

Kharif grain sorghum - 2011

Contents

Executive summary	3
Detailed report	7
Kharif - 2011	7
I. Multi-location AICSIP trials	7
Advanced hybrid Trial (Tables A, 1.A, and 1.B).....	7
Advanced Varietal Trial (Tables B, 2.A, and 2.B).....	9
Initial Hybrid Trial (Tables 3.A. to 3.B.).....	10
Initial Varietal Trial (Tables 4.A and 4.B).....	11
Advanced Hybrid Trial –Dual Purpose (Table 5A and 5B).....	13
Advanced Varietal Trial –Dual Purpose (Table 6.A and 6.B).....	14
Late kharif	15
Advanced Hybrid and Varietal Trial (Table 7.A).....	15
Initial Varietal Trial- Late kharif (Tables 8A).....	15
Initial Hybrid Trial- Late kharif (Tables 9.A).....	16
II. Coordinated sorghum breeding research	17
III. Achievements in sorghum breeding at DSR	18
Breeding for micronutrient enrichment in sorghum (K Hariprasanna, M Elangovan & R Madhusudhana).....	18
Identification of molecular markers associated with heterosis and combining ability (Rajendrakumar, K Hariprasanna & R Madhusudhabna).....	18
Parental line development (K Hariprasanna, AV Umakanth, C Aruna & Rajendrakumar).....	19
Developing early duration and photoperiod insensitive grain sorghum MS and R lines (Sunil Gomashe, Sujay Rakshit, TG Nageshwar Rao & MY Samdur).....	19
Germplasm evaluation: assessing value for cultivation and use (VCU) (Sunil Gomashe, M Elangovan, G Shyam Prasad & IK Das).....	19
Development of superior forage sorghum genotypes (C Aruna, BV Bhat, AV Umakanth, VR Bhagwat, G Shyam Prasad & CV Ratnavathi).....	19
Studies on sucrose accumulation for efficient ethanol production from Sweet sorghum- National Fund project (CV Ratnavathi, C Aruna & Visarada).....	22
Studying the therapeutic properties and establishing sorghum grain as a functional food- DBT project (CV Ratnavathi & C Aruna).....	22
Genetic variation among mini core collections and elite lines for yield and quality traits (Ganapathy, S Audilakshmi, Sujay Rakshit & K Hariprasana).....	22
Combining ability studies in sweet sorghum (AV Umakanth, BV Bhat, G Shyam Prasad & SS Rao).....	22
Creating new variability for developing varieties and hybrid parents in rabi sorghum (<i>Sorghum bicolor</i> (L.) Moench) for medium to deep soils (P. Sanjana, JV Patil, Prabhakar, Sujay Rakshit, Subbarayudu & Sunil Gomashe).....	23
Genetic modification of sorghum for improving sorghum grain quality (S Audilakshmi, IK Das, C Aruna & Ganapathi).....	24

Collation, evaluation, documentation and utilization of sorghum genetic stocks (Sujay Rakshit, Sunil Gomashe, KN Ganapathy, VR Bhagwat & IK Das)	27
Development of rabi parental lines and varieties with rabi adaptability (Prabhakar, HS Talwar, VR Bhagwat, Gadewar & MY Samdur)	29
IV. Achievements in sorghum breeding at AICSIP centers.....	31
1. Akola.....	31
2. Indore	35
3. Surat.....	38
4. Coimbatore.....	39
5. Palem.....	40
6. Parbhani	40
7. Dharwad.....	41
8. Udaiapur	42
9. Bijapur.....	43
10. Rahuri	47
11. Tandur.....	49
12. Pantnagar	49
13. Hisar	52
V. Publications.....	52



Executive summary

During 2011, we have dealt with applied as well as basic and strategic research. Applied aspects deal with multi-location yield trials to evaluate finished or nearly finished products mainly at various centers of the All India Coordinated Improvement Project. We consolidated the basic and strategic research on drought we were conducting in net work mode for last 3-4 years and published an article in international journal. Under basic and strategic research, we have collected MS and R lines developed at various centers and developed hybrids. These hybrids were evaluated at multi-locations in two hybrid nursery trials. AICSIP centers have successfully registered sorghum genetic stocks and released new state varieties. Following are the details of progress made during this year (2011 to 2012).

