSR-196 x ICSR-135</td>
<td>20</td>
<td>13</td>
<td>ICSR-69 x ICSR-196</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>ICSR-135 x ICSR-72-2</td>
<td>32</td>
<td>14</td>
<td>ICSR-72 x ICSR-196</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>ICSR-69 x ICSR-113</td>
<td>70</td>
<td>15</td>
<td>ICSR-135 x ICSR-72-1</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>ICSR-69 x ICSR-34</td>
<td>36</td>
<td>16</td>
<td>ICSR-113 x AKSV-144-4</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>ICSR-69 x ICSR-135</td>
<td>22</td>
<td>17</td>
<td>ICSR-113 x IVT 4061</td>
<td>18</td>
</tr>
<tr>
<td>9</td>
<td>ICSR-34 x ICSR-69</td>
<td>10</td>
<td>18</td>
<td>ICSR-113 x (436 x 670)</td>
<td>14</td>
</tr>
</tbody>
</table>

**5 Station hybrid/varietal trial**

**Table-11**

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Name of trial</th>
<th>No.of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Multlocation Varietal cum Hybrid Trial (MVHT)</td>
<td>24</td>
<td>PVK-809, CSV-20, CSV-23,CSV-14,CSV-16,SPH-1635, SPH-35</td>
<td>MVHT-1483, 1487, 1490, 1491, 1494, 1495</td>
</tr>
<tr>
<td>2</td>
<td>Multlocation Hybrid Trial (MHT)</td>
<td>20</td>
<td>CSV-14,CSV-25,SPH-1635,SPH-35</td>
<td>MHT-1556, 1560,1563</td>
</tr>
</tbody>
</table>
Total six station trials were successfully conducted. (Table-11)

Besides these trials, under the project "Identification of micronutrients dense sorghums for better health in western and central Africa (WCA) and India" funded by HarvestPlus Programme of CGIAR, three trials were received from ICRISAT, Hyderabad and conducted successfully.

D. AICSIP trial:

<table>
<thead>
<tr>
<th>S. no.</th>
<th>No. of AICSIP trials allotted - Kharif Grain Breeding</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8 (AHT, AVT, IHT, IVT, IIIHT, IIHT, B-Line trial, R-Line trial)</td>
<td>8</td>
</tr>
</tbody>
</table>

All the eight AICSIP trials were successfully conducted. Under the project CRP on Agrobiodiversity, evaluation of 1000 Kharif Sorghum Germplasm lines was done.

E. Other activities

a. Student guidance – Ph.D.-1 students and M.Sc.-2 students

ii. Training organized - One (On Sorghum Seed Production under RKVY)

iii. Publications: Research papers- 9; Popular articles- 10

Other points regarding the breeding material

Maintainance of A B lines-26
No. of Restorer lines-474
No. of experimental hybrids-45
No. of varietal selections- 173
Wani sorghum selections-52

b) COIMBATORE

Grain sorghum breeding programme

R line development programme

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>F2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>F3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>F4</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>F5</td>
<td>12</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>39</td>
<td>54</td>
</tr>
</tbody>
</table>

4. Trait-specific line development programme: Trait 1 - shoot fly & stem borer

A. R line development programme:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>F2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>F3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>F4</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>14</td>
<td>21</td>
</tr>
</tbody>
</table>

Trait 2 – drought

1. R line development programme:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F4</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

5. Station hybrid/varietal trial:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer 2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>MLT Grain sorghum (S2016)</td>
<td>4</td>
<td>Co 30, K12, APK 1</td>
<td>Among four cultures tested the highest grain yield of 4200 kg/ha was noted by TNS 648 with yield increase of 11% over the check variety Co 30 and fodder yield of</td>
</tr>
</tbody>
</table>
Sr. No. | Name of trial | No. of entries tested | Checks used | Superior entries
--- | --- | --- | --- | ---
1 |  |  |  | 12981 kg/ha with yield increase of 10 per cent. The culture also recorded shoot fly incidence of 11.9 %
2 | MLT grain sorghum (K 2016) | 5 | Co 30 K12 CO 5 Paiyur 2 | Three TNS cultures and two hybrids were tested along with checks. Among the cultures TNS 648 recorded highest grain yield of 3319 kg/ha with yield increase of 16.3 and 31.7 per cent increase over the check CO 30 and K12 respectively. The hybrids viz., TNSH 487 and TNSh 488 recorded highest grain yield of 36 and 20 % over Co 5.
3 | UVT-I | 13 | Co 30 | Among thirteen entries tested six entries recorded highest grain yield than the check and yield performance ranged from 2176 (IS 18417 x CO 25-4-3-1-3) to 2685 kg/ha (APK 1 x M 35-1-2-2-3). The grain yield increase observed was 11.9 to 38.1 percent than the check. The highest fodder yield was also noted in the cross derivative IS 18417 x CO 25-4-3-1-3 (12638 kg/ha) followed by CO 26 x IS 4646-3-1-1-2 (12768 kg/ha.) The fodder yield increase observed was 5.6 to 21.8 per cent. The shoot fly incidence noted was below 14 % in all the entries.
4 | UVT-II | 11 | Co 30 | Eleven entries along with check Co 30 were tested. Five entries excelled in grain yield performance than the check. The highest grain yield was noted in the cross derivatives TNS 636 x TNS 634-5-1-2 (2867 kg/ha) and TNS 633 x TNS 634-4-3-1 (2585 kg/ha) with yield increase of 21 and 35 % over check. The highest fodder yield was observed in TNS 630 x TNS 634-5-2-2 (12926 kg/ha) followed by TNS 631 x TNS 633-3-2-5 (12040 kg/ha).
5 | NRRYT (S 2016) | 15 | CO 30 | Fifteen entries were evaluated under NRRYT. The grain yield performance were recorded and it ranged from 648 (CO 26 x EP 60 - 5-1-1-3-1-1) to 2222 kg/ha (CO 26 x EP 60 - 5-1-1-3-2-3). Many of the entries excelled check CO 30. However the yield performance will be confirmed in replicated trial.
6 | Hybrid evaluation | 4 |  | Five cross combinations were evaluated. Among this the cross combination ICS 12 A x Co 26 recorded highest single plant yield (33 g) as well showed phenotypic uniformity.
7 | Breeder seed | 1 |  | For state released variety Co 30, 40 kg of breeder seeds and 700 kg of TFL seeds were produced.
8 | New crosses synthesised | - | - | Nine new crosses using Co 26, APK 1, Co 28 and BSR 1 as seed parent and SPV 2296, Chinna vellai cholam, Vellai cholam, ICSV 700 as pollen parent were made.
9 | AX R cross synthesised |  |  | The cross combinations viz., ICS 51 A x CO 30, ICS 486 A x CO 30, ICS 452 A x CO 30, ICS 49 A x CO 30, ICS 323 A x Co 30 ICS 486 A x TNS 30, ICS 452 A x TNS 30, ICS 49 A x TNS 30, and ICS 323 A x TNS 30 were synthesized for further evaluation.

2. **AICSIP trial:**

<table>
<thead>
<tr>
<th>Sr.no.</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grain sorghum = 6</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Pathology = 5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Entomology = 5</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>= 16</td>
<td>16</td>
</tr>
</tbody>
</table>

3. **Other activities**

b. **Student guidance**: 2
c. **PG teaching**: 1
d. **Training organized-**

4. **Publications**

Research articles: 2

**Other points regarding the breeding material**

- Maintenance of A B lines = -
- No. of Restorer lines = 5
- No. of experimental hybrids = 18
- No. of varietal selections = 29

**Other Important Points**

*Attended Sorghum AICSIP monitoring at Kovilpatti centre on 25th January, 2016*
### Forage sorghum/ sweet sorghum breeding program

#### R line development programme

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>F2</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>F3</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>F4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>F5</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>32</strong></td>
<td><strong>63</strong></td>
</tr>
</tbody>
</table>

#### B line development programme:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### MS Conversion programme:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected(Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Trait – Forage sorghum & Sweet sorghum

##### A. R line development programme:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>F2</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>F3</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>F4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>F5</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>32</strong></td>
<td><strong>63</strong></td>
</tr>
</tbody>
</table>

**B line development programme: NIL**

**MS Conversion programme: NIL**

### Station hybrid/varietal trial:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Summer 2016

1. MLT forage sorghum
   - No. of crosses: 3
   - Checks used: K 11
   - Superior entries: Culture TNS 213 recorded highest green fodder yield of 2941 kg/ha by recording 38.76% increase over check K11.

2. MLT Sweet sorghum
   - No. of crosses: 2
   - Checks used: CSV 24 SS
   - Superior entries: Culture TNS 212 recorded green fodder yield of 31827 kg/ha and 16% increase over check CSV 24 SS.

3. RRYT Forage sorghum
   - No. of crosses: 28
   - Checks used: K11 CSV 24 SS
   - Superior entries: A total of 28 cultures were tested and recorded 8-45% superior performance over check.

4. RRYT Sweet sorghum
   - No. of crosses: 8
   - Checks used: K11 CSV 24 SS
   - Superior entries: A total eight entries were tested and recorded superior performance over check ranged between 22-35%.

#### Kharif 2016

5. MLT Forage sorghum
   - No. of crosses: 4
   - Checks used: CO 27 K 11
   - Superior entries: The entry TNFS 213 (29413 kg/ha) expressed 38 and 48% superior performance over checks Co 27 and K11, respectively.