Multi-location AICSIP trials: During 2011, we conducted 9 multi-location yield trials, 6 in *kharif* and 3 in late *kharif*.

Advanced Hybrid Trial (Tables 1.A, 1.B and 1.1 to 1.6)

- *Zone I (Table 1.A):* In Zone I, the top hybrid, SPH 1674 (5587 kg/ha) for grain yield showed superior fodder yield (17205 kg/ha) as compared to 5311 kg/ha of grain and 15755 kg/ha of fodder of CSH 16, check.
- *Zone II (Table 1.B):* Five hybrids performed significantly superior for grain yield over the check, CSH 16. SPH 1648 recorded high grain (5113 kg/ha) and high fodder yield of 14761 kg/ha against that of CSH 16 (4409 kg/ha of grain and 12556 kg/ha of fodder). The second best hybrid, SPH 1674 also recorded high grain (5002 kg/ha) and fodder yield (14789 kg/ha).

Advanced Varietal Trial (Tables 2.A, 2.B and 1.1 to 1.6)

- *Zone I (Table 2.A):* One variety, SPV 1999 showed marginal yield improvement (3.6%) over CSV15 and 21% yield improvement over CSV23. SPV 1999 ranked first by yielding 3858 kg/ha of grain against 3723 kg/ha of CSV 15, check.
- *Zone II (Table 2.2):* SPV 1999 was superior to CSV23, check by 8.6% for grain yield, and SPV 2061 for fodder yield by 5% over CSV15.

Initial Hybrid Trial (Tables 3.A, 3.B and 3.1 to 3.6)

- *Zone I (Table 3.A):* The top yielding hybrids, SPH Nos 1703, 1704, 1706, showed 3 to 9% increase for grain yield over the check, CSH 16. Hybrids superior for grain and fodder yields were SPH 1703 and SPH 1704. SPH 1703 recorded 4942 kg/ha of grain and 10662 kg/ha of fodder against 4521 kg/ha grain and 10198 kg/ha fodder of CSH 16.
- *Zone II (Table 3.B):* Six out of 10 hybrids performed superiorly (13 to 4% increase over the check, CSH 16). SPH 1702 and SPH 1705 showed high grain and fodder yields. SPH 1702 recorded grain yield of 4658 kg/ha and fodder yield of 15585 kg/ha as compared to grain yield of 4133 kg/ha and fodder yield of 14541 kg/ha of CSH16.

Initial Varietal Trial (Tables 4.A, 4.B and 4.1 to 4.6)

- *Zone I (Table 4.A):* The variety, SPV 2122 yielded highest grain yield of 4431 kg/ha and fodder yield of 13507 kg/ha. The check, CSV 23 yielded 3775 kg/ha of grain yield and 14460 kg/ha of fodder yield.
- *Zone II (Table 4.B):* SPV 2114 (GY =3935 kg/ha; FY = 19390 kg/ha) and SPV 2122 (GY =3792 kg/ha; FY = 18860 kg/ha) were superior to CSV 20 (GY =3569 kg/ha; FY = 17479 kg/ha) for grain and fodder yields.

Late kharif

Advanced hybrid and varietal Trial (Tables 7.A and 7.1 to 7.6)

- *Hybrids:* Hybrids superior for grain and fodder yields were SPH 1648, SPH 1679, SPH 1680 and SPH 1683. SPH1648 recorded 4025 kg/ha of grain and 10713 kg/ha of fodder against 3399 kg/ha grain and 9470 kg/ha fodder of CSH 16.
- *Varieties:* The test variety SPV 2078 recorded highest grain yield of 3414 kg/ha as compared to 2965 kg/ha of CSV 20 and 3212 kg/ha of CSV23.

The high grain yielding variety, SPV 2078 showed less fodder yield as compared to the check, CSV 23.