6. Crossing block for A x R crosses
   - No. of crosses: 3
   - Checks used: ICSA 324xCSV 19SS; ICSA 12x SSV84; ICSA12xR 820

7. Crossing block for Emasculation based crosses
   - No. of crosses: 9
   - Checks used: BSR 1x Co 27; Co26 x Co 18; CSV 22SS x Co 18; Co 26 x Black sorghum; K12 x Black sorghum; K12 x CO 18; IS18551 x Vellai sorghum; CO 30 x Irungu; orghum CO 26 x Irungu sorghum

8. Breeder seed
   - No. of crosses: 1
   - Checks used: CSV 33 MF
   - Superior entries: A quantity of 200 kg produced. (Awaiting for seed lot inspection for want of Notification number)

9. Germplasm
   - No. of crosses: 126
   - Checks used: Germplasm lines 126 numbers are characterised with minimum DUS traits.

10. Screening of drought tolerance
    - No. of crosses: 100
    - Checks used: B 35 (resistant); Co 26 (Susceptible)
    - Superior entries: Germplasms were subjected to screening for drought tolerance based on leaf area index, SPAD chlorophyll, relative water content, plant height, proline, stay-green and grain yield. The genotypes IS23399, DRT1030, MS7735, KOSSS53 and KOSSS186 are identified as tolerant.
5. **AICSIP trial:**

<table>
<thead>
<tr>
<th>Sr.no.</th>
<th>Name of AICSIP trials allotted</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forage sorghum</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Sweet sorghum</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Pathology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Entomology</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Agronomy</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>

6. **Other activities**

   e. **Student guidance** –PG: 2 (member for Advisory committee)  
   UG: 1 batch (2016)

   f. **Training organized** - 5 No1

7. **Publications:**

   - Research papers- 2;  
   - Popular articles- 1;  
   - Folder - 1

Other points regarding the breeding material:

- Maintaince of A B lines = 30  
- No. of Restorer lines = 43  
- No. of experimental hybrids = 10  
- No. of varietal selections = 63  
- No. of germplasms studied = 125

Other points:

- Trainings attended:

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Date</th>
<th>Place</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.8-2016 to 15.9.2016</td>
<td>Punjab Agricultural University, Ludhiana</td>
<td>Attended 21days training on innovative breeding techniques for development of climate smart crops</td>
</tr>
<tr>
<td>2</td>
<td>27-29.5.2016</td>
<td>TNAU, Coimbatore and Tamil Inaiya Kalvi Kalagam, Chennai</td>
<td>E- content (Tamil) development workshop for Agricultural Professionals</td>
</tr>
</tbody>
</table>

c) **DEESA**

**Development of dual sorghum lines:**

- **New crosses attempted**: Attempted 8 new crosses for dual sorghum viz., DS 154 x DS 138, DS 141 x DS 154, DS 141 x DS 138, EC 483517 x HBS 9001, EC 483517 x IC 484618, IC 485202 x CSV 20, IC 484618 x DS 137, EC 484215 x SR 2932.

- **Generation advancements**:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of selections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F2</td>
<td>36 (12Rows of 6.5 M)</td>
<td>479 SPS</td>
</tr>
<tr>
<td>2</td>
<td>F4</td>
<td>82 progenies (11 crosses)</td>
<td>54 SPS</td>
</tr>
<tr>
<td>3</td>
<td>F5</td>
<td>380 Progenies (15 crosses)</td>
<td>271 SPS</td>
</tr>
<tr>
<td>4</td>
<td>F6</td>
<td>53 Progenies (10 crosses)</td>
<td>15 SPS</td>
</tr>
</tbody>
</table>

- **Development of fodder sorghum lines:**

- **New crosses attempted**: Attempted 25 new crosses of forage sorghum viz., DSF 132 x DSF 136, CSV 21 F x IVHT (SC) 7117, CSV 21 F x HBS 9060, CSV 21 F x HBS 9001, CSV 21 F x IVHT (SC) 7067, GFS 4 x DSF 123, IC 289213 x IVHT 7112, IC 289213 x DSF 153, EC 487205 x DSF 117, SS 59-3 x Malwan, UTML529-10 (8) x DSF 117, UTML 529-10 (8) x CSV 21F, DSF 132 x DSF 136, DSF 117 x CSV 15, DSF 117 x CSV 21F, DSF 117 x DSF 123, DSF 117 x DSF 136, DSF 123 x DSF 136, DSF 123 x CSV 15, CSV 15 x CSV 21F, DF 136 x CSV 21F, DF 136 x CSV 127, DSF 136 x CSV 15, DSF 127 x CSV 21F and DSF 123 x CSV 21F.

- **Evaluation of F₁ material**: Progeny of 33 forage crosses were evaluated during Kharif 2016 and out of these crosses 15 crosses will further advanced.

- **Generation advancement of forage crosses**:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F3</td>
<td>26 Progenies (15 crosses)</td>
<td>2 SPS</td>
</tr>
<tr>
<td>2</td>
<td>F4</td>
<td>108 Progenies (12 Crosses)</td>
<td>5 SPS</td>
</tr>
<tr>
<td>3</td>
<td>F5</td>
<td>33 Progenies (19 crosses)</td>
<td>2 SPS</td>
</tr>
<tr>
<td>4</td>
<td>F6</td>
<td>55 Progenies (7 crosses)</td>
<td>79 SPS</td>
</tr>
<tr>
<td>5</td>
<td>F7</td>
<td>64 Progenies (10 crosses)</td>
<td>39 SPS</td>
</tr>
</tbody>
</table>
Germplasm collection, evaluation and maintenance:
A total of 1000 germplasm of dual and fodder sorghum were evaluated under CRP Agro biodiversity platform in the augmented block design using two checks viz., CSV 15 and CSV 21F. All the germplasm characterized for different characteristics as per descriptors. Total 35 new germplasm collected from sorghum growing area of North Gujarat.

Station hybrid/varietal trial: Under the state and station trial evaluation programme two station trials and five state trials were conducted during 2016-17. Brief summary are given as below.

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Preliminary Evaluation Trial of Dual Sorghum</td>
<td>26 (Deesa)</td>
<td>GJ 39 and CSV 20</td>
<td>DS 157, DS 172, DS 165, DS 149 and DS 171</td>
</tr>
<tr>
<td>2.</td>
<td>Preliminary Evaluation Trial Forage Sorghum</td>
<td>24 (Deesa)</td>
<td>CSV-21 F and GFS-5</td>
<td>DSF 145, DSF 133 and DSF 158</td>
</tr>
<tr>
<td>3.</td>
<td>Small Scale Varietal Trial (Dual Sorghum)</td>
<td>20 (6 locations)</td>
<td>GJ 39, GJ 42, GNJ 1 and CSV 20</td>
<td>DS 127, SR 2935 and DS 137</td>
</tr>
<tr>
<td>4.</td>
<td>Small Scale Varietal Trial (Grain Sorghum)</td>
<td>14 (6 locations)</td>
<td>GJ 38, GJ-42, GNJ 1 and CSV 20</td>
<td>SR 2980, SR 2984 and SR 2983</td>
</tr>
<tr>
<td>5.</td>
<td>Large Scale Varietal Trial (Grain Sorghum):</td>
<td>14 (6 locations)</td>
<td>GJ-38, GJ-42, GNJ 1 and CSV 20</td>
<td>SR 2812</td>
</tr>
<tr>
<td>6.</td>
<td>Small Scale Varietal Trial(E &amp;M) of Forage Sorghum</td>
<td>18 (6 locations)</td>
<td>CSV-21 F and GFS-5</td>
<td>SRF 353, SRF 332, SRF 370 and DSF 153</td>
</tr>
<tr>
<td>7.</td>
<td>Large Scale Varietal Trial of Forage Sorghum</td>
<td>10 (8 locations)</td>
<td>CSV-21 F and GFS-5</td>
<td>SRF 347 and DSF 117</td>
</tr>
</tbody>
</table>

AICSIP trials: All the following 8 trials were successfully conducted and data was reported.

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>8 (IVT GS, AVT GS, IHT GS, AHT GS, IVHT SC, AVHT SC, IAVHT MC, HBS)</td>
<td>8 IVT GS, AVT GS, IHT GS, AHT GS, IVHT SC, AVHT SC, IAVHT MC, HBS</td>
</tr>
</tbody>
</table>

Frontline demonstrations: 100 TSP demonstrations conducted.

Other activities

Student guidance – M Sc. Student : Major guide : 1, Committee member : 3

Teaching- 2 courses [PBG 4.2 (2+1), PBG 5.3 (2+1)]

Training organized- Nil

Research Papers- 5

Popular articles- 5

Other points of breeding material-
No. of varietal selections- 45
Old germplasm maintained: 146
SPS from germplasm: 42

d) DHARWAD

6. R line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>F4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>F6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

7. B line development programme: nil

8. MS Conversion programme: nil

9. Trait-specific line development programme

Trait 1- Shoot fly resistant R line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>F4</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

Trait 2 – Grain mold R line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>F5</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>
10. Station hybrid/varietal trial

<table>
<thead>
<tr>
<th>S.no</th>
<th>Name of trial</th>
<th>No. of entries</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Multilocation Varietal trial</td>
<td>15</td>
<td>DSV-6 &amp; CSV-23</td>
<td>SPV-2306 and SVD-1307</td>
</tr>
<tr>
<td>2</td>
<td>Multilocation Hybrid trial</td>
<td>12</td>
<td>CSH-14, CSH-18 &amp; CSH-30</td>
<td>SPH-1817</td>
</tr>
<tr>
<td>3</td>
<td>Station hybrid trial-I</td>
<td>15</td>
<td>CSH-14, CSH-16 &amp; CSH-30</td>
<td>SHD-111 and SHD-116</td>
</tr>
<tr>
<td>4</td>
<td>Station hybrid trial-II</td>
<td>15</td>
<td>CSH-14, CSH-16 &amp; CSH-30</td>
<td>SHD-130, SHD-131, SHD-92</td>
</tr>
</tbody>
</table>

11. AICSIP trial:

<table>
<thead>
<tr>
<th>Sr.no</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IVT (GS), IHT (GS), AVT (GS), AHT (GS) &amp; IIHT</td>
<td>All five trials</td>
</tr>
</tbody>
</table>

12. Other activities

- **Student guidance** – One Phd + two Msc (Agri) students on sorghum
  - Msc (Agri):- 1. Study of induced variability for grain mold tolerance, grain quality and productivity in *kharif* sorghum
  - 2. Genetic studies on variability for rust resistance and yield parameters in *rabi* sorghum
  - PhD:- 1. Genetic studies related to bio-fortification (Fe & Zn) and grain quality in *rabi* sorghum (*Sorghum bicolor* (L.) Moench).

- **Training organized**- Recommended varietal features of *rabi* sorghum for Karnataka

13. Publications:

- Research papers- 2
- Book- Improved Cultivation Practices Pages 364, Published by Directorate of Extension, UAS Dharwad
- Folder- Jowar-Improved Production Technologies (kannada)

**Other points regarding the breeding material**

1. Maintenance of A B lines- 20 (summer)
2. No. of Restorer lines- 18 (summer)
3. No. of experimental hybrids- 26
4. No. of varietal selections- 24
5. Germplasm lines- 170
6. Large scale demonstration of varieties/hybrids- 12 (7 hybrids + 5 varieties)
7. Large scale demonstration in farmer's field – 3 nos. (SPH-1787, CSH-30, SPV-2299 & DSV-6)

**Other Important Points**

- Hon. State Minister for Agriculture, GOK, Shri Krishna Byregowda, Vice chancellor Dr. D. P. Biradar and officers of the University visited sorghum research field and large scale demonstration on 24-10-2016.
- Dr. S. T. Kajjidoni worked as member of board of studies at UAS, Dharwad for UG & PG programme (2016-17).
- Dr. S. T. Kajjidoni worked as member of research council and Extension council, UAS, Dharwad (2016-17).
- Dr. S. T. Kajjidoni served as University Head, Department of Genetics and Plant Breeding, UAS, Dharwad.
- Dr. S. T. Kajjidoni worked as member of committee for contingency crop planning, UAS, Dharwad.

**e) HISAR**

Forage sorghum improvement

1. **Trait-specific line development programme**

**Trait 1- For multicut type**

**Varietal development programme**

For forage sorghum multicut traits are very important. Because, multicut genotypes provide more green fodder as well as dry fodder for longer duration. So keeping this in view we evaluated various crosses in various filial generations to increase fodder production.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected (Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>F₂</td>
<td>1</td>
<td>180</td>
</tr>
<tr>
<td>3</td>
<td>BC₁F₂</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>F₃</td>
<td>2</td>
<td>170 plants of 541 x COFS 29, 60 plants of 541 x SSG 59-3</td>
</tr>
<tr>
<td>5</td>
<td>F₄</td>
<td>1</td>
<td>160 plants of 541 x SSG 59-3</td>
</tr>
<tr>
<td></td>
<td>F₅</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>14</strong></td>
<td><strong>650</strong></td>
</tr>
</tbody>
</table>
Trait 2 – Stem Borer resistance

8. Varietal development programme

Stem borer is major pest of forage sorghum. It is the most damaging insect pest which causes 45% losses in fodder yield of sorghum during kharif and rabi seasons. Hisar has been identified as hot spot for stem borer infestation and screening. The list of the crosses evaluated and no. of plants selected have been given below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected (Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>F₂</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>F₃</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>F₄ (Bulk)</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>8</td>
<td>222</td>
</tr>
</tbody>
</table>

Trait 3 – Seed yield

B. Varietal development programme

Seed production for forage crops is a major task. We require genotypes which provide good green fodder and seed yield.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected (Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>F₃</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5</td>
<td>33</td>
</tr>
</tbody>
</table>

Trait 4 – Green fodder yield

E. Varietal development programme

Livestock is a major component of Indian agriculture. With the increase in livestock population during past few years there is huge gap in demand and supply of green as well as dry fodder, hence forage crops improvement programme needs to be strengthened.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected (Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>BC₁:F₂</td>
<td>2</td>
<td>170</td>
</tr>
<tr>
<td>3</td>
<td>F₃</td>
<td>2</td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7</td>
<td>252</td>
</tr>
</tbody>
</table>

2. Station hybrid/varietal trial

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hybrid evaluation programme</td>
<td>110</td>
<td>SSG 59-3, CSH 24MF</td>
<td>HH 628, HH 715 and HH 807</td>
</tr>
<tr>
<td>2</td>
<td>Progeny Row trial</td>
<td>37</td>
<td>SSG 59-3, HJ 541</td>
<td>S 677, S 754, S 662 and S 745</td>
</tr>
<tr>
<td>3</td>
<td>Small Scale Trial</td>
<td>26</td>
<td>SSG 59-3, HJ 541</td>
<td>S 729, S 752 and S 753</td>
</tr>
<tr>
<td>4</td>
<td>Large Scale Trial</td>
<td>7</td>
<td>SSG 59-3, HJ 541</td>
<td>S 709 is superior than check HJ 541</td>
</tr>
</tbody>
</table>

9. AICSIP trial:

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>No. of AICSIP trials allotted</th>
<th>Trials conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IAVHT-MC TRIAL 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>2</td>
<td>IVHT-SC TRIAL 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>3</td>
<td>AVHT-SC TRIAL 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>4</td>
<td>Seed trial 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>5</td>
<td>SML Trial</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>6</td>
<td>IIFH Trial</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>7</td>
<td>Entomology IAVHT-MC Kh 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>8</td>
<td>Entomology IVHT-SC Kh 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>9</td>
<td>Entomology AVHT-SC Kh 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>10</td>
<td>Entomology IAVHT-SS Kh 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>11</td>
<td>Entomology AICSIP-SPN Kh 2016</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>12</td>
<td>Response of pre-released single-cut forage sorghum genotypes to different fertility levels- Trial 1KE</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>13</td>
<td>Response of pre-released multicut forage sorghum genotypes to different fertility levels - Trial 1KF</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>14</td>
<td>Optimization of production factors under resource constraints (Forage Sorghum single cut) - Trial 6K</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>15</td>
<td>Evaluation of sorghum elite lines (sweet sorghum) for salinity tolerance - Trial 3K</td>
<td>Successfully Conducted</td>
</tr>
<tr>
<td>16</td>
<td>25 FLD’s on Forage Sorghum</td>
<td>Successfully Conducted</td>
</tr>
</tbody>
</table>
10. Other activities
   i. Student guidance – Ph.D 4, M.Sc 2
   j. Training organized- 20 trainings in 20 districts of Haryana was organized by Forage Section, CCS HAU Hisar under RKVY Project entitled “Farmers’ trainings on scientific cultivation of forage crops to ensure quality seed production”

11. Publications:
    Research papers: 7  Book chapter: 1  Popular Article: 5  Abstracts:8  Paper presentations: 2

Other points regarding the breeding material
Maintainance of A and B lines- 19
No. of Restorer lines- 23
No. of experimental hybrids- 110
No. of varietal selections- Two entries (including one hybrid) will be submitted for IAVHT MC trial and two entries will be submitted in IVHT SC trial.

Other Important Points:
1. Project entitled “Farmers' trainings on scientific cultivation of forage crops to ensure quality seed production” is sanctioned by RKVY for 2015-2017.
2. Project entitled “Breeding for stem borer resistance and quality characters in forage sorghum” is submitted under gap-filling ad-hoc research scheme of CCS Haryana Agricultural University Hisar for 2016-2019.

f) INDORE
   R line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>82</td>
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</tr>
</tbody>
</table>

B line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td>1</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>129</td>
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</tr>
</tbody>
</table>

MS Conversion programme

<table>
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<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected(Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Advancement of BC pairs made during the year)</td>
</tr>
<tr>
<td>BCS</td>
<td>5/ 40 pairs</td>
<td>86</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>86</td>
<td>-------------------------------------------------------------------------------------</td>
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</table>

Dual purpose varietal developmental programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>6</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>3</td>
<td>16</td>
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</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>51</td>
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</tr>
</tbody>
</table>

Trait-specific line development programme

Trait 1- Mold

R line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>2</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>18</td>
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</tbody>
</table>

B line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>1</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td>1</td>
<td>20</td>
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<td>Total</td>
<td>2</td>
<td>33</td>
<td></td>
</tr>
</tbody>
</table>
Station hybrid/varietal trial

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHT I</td>
<td></td>
<td>58</td>
<td>CSH18, CSH16, CSH25</td>
<td>43-5-10-4-7 A X 3-11-2-2-9, 43-5-10-4-7 A X I12, IMS18A X 46-2-2-4, IMS9A X 27-2-6-1-3, IMS9A X 46-2-2-4, 9-2-1-12-1A X I12</td>
</tr>
<tr>
<td>SHT II</td>
<td></td>
<td>25</td>
<td>CSH18, CSH18, CSH25, CSH30</td>
<td>IMS 15 A X I 34, IH 16-6, IH 16-3, IH 16-9, CSH25</td>
</tr>
<tr>
<td>SVT I</td>
<td></td>
<td>22</td>
<td>CSV17, CSV21f, CSV27, CSV23, RVJ 1862</td>
<td>(CSV20 X E 253) 1-2-2-6-1 X IV 16-2, IV 14-6, IV 14-7, CSV20X CSV17R) 5-1-1-4, IV 14-3, IV 14-5</td>
</tr>
<tr>
<td>SVT II</td>
<td></td>
<td>22</td>
<td>CSV17, CSV23, CSV20, CSV30F JJ1041, RVJ 1862</td>
<td>( GMN 46 x DSV 6)15-2, 9 CSV20 X E253) 1-2-2-8, (E 216 X CSV20) 2-1-1-1-4-6, CSV23, RVJ 1862</td>
</tr>
</tbody>
</table>