Initial Varietal Trial (Table 8.A)

- Variety, SPV 2117 recorded grain superiority by yielding 4480 kg/ha of grain yield against 3865 kg/ha of CSV 23, check. This variety showed 2% increase for fodder yield over CSV 20.

Initial Hybrid Trial (Table 9.A)

- Hybrids superior for grain and fodder yields were SPH 1707 and SPH 1706. SPH 1701. SPH 1707 recorded 3854 kg/ha of grain and 12649 kg/ha of fodder against 3482 kg/ha grain and 9363 kg/ha fodder of CSH 16.

Coordinated sorghum breeding research

As in previous year, we have published jointly with AICSIP associates one article on drought tolerance in international journal. During 2011, we developed hybrids with the parental lines from different centers and evaluated hybrid performance in multi-locations. The inter-institutional hybrids, CMS 10-2A × NR 486 topped across three locations followed by 70A × AKR 505. Six hybrids performed better than CSH 25. During 2011, 17 CMS lines were obtained from Parbhani (2), Indore (4), Akola (2), Dharwad (5) and DSR (4). Seeds were provided to Parbhani, Indore, Akola and DSR for development of new sets of inter-institutional hybrids.

Achievements in sorghum breeding at AICSIP centers

Akola center is focusing on development of parental lines with tolerance to gain mold and shootfly. Thirty three pairs of MS lines and 10 restorers are in advanced generation. At Indore, 20 newly developed R lines were evaluated for grain yield and out of these, 6 R lines namely I-28, I-26, I-27, I-29, I-16, 20-1-1-2-1, and 2-2-3-1-3, were superior to C43, check for gain yield. Surat center collected, evaluated and maintained grain sorghum (491), forage germplasm (72), rabi sorghum (40) and sweet sorghum (144). A New hybrid Co 5 from Coimbatore tolerant to shootfly and grain mold was released for Tamilnadu state during 2011. Palem submitted identification proposal of a dual purpose variety PSV56. At Parbhani, 10 rabi based MS pairs and 16 kharif MS pairs are maintained along with 40 rabi and 18 kharif restorers. Dharwad: one variety SVD-0203 (4371 kg/ha) recorded significantly superior grain yield over DSV-6 (3569 kg/ha) check variety. Udaipur: Variety, Pratap Chari 1080 was released at state level and notified.

Bijapur: A total of four special food purpose varieties viz., AKJ-1 (for flaking), SMJ-1 & RSJ-1 (for hurda purpose) and KMJ-1 (for pop purpose) were notified by University for further release at state level for commercial cultivation. Two R354-shoot fly resistance QTL introgressed lines (RSF 0810 and RSF 0833) were found promising in hybrid combinations with 104A for shoot fly resistance components. Tandur: During rabi 2011-12, an entry TNDS -1 (PV 15 × CSV 216 R) was given for minikit testing in Ranga Reddy, Nalgonda, Kurnool, Adilabad, Khammam and Mahabubnagar districts. The entry topped in grain (3178 kg/ha) and fodder yields in multi-location testing at Nandyal, Palem, Madhira and Tandur centers in A. P.

Panthagar: Notification of single cut forage sorghum variety, Pant Chari 7 and multi-cut forage sorghum variety, Pant Chari 8 was issued by "Central Sub-Committee on Crop Standards, Notification & Release of Varieties in Agricultural Crops". Hisar: Forage sorghum genotype, S 541 was identified by University varietal identification committee for its release at state level. The proposed variety has given 12.8 and 5.2% increase over the check,

HC 308 in green and dry fodder yields, respectively and was notified by University for further release at state level for commercial cultivation.

Achievements in sorghum breeding at DSR

At DSR, the emphasis is laid on basic and strategic research resulting in development of grain sorghum genotypes with particular end uses (starch and nutritional), superior rabi sorghum, forage and sweet sorghum genotypes.