AICSIP trial:

<table>
<thead>
<tr>
<th>Sr.no.</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

3. Other activities
   k. Student guidance – 3
   l. Training organized – NIL
4. Publications: Nil
   Folder- 2

5. Other points regarding the breeding material
   Maintainance of A B lines- 20 MS lines
   No. of Restorer lines- 46
   No. of experimental hybrids- 20
   No. of varietal selections- 4
   No of crosses made- 6

6. Other Important Points: Characterization of One thousand exotic germplasm under CRP- Agro biodiversity (27 traits)

KOVILPATTI

1. R line development programme Nil
2. B line development programme: Nil
3. MS Conversion programme: Nil
4. Trait-specific line development programme: Nil

5. Station varietal trial (Rabi 2016)

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Advanced Yield Trial – Grain Sorghum</td>
<td>9</td>
<td>K 8, K 12, CO 30 CSV 17</td>
<td>TKSV 1103, TKSV 1161, TKSV 1308 the trial was taken up in protected irrigation.</td>
</tr>
<tr>
<td>2.</td>
<td>Preliminary Yield Trial – Grain Sorghum</td>
<td>5</td>
<td>K 8, K 12, CO 30 CSV 17</td>
<td>TKSV 1405, TKSV1404 the trial was taken up in protected irrigation.</td>
</tr>
<tr>
<td>3.</td>
<td>Initial Yield Trial – Grain Sorghum</td>
<td>5</td>
<td>K 8, K 12, CO 30 CSV 23</td>
<td>TKSV 1501, TKSV 1502 the trial was taken up in protected irrigation.</td>
</tr>
<tr>
<td>4.</td>
<td>Advanced Yield Trial – Forage Sorghum</td>
<td>8</td>
<td>K 11, CO 31</td>
<td>The trial was vitiated due to the failure of North East monsoon</td>
</tr>
<tr>
<td>5.</td>
<td>Preliminary Yield Trial – Forage Sorghum</td>
<td>9</td>
<td>K 11, CO 31</td>
<td>The trial was vitiated due to the failure of North East monsoon</td>
</tr>
<tr>
<td>6.</td>
<td>Initial Yield Trial – Forage Sorghum</td>
<td>7</td>
<td>K 11, CO 31</td>
<td>The trial was vitiated due to the failure of North East monsoon</td>
</tr>
<tr>
<td>7.</td>
<td>Multilocation Trial – Grain Sorghum</td>
<td>7</td>
<td>K 12, CO 30, APK 1</td>
<td>The trial was vitiated due to the failure of North East monsoon</td>
</tr>
<tr>
<td>8.</td>
<td>Multilocation Trial – Forage Sorghum</td>
<td>2</td>
<td>K 11, CO 27</td>
<td>The trial was vitiated due to the failure of North East monsoon</td>
</tr>
</tbody>
</table>

Segregating generations

| 1.     | F₁ | 15 | - | Selfed and harvested |
| 2.     | F₂ | 36 | - | 62 |
| 3.     | F₃ | 30 | - | 40 |
3. Midge resistance development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td></td>
<td>33</td>
<td>-</td>
<td>The trial was vitiated due to the failure of North East monsoon</td>
</tr>
<tr>
<td>4. F5</td>
<td></td>
<td>10</td>
<td>-</td>
<td>The trial was vitiated due to the failure of North East monsoon</td>
</tr>
<tr>
<td>5. F6</td>
<td></td>
<td>11</td>
<td>-</td>
<td>The trial was vitiated due to the failure of North East monsoon</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>135</td>
<td>-</td>
<td>102</td>
</tr>
</tbody>
</table>

4. Drought tolerant development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td></td>
<td>12</td>
<td>-</td>
<td>Selfed and harvested</td>
</tr>
</tbody>
</table>

5. Crossing block

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td></td>
<td>5</td>
<td>-</td>
<td>Selfed and harvested</td>
</tr>
</tbody>
</table>

6. AICSIP trial:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeding</td>
<td>1. AVT – Grain sorghum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2. AHT – Grain sorghum</td>
<td></td>
</tr>
<tr>
<td>Entomology</td>
<td>1. IAHT – DS</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2. IAHT – DS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. IAHT – SS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. AICSIP – SPN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Pest management Tactics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Pest survey in farmers field</td>
<td></td>
</tr>
</tbody>
</table>

7. Other activities

1. Teaching: Diploma in Agriculture
   - STH A21- Seed production techniques in field crops (1+1) IV semester
   - ODL-DAI-103 Seed production technology for the ODL – Diploma in Agri – Inputs Programme.

Research Papers- Nil
Book- Nil
Folder- Nil

8. Other points regarding the breeding material

1. Germplasm - A total of 260 number of working sorghum germplasm were raised and maintained at ARS, Kovilpatti.
2. Breeder seed - A quantity of 30 kg of K 8 sorghum and 20 kg of K 12 sorghum breeder seed production indent was given from Director, CPBG, TNAU, Coimbatore. The crop was raised under protected irrigated condition and the estimated yield is about 100 kg/ha.
3. Local collections: Collections of local sorghum were made from Vilvamarathupatti (2 nos) and from duraisamipuram (3 nos).

9. Other Important Points

1. Attended the workshop on Analytical platform for metabolomics on 14.02.2017 at AC&RI, Madurai.

h) LUDHIANA

Forage sorghum improvement

1. R line development programme- Nil
2. B line development programme
3. MS Conversion programme
4. Trait-specific line development programme-Nil

5. Station hybrid/varietal trial

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Name of trial</th>
<th>No. of entries</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Evaluation of promising hybrids with better forage yield and quality over the locations</td>
<td>8</td>
<td>CSH 20MF &amp; CSH 24MF (NC), SSG 59-3 (ZC), PSC 4 (LC)</td>
<td>PSC 10, PSC 13</td>
</tr>
<tr>
<td>2</td>
<td>Evaluation of new hybrids for forage yield and quality having resistance to insect pests &amp; diseases</td>
<td>11</td>
<td>PSC 4</td>
<td>PSC 21, PSC 22</td>
</tr>
<tr>
<td>3</td>
<td>Evaluation of varieties for forage yield and quality having resistance to insect pests &amp; diseases</td>
<td>10</td>
<td>PSC 4</td>
<td>SSG 69 (comparable)</td>
</tr>
<tr>
<td>4</td>
<td>Evaluation of single cut private company hybrids for fodder yield and quality</td>
<td>4</td>
<td>SL 44 &amp; PSC 4</td>
<td>Sugargraze</td>
</tr>
<tr>
<td>5</td>
<td>Evaluation of sweet sorghum varieties/hybrid for ethanol production</td>
<td>5</td>
<td></td>
<td>CSV 24SS &amp; CSH 22SS</td>
</tr>
</tbody>
</table>

6. AICSIP trial:

<table>
<thead>
<tr>
<th>Sr.no.</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nine – Five - forage sorghum trials</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One - seed yield trial</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Three - sweet sorghum trials</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nine</td>
<td></td>
</tr>
</tbody>
</table>

7. Other activities

m. Student guidance –
   Dr R S Sohu - One - Ph.D.; One - M.Sc. (as Major advisor); Three - M.Sc. (as committee member)
   Dr Devinderpal Singh- One - M.Sc. (as Major advisor)

n. Training organized-

8. Publications:

Research Papers- Nil
Popular Articles-Nil

9. Other points regarding the breeding material

- Maintenance of A B lines - 35 A/B pairs
- No. of Restorer lines - 70 R lines
- No. of experimental hybrids - 5 new inter-institutional hybrids
- No. of varietal selections - Development of composite variety
- Maintenance of germplasm - 110 sorghum lines
- 16 sweet sorghum lines
- 230 lines of segregating material

10. Other Important Points

- MOU with Pvt. Company (Stargene Hybrid Seeds) for seed production of PSC 4 sorghum hybrid
- Proposal of PSC 4 hybrid (Punjab Sudax Chari 4) submitted for registration under PPV&FRA
- Lectures, TV talks and radio talks given on fodder cultivation in the state
- Seed production of PSC 1 & PSC 4 hybrids released by PAU along with their parental lines; and single cut variety SL 44

i) PALEM

1. R line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>Details of the pedigree/cross</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₀</td>
<td>09R-SF 61/Shoot fly resistance</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>F₁</td>
<td>09R-SF 63/ Shoot fly resistance</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>F₇</td>
<td>10R-SF 25/SFRIL 36 x SFRIL 128</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>F₇</td>
<td>10R-SF 28/ ICSR18 x RS29</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
2. B line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>Details of the pedigree/cross</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;6&lt;/sub&gt;</td>
<td>O9B-AGR12/Agronomic superiority</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>F&lt;sub&gt;8&lt;/sub&gt;</td>
<td>O9B-AGR14/Agronomic superiority</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>Details of the pedigree/cross</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;7&lt;/sub&gt;</td>
<td>10B-SF1/415B x ICSR 13</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>F&lt;sub&gt;7&lt;/sub&gt;</td>
<td>10B-SF2/418B x 2219 B</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

3. Trait-specific line development programme

Development of lines resistant to various stresses/important characters:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Trait</th>
<th>Generation</th>
<th>No. of lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Shoot fly resistance</td>
<td>F8</td>
<td>3 R lines</td>
</tr>
<tr>
<td>2.</td>
<td>Agronomic superiority</td>
<td>F8</td>
<td>2 B lines</td>
</tr>
<tr>
<td>4.</td>
<td>Early maturity</td>
<td>F7</td>
<td>3 R lines</td>
</tr>
<tr>
<td>5.</td>
<td>Yellow pericarp sorghum</td>
<td>F5</td>
<td>4 lines</td>
</tr>
</tbody>
</table>

4. Station hybrid/varietal trial

<table>
<thead>
<tr>
<th>Sl.n o</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AVT-GS-II</td>
<td>17</td>
<td>CSV-31</td>
<td>3 (PSVGS-303, PSVGS-318 and PSVGS-320)</td>
</tr>
<tr>
<td>2</td>
<td>AVT-GS-I</td>
<td>17</td>
<td>CSV-31</td>
<td>3 (PSVGS-421, PSVGS-406 and PSVGS-414)</td>
</tr>
<tr>
<td>4</td>
<td>F&lt;sub&gt;6&lt;/sub&gt;</td>
<td>18</td>
<td>CSV-31</td>
<td>3 (PSVGS-6007, PSVGS-6001 and PSVGS-6009)</td>
</tr>
<tr>
<td>5</td>
<td>YPS</td>
<td>21</td>
<td></td>
<td>3 (YPS-17, YPS-11 and YPS-2)</td>
</tr>
</tbody>
</table>

12. AICSIP trial:

<table>
<thead>
<tr>
<th>S No.</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

13. Other activities

o. Student guidance – Nil
p. Training organized- Nil

14. Publications:

Research Papers-Nil
Popular Articles- 5
Folders- 2

Other points regarding the breeding material: Nil

Other Important Points:

➢ PYPS-2 Sorghum field day was organized on 20.8.2016 at Venkatapur village of Kosgi mandal of Kodangal Division

j) PANTNAGAR

Forage Sorghum improvement

1. R line development programme

Within as well as between progenies selection was practiced in various generations as per following details for development of restorers (R line) for multicut hybrid development, open pollinated varieties of single cut and multicut types and donors for various traits of economic importance in forage sorghum.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses/progenies attempted/evaluated</th>
<th>No. of families (crosses)/ single plants/progenies selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Attempted 15 crosses</td>
<td>Will be planted in Kharif 2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evaluated 18 crosses</td>
<td>11 crosses</td>
</tr>
<tr>
<td>2</td>
<td>F&lt;sub&gt;2&lt;/sub&gt;</td>
<td>31 crosses/8352 plants (Approx.)</td>
<td>21 crosses /254 SPS</td>
</tr>
<tr>
<td>3</td>
<td>F&lt;sub&gt;3&lt;/sub&gt;</td>
<td>33 crosses /339 SPPs</td>
<td>25 crosses /489 SPPs from 119 SPPs</td>
</tr>
<tr>
<td>4</td>
<td>F&lt;sub&gt;4&lt;/sub&gt;</td>
<td>39 crosses /349 SPPs</td>
<td>16 crosses /198 SPPs from 80 SPPs</td>
</tr>
<tr>
<td>5</td>
<td>F&lt;sub&gt;5&lt;/sub&gt;</td>
<td>10 crosses /23 SPPs</td>
<td>8 crosses /105 SPPs from 20 SPPs</td>
</tr>
<tr>
<td>6</td>
<td>F&lt;sub&gt;6&lt;/sub&gt;</td>
<td>5 crosses /36 Progeny bulks</td>
<td>4 crosses /16 Progeny bulks</td>
</tr>
<tr>
<td>7</td>
<td>F&lt;sub&gt;7&lt;/sub&gt;</td>
<td>5 crosses /19 Progeny bulks</td>
<td>4 crosses /8 Progeny bulks</td>
</tr>
<tr>
<td>8</td>
<td>Screening plots (F&lt;sub&gt;7&lt;/sub&gt; onwards)</td>
<td>27 crosses /80 progeny bulks</td>
<td>26 crosses /61 Progeny bulks</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>183 crosses /9198 single plant progenies + progeny bulks</td>
<td>115 Crosses /1131 SPSs and Bulk selections</td>
</tr>
</tbody>
</table>
2. **B line development/improvement programme:**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>17</td>
<td>11 crosses /78 SPSs</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>17</td>
<td>11 crosses /78 SPSs</td>
</tr>
</tbody>
</table>

3. **MS Conversion programme**

Following A x B crosses were found to be best based on sterility and heterosis for panicle size and combining ability) and showed complete sterility. These will be advanced by back crossing with B lines in the next season.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected (Advancement of BC pairs made during the year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;1&lt;/sub&gt; (attempted)</td>
<td>ICSA 469 x ICSB 467</td>
<td>Will be advanced after back crossing with B lines</td>
</tr>
<tr>
<td>2</td>
<td>BC&lt;sub&gt;1&lt;/sub&gt;</td>
<td>104 Ax ICSB 467</td>
<td>Back crossing was done with B line</td>
</tr>
<tr>
<td>3</td>
<td>BC&lt;sub&gt;2&lt;/sub&gt;</td>
<td>ICSA 469 x 104 B ICSA 276 x 104 B ICSA 351 x ICSB 467 ICSA 467 x 104 B 2219 A x ICSB 467</td>
<td>Back crossing was done with B line</td>
</tr>
</tbody>
</table>

Total 8

4. **Trait-specific line development programme**

**Trait 1 - Foliar Disease Resistance**

**C. R line/ donor development programme**

Selection was practiced as per following details for various foliar diseases (anthracnose, Zonate leaf spot and leaf blight etc.) resistant plants at flowering stage as well as at maturity stage for stay green expression, for their use as restorers as well as donors.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses/progenies evaluated</th>
<th>No. of families (crosses)/single plant/progenies selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>3 crosses</td>
<td>3 crosses/116 SPSs</td>
</tr>
<tr>
<td>2</td>
<td>Advanced generations (F&lt;sub&gt;7&lt;/sub&gt; onwards)</td>
<td>5 crosses/28 Progeny bulks</td>
<td>5 crosses/22 Progeny bulks</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>34/2361 single plant progenies + progeny bulks</td>
<td>25/214 single plant selections + bulk selections</td>
</tr>
</tbody>
</table>

**Trait 2 – Brown Mid Rib**

**15. R line/ donor development programme**

Selection was practiced for individual plants showing brown mid rib at flowering and brown stem with brown pith at maturity along with tan, early to medium, tall, juicy plants with less foliar diseases and white seed. Each selected plant will be evaluated for fodder quality trait viz. digestibility, protein per cent and fiber content for validation before use as donors.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses/progenies evaluated</th>
<th>No. of families (crosses)/single plant/progenies selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>1 cross/5 SPPs</td>
<td>1 cross/3 SPSs</td>
</tr>
<tr>
<td>2</td>
<td>Advanced generations (F&lt;sub&gt;7&lt;/sub&gt; onwards)</td>
<td>Scrosses/28 Progeny bulks</td>
<td>5 crosses/22 Progeny bulks</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>6/33 progeny bulks</td>
<td>6/25 progeny bulks</td>
</tr>
</tbody>
</table>

**Trait 3 – Sweetness and Juiciness of stem**

**C. R line & donor development programme**

Individual plants as well as bulk selections were practiced for juicy and sweet stemmed (TSS at maturity more than 15%), tall and leafy plants with foliar disease resistance to be use as donors and elite lines.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses/progenies evaluated</th>
<th>No. of families (crosses)/single plant/progenies selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>4 crosses</td>
<td>Will be planted in Kharif 2017</td>
</tr>
<tr>
<td>2</td>
<td>F&lt;sub&gt;2&lt;/sub&gt;</td>
<td>1 cross/270 plants</td>
<td>Nil (rejected)</td>
</tr>
</tbody>
</table>
Trait 4 – Multicut type (tillering and fast regeneration), juiciness with good seed yield

### a. R line and varietal development programme

Individual plants as well as bulk selections were practiced for juicy, tall, early, high tillering type plants with foliar disease resistance, to be used as restorers in multicut hybrid development programme as well as open pollinated multicut varieties.

### Trait 5 – Single cut fodder/dual purpose

#### A. R line and varietal development programme

Individual plants as well as bulk selections were practiced for juicy, tall, leafy, early to medium flowering plants with foliar disease resistance and good seed yield, to be used as open pollinated single cut/dual purpose varieties of forage sorghum as well as restorers for development of single cut hybrids.

### Station hybrid/varietal trial

#### i. Station Trials:

Two station trials on multicut and single cut forage sorghum as per following details were conducted to identify the promising experimental elite lines for their testing in State as well as All India Coordinated Trials.

---

**Sl. No.** | **Generation** | **No. of crosses/progenies/ single plants evaluated** | **No. of families (crosses)/single plants/progenies selected**
---|---|---|---
3 | F<sub>3</sub> | 7 cross/74 SPPs | 6 crosses/72 SPPs
4 | F<sub>4</sub> | 3 crosses/53 SPPs | 3 crosses/29 SPPs
5 | F<sub>5</sub> | 1 crosses/3 SPPs | 1 crosses/2 progeny bulks
6 | F<sub>7</sub> | 2 crosses/6 progeny bulks | 2 crosses/3 progeny bulks
7 | Advanced generations (F<sub>7</sub> onwards) | 2 cross/4 progeny bulk | 2 cross/4 progeny bulk

**Total** | 21/410 single plant progenies + progeny bulks | 15/110 single plant selections + bulk selections

**Trait 4 – Multicut type (tillering and fast regeneration), juiciness with good seed yield**

Individual plants as well as bulk selections were practiced for juicy, tall, early, high tillering type plants with foliar disease resistance, to be used as restorers in multicut hybrid development programme as well as open pollinated multicut varieties.

**Sl. No.** | **Generation** | **No. of crosses/progenies/ single plants evaluated** | **No. of families (crosses)/single plants/progenies selected**
---|---|---|---
1 | F<sub>1</sub> | Attempted 4 crosses | Will be planted in Kharif 2017
Evaluated 9 crosses | 5 crosses
2 | F<sub>2</sub> | 5 crosses/1080 plants | 3 crosses/45 SPSs
3 | F<sub>3</sub> | 14 cross/137 SPPs | 11 cross/196 SPSs
4 | F<sub>4</sub> | 14 crosses/109 SPPs | 2 crosses/41 SPSs
5 | F<sub>5</sub> | 3 crosses/21 progeny bulks | 2 crosses/10 progeny bulks
6 | F<sub>7</sub> | 1 crosses/4 progeny bulks | Nil (rejected)
7 | Advanced generations (F<sub>7</sub> onwards) | 7 cross/17 progeny bulk | 7 cross/10 progeny bulk

**Total** | 57/1368 single plant progenies + progeny bulks | 30/302 single plant selections + bulk selections

**Trait 5 – Single cut fodder/dual purpose**

#### A. R line and varietal development programme

Individual plants as well as bulk selections were practiced for juicy, tall, leafy, early to medium flowering plants with foliar disease resistance and good seed yield, to be used as open pollinated single cut/dual purpose varieties of forage sorghum as well as restorers for development of single cut hybrids.

**Sl. No.** | **Generation** | **No. of crosses/progenies/ single plants evaluated** | **No. of families (crosses)/single plants/progenies selected**
---|---|---|---
1 | F<sub>1</sub> | Attempted 4 crosses | Will be planted in Kharif 2017
Evaluated 2 crosses | 1 crosses
2 | F<sub>2</sub> | 4 cross/1332 plants | 4 cross/71 SPSs
3 | F<sub>3</sub> | 14 crosses/152 SPPs | 12 crosses/217 SPSs
4 | F<sub>4</sub> | 29 crosses/309 SPPs | 13 crosses/195 SPSs
5 | F<sub>5</sub> | 9 crosses/22 SPPs | 7 crosses/19 progeny bulks
6 | F<sub>6</sub> | 2 crosses/15 progeny bulks | 2 crosses/6 progeny bulks
7 | F<sub>7</sub> | 4 crossed/15 progeny bulks | 4 crosses/5 progeny bulks
8 | Advanced generations (F<sub>7</sub> onwards) | 21 cross/67 progeny bulks | 19 crosses/52 progeny bulks

**Total** | 89/1912 single plant progenies + progeny bulks | 62/565 single plant selections + bulk selections

---

**Sl. No.** | **Name/ title of trial** | **No. of entries tested** | **Checks used** | **Superior entries (% superiority over best check)**
---|---|---|---|---
1 | Station vanetal and hybrid trial (multicut) | 6 hybrids and 4 varieties | CSH 20 MF, CSH 24 MF (Hybrid check) Pant Chari 6 SSG 59-3 (Varietal check) | SHTMC 4(10.91% over CSH 24 MF) and SVTMC1 (42.30%) SVTMC 2(17.95%) SVTMC 3(12.82%) over SSG 59-3/ Pant Chari 6
2 | Station vanetal trial (single cut) | 18 | CSV 21F | SVTSC 4 (11.11%), SVTSC 5 (12.25%), SVTSC 12 (11.25%), SVTSC 14 (22.22%), SVTSC 15 (15.17%)
II. State Trial:

Two State Varietal Trials (SVT) on single cut and multicut forage sorghum, as per following details, were conducted to identify the promising experimental hybrids and varieties for their release in the State through Uttarakhand State Variety Release Committee.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior/best entries (Coded numbers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SVT-Single cut (Single cut varieties)</td>
<td>9</td>
<td>CSV 21 F</td>
<td>SST 1803, SST 1808, SST 1807, SST 1805 and SST 1804</td>
</tr>
<tr>
<td>2</td>
<td>SVT-Multicut (Multicut varieties)</td>
<td>6</td>
<td>Pant Chari 6 &amp; SSG 59-3</td>
<td>SMT 1703, SMT 1701, SMT 1704 and SMT 1702</td>
</tr>
</tbody>
</table>

6 AICSIP trials:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of AICSIP trials allotted</th>
<th>Number of entries</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AVHT single cut (Trial 1)</td>
<td>18</td>
<td>All the six (6) AICSIP Trials were conducted successfully and data was submitted timely through automation system.</td>
</tr>
<tr>
<td>2</td>
<td>PVHT single cut trial (Trial 2)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IAVHT multicut cut trial (Trial 3)</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Seed yield forage trial (Trial 4)</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Evaluation of sorghum-maize intergeneric derivatives (SML) - Multicut (Trial 5)</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>IAVHT Sweet Sorghum</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

7 Other activities

q. Student guidance

One Ph. D. (Seed Science & Technology) and one M. Sc. (Genetics & Plant Breeding) student completed their thesis research work and degree programme on sorghum seed technology and sorghum breeding, respectively during 2015-16 as per following details.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the Student</th>
<th>Major/Degree</th>
<th>Minor</th>
<th>Thesis title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ms. Priyamvada</td>
<td>Seed Science &amp; Technology (Ph. D)</td>
<td>Genetics &amp; Plant Breeding</td>
<td>Heterosis and hybridity assessment for seed quality parameters through morphological and molecular methods in sorghum [Sorghum bicolor (L.) Moench]</td>
</tr>
<tr>
<td>2</td>
<td>Mr. Devendra Upreti</td>
<td>Genetics &amp; Plant Breeding (M.Sc.)</td>
<td>Nil</td>
<td>Studies on genetic divergence and morphological characterization of sweet sorghum [Sorghum bicolor (L.) Moench] genotypes.</td>
</tr>
</tbody>
</table>

r. Training organized- Advanced Training on Fodder Seed Production, March 15-19, 2016 (sponsored by Indian Institute of Seed Science, Mau and NDDB, Anand)

8 Publications: Research Papers- 2 Popular Articles- 1 Book- Nil Folder- Nil

Other points regarding the breeding material

Maintaince of A/ B lines- 74 pairs

No. of restorer lines for multicut hybrid development
10 lines with high tillering earliness and good pollen production

No. of lines to be used as donors for various traits
22 lines with stable brown mid expression for use in crossing/ hybridization programme; 7 lines with high sweetness and juiciness of stem for use in crossing/ hybridization programme; 18 lines with high resistance to foliar diseases/ stay green expression for use in crossing/ hybridization programme

No. of experimental hybrids under test in AICSIP Trials- 4 multicut and 3 single cut type

No. of varieties under test in AICSIP Trials- 3 single cut type

No. of varietal selections- 32 elite lines of multicut and single cut types were identified for multi location testing for yield and quality

PARBHANI

R line development programme

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/singles plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>35</td>
<td>15 F₁:s</td>
</tr>
<tr>
<td>2</td>
<td>F₂</td>
<td>15</td>
<td>36 SPS</td>
</tr>
<tr>
<td>3</td>
<td>F₃</td>
<td>40</td>
<td>20 SPS</td>
</tr>
<tr>
<td>4</td>
<td>F₄</td>
<td>12</td>
<td>21 SPS</td>
</tr>
<tr>
<td>5</td>
<td>F₅</td>
<td>15</td>
<td>7 Families</td>
</tr>
<tr>
<td>6</td>
<td>F₆</td>
<td>07</td>
<td>4 Families</td>
</tr>
<tr>
<td>7</td>
<td>F₇</td>
<td>06</td>
<td>3 Families</td>
</tr>
</tbody>
</table>
## B line development programme

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/singles plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>11</td>
<td>8 F₁,s</td>
</tr>
<tr>
<td>2</td>
<td>F₂</td>
<td>08</td>
<td>28 SPS</td>
</tr>
<tr>
<td>3</td>
<td>F₁</td>
<td>22</td>
<td>37 SPS</td>
</tr>
<tr>
<td>4</td>
<td>F₁</td>
<td>15</td>
<td>20 SPS</td>
</tr>
<tr>
<td>5</td>
<td>F₃</td>
<td>07</td>
<td>5 Families</td>
</tr>
<tr>
<td>6</td>
<td>F₅</td>
<td>05</td>
<td>3 Families</td>
</tr>
</tbody>
</table>

## Trait specific lines development Programme:

### I) Grain mold

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/singles plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>10</td>
<td>6 F₁,s</td>
</tr>
<tr>
<td>2</td>
<td>F₂</td>
<td>10</td>
<td>35 SPS</td>
</tr>
<tr>
<td>3</td>
<td>F₃</td>
<td>20</td>
<td>16 SPS</td>
</tr>
<tr>
<td>4</td>
<td>F₅</td>
<td>07</td>
<td>04 Families</td>
</tr>
</tbody>
</table>

### II) Shoot fly

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/singles plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>09</td>
<td>05 F₁,s</td>
</tr>
<tr>
<td>2</td>
<td>F₂</td>
<td>18</td>
<td>25 SPS</td>
</tr>
<tr>
<td>3</td>
<td>F₃</td>
<td>07</td>
<td>04 Families</td>
</tr>
</tbody>
</table>

## CMS Conversion Programme

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/singles plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BC-III</td>
<td>18</td>
<td>07</td>
</tr>
<tr>
<td>2</td>
<td>BC - V</td>
<td>06</td>
<td>06</td>
</tr>
</tbody>
</table>

## Station hybrid/Varietal trial

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preliminary Hybrid Trial</td>
<td>33</td>
<td>03 (CSH 25, CSH 16, CSH 30)</td>
<td>3, 11, 14, 17, 18, 20, 21, 29, 36.</td>
</tr>
<tr>
<td>2</td>
<td>Preliminary Varietal Trial</td>
<td>20</td>
<td>02 (PVK 801, CSV 27.)</td>
<td>7, 11, 4.</td>
</tr>
<tr>
<td>3</td>
<td>Preliminary Varietal Trial(SC) II</td>
<td>12</td>
<td></td>
<td>01</td>
</tr>
<tr>
<td>4</td>
<td>Evaluation of sorghum land races for Hurda purpose</td>
<td>12</td>
<td></td>
<td>02</td>
</tr>
</tbody>
</table>

## AICSIP trial

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>IVT (GS)</td>
<td>24</td>
<td>01</td>
<td>Rl: 4013, 4015, 4009, 4000, 4023, 4024, 4010. Rll: 4072, 4073, 4065, 4066, 4070, 4004, 4069, 4056, 4068, 4059, 4074, 4050, 4063. Rlll: 4102, 4104, 4110, 4111, 4107, 4122, 4119, 4124, 4113.</td>
</tr>
<tr>
<td>9</td>
<td>AVHT-SC</td>
<td>17</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>IVHT-SC</td>
<td>19</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>HBT</td>
<td>11</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>IAVHT-SS</td>
<td>18</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Evaluation and selection of F2 population</td>
<td>14</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
7. Other activities
   i. Student guidance: 03
   ii. Training organized: NIL

8. Publications:
   Research Papers: 7
   Popular articles: 10
   Books: 01
   Folders: 05

9. Other points regarding the breeding material
   Maintenance of A B lines: Kharif: 17 Rabi: 13
   No. of Restore lines: Kharif: 25 Rabi: 20
   No. of experimental hybrids: Kharif: In Progress Rabi: In Progress
   No. of Varietal selections: 19

k) PHALTAN
   Sweet sorghum improvement
   1. R line development programme

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F4</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>F8</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3</td>
<td>43</td>
</tr>
</tbody>
</table>

2. B line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F8</td>
<td>7</td>
<td>45</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7</td>
<td>45</td>
</tr>
</tbody>
</table>

3. MS Conversion programme: Nil

4. Trait-specific line development programme
   Trait 1 - Stem borer tolerance
   D. R line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F2</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5</td>
<td>20</td>
</tr>
</tbody>
</table>

E. B line development programme: Nil

F. MS conversion programme: Nil

Trait 2 - Shoot fly tolerance

16. R line development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F2</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5</td>
<td>20</td>
</tr>
</tbody>
</table>

17. B line development programme: Nil

18. MS Conversion programme: Nil

5. Station hybrid/varietal trial

6. AICSIP trial:

<table>
<thead>
<tr>
<th>Sr.no.</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 (Kharif)</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>2 (Rabi)</td>
<td>2</td>
</tr>
</tbody>
</table>
7. Other activities
   s. Student guidance – Nil
   i. Training organized- Nil

8. Publications:
   Research Papers- Nil
   Popular Articles- Nil
   Books- Nil
   Folder- Nil

9. Other points regarding the breeding material
   Maintenance of A-B lines - 174 A-B lines
   Maintenance of germplasm - 581
   No. of restorer lines - 26
   No. of experimental hybrids - 47
   No. of varietal selections - 67 lines

10. Other Important Points:
   1) Standardized the protocol of vinegar production from sweet sorghum juice.
   2) Syrup was produced from sweet sorghum juice.
   3) Standardized the protocol for membrane stability index with National Institute of Abiotic Stress Management (NIASM), Baramati (Maharashtra)

I) RAHURI
Varietal development programme:
In view to develop a variety for high biomass coupled with shootfly tolerance and better juice quality parameters, the 12 straight crosses has been effected during the rabi season. The F₁ to F₆ generations were evaluated and promising IPS were selected. The details are given in table 1.

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Generation</th>
<th>No.of crosses evaluated</th>
<th>No. of progenies</th>
<th>No.of Families/IPS selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F₁</td>
<td>10</td>
<td>-</td>
<td>F₁ grown</td>
</tr>
<tr>
<td>2</td>
<td>F₂</td>
<td>12</td>
<td>-</td>
<td>59</td>
</tr>
<tr>
<td>3</td>
<td>F₃</td>
<td>10</td>
<td>83</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>F₄</td>
<td>15</td>
<td>53</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>F₅</td>
<td>14</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>F₆</td>
<td>25</td>
<td>66</td>
<td>33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>AICSIP Trials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ISSAVHT-Kharif</td>
<td>18</td>
<td>Coded</td>
<td>8011, 8068, 8104</td>
</tr>
<tr>
<td>2</td>
<td>High biomass Trial</td>
<td>11</td>
<td>Coded</td>
<td>9007, 9058, 9104</td>
</tr>
<tr>
<td>3</td>
<td>Inter-Institutional Hybrid Trial (HNC-I)</td>
<td>30</td>
<td>Coded</td>
<td>7.37,67</td>
</tr>
<tr>
<td>4</td>
<td>Inter-Institutional Hybrid Trial (HNC-I)</td>
<td>30</td>
<td>Coded</td>
<td>25,35,84</td>
</tr>
<tr>
<td>5</td>
<td>Inter-Institutional Hybrid Trial (HNC-I)</td>
<td>30</td>
<td>Coded</td>
<td>14,54,75</td>
</tr>
</tbody>
</table>

Evaluation of sweet sorghum genotypes for cane yield and quality parameters
Different genotypes/ hybrids has been evaluated for cane yield and promising genotypes/hybrids has been given in the table 2.

<table>
<thead>
<tr>
<th>Sr.no.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Univ.MLT Sweet Sorghum</td>
<td>14</td>
<td>SSV 84, CSV 19SS, P. Vasundhara</td>
<td>P. Vasundhara</td>
</tr>
<tr>
<td>C</td>
<td>Station varietal/Hybrids trials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Station Trial Set I</td>
<td>20</td>
<td>SSV 84; CSV 19SS P. Vasundhara</td>
<td>P. Vasundhara, RSSV 522, RSSV 521</td>
</tr>
<tr>
<td>2</td>
<td>Station Trial Set II</td>
<td>20</td>
<td>CSV 19SS</td>
<td>RSSV 542, RSSV 544</td>
</tr>
<tr>
<td>3</td>
<td>Station Hybrid Trial</td>
<td>20</td>
<td>CSV 19SS; P. Vasundhara</td>
<td>P. Vasundhara</td>
</tr>
</tbody>
</table>

Hybrid development programme: In order to develop sweet sorghum hybrids having high biomass with better quality parameters, 21 experimental hybrids has been developed on CMS 185A,1409A and 479Aby utilizing elite sweet sorghum restorer during rabi season.
m) SURAT

1. Trait-specific line development programme

   Trait 1 - High yielding with shoofly and stem borer resistant grain sorghum kharif variety
兽经发展计划

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1</td>
<td>11</td>
<td>4/35</td>
</tr>
</tbody>
</table>

   Trait 2 - High yielding with grain mold resistant grain sorghum kharif variety

   Trait 3 - High yielding grain sorghum kharif variety

   A. Germplasm collection, evaluation and maintenance programme

   Total 256 including 228 old and 28 new lines evaluated and 256 lines maintained

Programme name: Fodder Sorghum variety development Programme

   Trait 1 –

   D. High yielding variety development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1</td>
<td>8</td>
<td>3/2</td>
</tr>
</tbody>
</table>

   2

   E. Germplasm collection, evaluation and maintenance programme

   Total 192 lines evaluated and 154 lines were maintained

Programme name: Sweet Sorghum Programme

   A. Germplasm collection, evaluation and maintenance programme

   Total 26 evaluated and 23 lines were maintained

Rabi 2016-17

   Trait 1 - High yielding rabi grain sorghum variety

   A. Variety development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F3</td>
<td>254</td>
<td>0 / 132</td>
</tr>
</tbody>
</table>

   2

   B. Germplasm collection, evaluation and maintenance programme

   Total 165 lines (Old: 124, New collection 41) evaluated and 142 lines were maintained

   Trait 2 - High yielding with better grain quality rabi variety

   A. Variety development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F3</td>
<td>107</td>
<td>0 / 63</td>
</tr>
</tbody>
</table>

   2

   B. Germplasm collection, evaluation and maintenance programme

   Total 47 lines collected & evaluated [14 single plant selected]

   Trait 3 - Development of Hurda type sorghum variety

   A. Variety development programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No. of families/single plant selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F3</td>
<td>39</td>
<td>0 / 12</td>
</tr>
</tbody>
</table>

   B. Germplasm collection, evaluation and maintenance programme

   Total 15 lines collected & evaluated [5 single plant selected]

7. Station hybrid/varietal trial

   Kharif-2016

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of trial</th>
<th>No. of entries tested</th>
<th>Checks used</th>
<th>Superior entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Large scale varietal trial on grain sorghum</td>
<td>10</td>
<td>GJ-38, GJ-42, GNJ-1CSV-20 (NC)</td>
<td>SR 2957, SR 2914, SR 2950</td>
</tr>
<tr>
<td>2</td>
<td>Small scale varietal trial on grain sorghum</td>
<td>10</td>
<td>--do--</td>
<td>SR 2896, SR 2958, SR 2980</td>
</tr>
<tr>
<td>3</td>
<td>Small Scale Varietal Trial on dual purpose sorghum</td>
<td>16</td>
<td>GJ-39, GJ-42, GNJ-1</td>
<td>DS 127, DS 123, DS 137, SR</td>
</tr>
</tbody>
</table>
### S. No. | Name of trial | No. of entries tested | Checks used | Superior entries
--- | --- | --- | --- | ---
4 | Preliminary evaluation trial on grain sorghum | 19 | GJ-38, GJ-39, GJ-42, GNJ-1, CSV-20 (NC) | SR 2985, SR 2926, SR 2999, SR 3003
5 | Large Scale varietal trial on forage sorghum (single cut) | 8 | GFS – 5, CSV-21F(NC) | SRF-347, DS-117, DS-123, SRF-316
6 | Small scale varietal trial on forage sorghum (single cut) | 16 | GFS – 5, CSV-21F(NC) | SRF-332, SRF-370, SRF-353
7 | Preliminary Evaluation trial on forage sorghum (single cut) | 18 | GFS – 5, CSV21F(NC) | SRF-364, SRF-355, SRF-348, SRF-363
9 | Hybrid Evaluation Trial-Grain Sorghum | 55 | CSH-25 | Seventeen

### Rabi 2015-16

| SN o | Name of trial | No. of entries tested | Checks used | Superior entries
--- | --- | --- | --- | ---
1 | Large scale varietal trial on grain sorghum | 10 | BP-53, NIZER GOTI, GJ-36, CSV-216R(NC) | SR 2952, RSV 1006, CRIS-13
2 | Small scale varietal trial on grain sorghum | 18 | NIZER GOTI, BP-53, CSV-216R(NC), CSV-22(NC) | SPV 1891, SR 2896, SPV 1835
3 | Preliminary evaluation trial on grain sorghum | 20 | NIZER GOTI, BP-53, CSV-216R(NC), CSV-22(NC) | SPV 2844, SPV 2287, SPV 1709

### AICSIP trial:

<table>
<thead>
<tr>
<th>Sr.no.</th>
<th>Name of Experiment</th>
<th>No. of AICSIP trials allotted</th>
<th>No. of AICSIP trials successfully conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grain sorghum</td>
<td>Surat (K)</td>
<td>Mangrol(K)</td>
</tr>
<tr>
<td>2</td>
<td>Forage sorghum</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Sweet sorghum</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>High Biomass Trial</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Total (12)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 20. Other activities

#### u. Student guidance –

<table>
<thead>
<tr>
<th>Name of Scientist</th>
<th>As a major advisor</th>
<th>Thesis evaluated</th>
<th>Thesis viva-voca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. B. K. Davda</td>
<td>M. Sc.</td>
<td>Ph. D.</td>
<td>4</td>
</tr>
</tbody>
</table>

#### v. Training organized– Three [Collaboration with KVK, Surat]

#### w. Training, Seminar attended by Scientist:

**Dr. Bharat K. Davda**

**Dr. Vilas D. Pathak**
- Time and man management during 5/9/16 to 17/9/16, SPIPA, Ahmedabad
- Prof. Madhu I. Patel
  - ICAR sponsored summer school on “Allele mining in crops: Methods and Utility” at C. P. College of Agriculture, SDAU, Dantiwada, Banaskantha during, Jul 18, 2016 to Aug 07, 2016
- Prof. N. V. Radadiya
  - Advances in Eco friendly pest management strategies in millets by IIMR, Hyderabad During 22/8/16 to 1/9/16
  - Team building and motivation (EDP) during 7/9/16 to 9/9/16, SPIPA, Ahmedabad
- Prof. S. J. Trivedi
  - Team building and motivation (EDP) during 7/9/16 to 9/9/16, SPIPA, Ahmedabad
- Prof. Lalita H. Saini
  - Time and man management during 15/9/16 to 17/9/16, SPIPA, Ahmedabad

#### x. Training, lectures given by Scientist:

**Dr. Bharat K. Davda**
- Delivered a lecture in Krishi Mela at Mandavi 04-04-16
- Given training to department officers in pre-seasonal training class for at KVK Surat on 08-06-2016.
To deliver lecture in pre-seasonal training meeting at Navsari on 08/07/16 [TPA No.875146786272]
Delivered a lecture in training on at KVK-Surat and on July,14 2016.
Delivered a lecture in the training on at KVK-Surat on October 17, 2016.
Farmers meeting and delivered a lecture at Mangrol, Balethi 25-10-16

Dr. V.D. Pathak
Field training programme to RAVE students of Seventh Semester September-2015
Field training programme to Student of MRS, VNSGU, Surat -16

Prof. Madhu I. Patel
Taught a course PB 234 Plant Breeding techniques in third semester at Aspee Shakilam Agricultural Biotechnology Institute, NAU, Surat.
Field training programme to RAVE students of Seventh Semester September-2016
Field training programme to Student of MRS, VNSGU, Surat 2016
Training to Student of the GABI regarding Sorghum Breeding.
Delivered lecture on Sorghum cultivation to Atma Project farmer of Patan District at Surat during 2016.

21. Publications:
Research Papers- 3
Popular Articles- 5
Book- Nil
Folder- Six

22. Other points regarding the breeding material
- Maintainance of A B lines- Fifty one
- No. of Restorer lines- Seventy three
- No. of experimental hybrids- Fifty five [Seventeen found promising]
- No. of varietal selections:

<table>
<thead>
<tr>
<th>Grain sorghum</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>No. of crosses evaluated</td>
</tr>
<tr>
<td>1</td>
<td>F1</td>
</tr>
<tr>
<td>2</td>
<td>F2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Forage sorghum</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>No. of crosses evaluated</td>
</tr>
<tr>
<td>5</td>
<td>F3</td>
</tr>
<tr>
<td>6</td>
<td>F2</td>
</tr>
<tr>
<td>7</td>
<td>Germplasm maintenance and evaluation programme</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sweet sorghum</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Germplasm maintenance and evaluation programme</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rabi sorghum</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>No. of crosses evaluated</td>
</tr>
<tr>
<td>9</td>
<td>F4</td>
</tr>
<tr>
<td>10</td>
<td>F3</td>
</tr>
<tr>
<td>11</td>
<td>Germplasm maintenance and evaluation programme</td>
</tr>
<tr>
<td>12</td>
<td>F3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hurda sorghum</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Germplasm maintenance and evaluation programme</td>
<td></td>
</tr>
</tbody>
</table>

n) UDAIPUR

1. R line development programme: Grain sorghum- Kharif 2016

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Generation</th>
<th>No. of crosses evaluated</th>
<th>No.of families/single plant selected</th>
<th>No of rows planted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1</td>
<td>Nil</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>F2</td>
<td>14</td>
<td>375</td>
<td>84</td>
</tr>
</tbody>
</table>
Sl. No. | Generation | No. of crosses evaluated | No. of families/single plant selected | No of rows planted |
--- | --- | --- | --- | --- |
3 | F3 | 03 | 273 | 108 |
4 | F4 | Nil | -- | -- |
5 | F5 | 12 | 182 | 288 |
6 | F6 | 10 | 211 | 200 |
7 | F7 | 06 | 40 | 36 |
**Total** | 45 | 1081 | 716 |

2. **R line development programme: Forage sorghum- Kharif 2016**

| Sl. No. | Generation | No. of crosses evaluated | No. of families/single plant selected | No of rows planted |
--- | --- | --- | --- | --- |
1 | F1 | Nil | -- | -- |
2 | F2 | Nil | -- | -- |
3 | F3 | 04 | 36 | 39 |
4 | F4 | 21 | 77 | 78 |
5 | F5 | Nil | -- | -- |
6 | F6 | 01 | Nil | 02 |
7 | F7 | Nil | -- | -- |
**Total** | 26 | 113 | 119 |

3. **B line development programme :Nil**
   MS Conversion programme :Nil
   Trait-specific line development programme

   **Trait 1** -
   G. R line development programme :Nil
   H. B line development programme :Nil
   I. MS Conversion programme :Nil

   **Trait 2** –
   23. R line development programme :Nil
   24. B line development programme :Nil
   25. MS Conversion programme :Nil

   **Trait 3** –
   F. R line development programme :Nil
   G. B line development programme :Nil
   H. MS Conversion programme :Nil

4. **Station hybrid/varietal trial**
   Varietal Programme

| S.n o | Name of trial | No. of entries | Checks used | Superior entries |
--- | --- | --- | --- | --- |
1 | Station Varietal Trial | 13 | (02) CSV 23 & PC 1080 | SU1595, SU1596, SU1598, SU1594, SU1591 |
2 | Station Fodder Trial | 12 | (02) CSV 21F, COFS-29 | None for GFY & DFY; U1600, SU1604, SU1605 and SU1609 for days to flowering |
3 | Regional Fodder Trial at Udaipur | 01(SPV 2185) | (04) PC 1080, CSV 21F, HC 308, RC-2 | SPV 2185SC |
4 | Regional Fodder Trial at ATC Chittorgarh | 01(SPV 2185) | (04) PC 1080, CSV 21F, HC 308, RC-2 | SPV 2185SC |

5. **AICSIP trial:**

| S. no | No. of AICSIP trials allotted | No. of AICSIP trials successfully conducted |
--- | --- | --- |
1 | 07(04 grains +02 Fodder SC +01 Fodder MC) | All successfully conducted and Reported |

6. **Other activities**
   y. **Student guidance** – Three under Advisory working on Sorghum
   z. **Training organized**- None

7. **Publications: Popular Articles**- Three  **Book**- None  **Folder**- None  **Pamplate:** Two

8. **Other points regarding the breeding material**
   Maintenance of A B lines- None (Not having)
   No. of Restorer lines- None
   No. of experimental hybrids- None
   No. of varietal selections-
F. Publications

Research papers


33. S. V. V. Malaghan and S. T. Kajjidoni. 2016. Genetic variability for grain micronutrient (Fe and Zn) content, plant morphological and other productivity related traits in rabi sorghum (Sorghum bicolor (h) Moench). The Bioscan; 11 (3): 1951-1954


**Conference papers/ abstracts**


Books
2. Improved Cultivation Practices Pages 364, Published by Directorate of Extension, UAS Dharwad

Book Chapters


**Technical/ Popular Articles - 41 in local languages**


**Folders: 16 in local languages**

SPV 2242 F: Multi cut fodder sorghum (Tamil and English)