Nutritional and industrial sorghum

- 240 genotypes comprising parental lines, released cultivars, and selected germplasm accessions were re-analysed for grain iron and zinc content. The grain iron content ranged from 12 to 75.5 ppm and zinc content from 6.3 to 51.4 ppm. EP 92 and EP 117 had above 75 ppm iron content and EP 127 had the highest zinc content.
- A set of 195 mini-core accessions along with 48 elite lines were evaluated for various grain yield and quality traits. IS 15744, IS 19153, IS 23514, IS 23586, IS 23579, IS 23891, IS 31706, ISA 4360, IS 4698 were promising for grain weight and grain yield.
- Two B lines, SBC 1174 (58 days) and SBC 1170 (59 days) were of early duration as compared to the check, 296B (67 days). Four MS lines, SBC 1170 (82.5 g/plant), BX 456 (84.5 g/plant), BX474 (80 g/plant) and SBC1184 (84 g/plant) were significantly superior to the check, 296B (57.5 g/plant).
- Six restorers, CB 122, 124, 127, 129, 136 and 137 were found promising with grain yield more than 100g per plant, where as C 43 yielded 76.5g/pl.

Rabi sorghum

- A total of 186 crosses were made between 20 rabi and kharif genotypes. The temperature during the entire crossing period recorded was below 15°C. Seed set was low in E 36-1, C 43, AKR 354 when used as both male and female parents indicating their susceptibility to cool temperatures. The seed set was good in CSV 8R, Phule Anuradha, Phule Chitra, Phule Vasudha, PKV Kranti, SPV 1595 when used as both male and female parents indicating their tolerance to cold stress.
- B line improvement for diversifying genetic base led to selection of 16 B lines out of 82 lines with rabi traits. Ten test hybrids, superior to CSH-15R for grain and fodder yields were selected. Selected B lines were SLB-9, 10, 12, 19, 22, 27, 45, 46, 56, 59, 60, 73, 82, 96, 101 and 104. R line improvement for diversifying genetic base led to selection of 21 R lines out of 63 lines with rabi traits.. Selected R lines were SLR-10, 13, 17, 24, 30, 31, 47, 57, 60, 67, 70, 72, 75, 87, 89, 90, 91, 97, 130, 136 and 143.

Forage sorghum

- Four fodder hybrids yielded more than 10% over both the checks, CSH 20MF and CSH 24MF for green and dry fodder yields. 417 A × PC 23 recorded about 30% improvement for green fodder yield and 16% improvement for dry fodder yield over the checks
- 220 forage germplasm lines were evaluated in augmented design using 2 checks, SSG 59-3 and CO (FS) 29. Lines performing superiorly for high number of tillers were IS nos. 697, 704, 722 and 698 and for high number of leaves were IS 3310, 3341, 3246 and FM 872.

Sweet Sorghum

- Combining ability studies (5 L × 4 T analysis) in sweet sorghum were carried out for brix, stalk yield and juice characters. Among lines, DMS 10B and DMS 8B exhibited significant and positive GCA effects for total biomass and juice yields while for brix content, DMS 30B was promising. Among testers, SSV 74 and CSV 19SS were promising general combiners for fresh stalk.

Marker assisted breeding

- A significant, moderate and positive correlation of coefficient of marker polymorphism (30 SSR markers) among the parental lines with mid-parental heterosis ($r = 0.42^*$) and better parent heterosis ($r = 0.56^*$) for grain yield was observed. EST-SSR and QTL-linked markers showed a better correlation (slightly >0.6) as compared to genomic SSR markers. This set of 30 SSR markers were validated among new parental lines and are considered to have the potential for the prediction of grain yield heterosis in sorghum.
- Cluster analysis revealed substantial diversity among the parental lines and elite genotypes as also evidenced from the Jaccard's genetic similarity values. A very high estimate of fixation index ($F_{ST} = 0.35$, $P = 0.001$) was obtained when genotypes were structured as rainy and post-rainy, a much higher estimate ($F_{ST} = 0.40$, $P = 0.001$) was obtained when classified as varieties, maintainers, restorers and germplasm lines indicating strong distinction based on usage groups.

Publications

- During 2011-12, we published 30 articles in international and national journals.

Detailed report

Introduction

During 2011, we have dealt with basic and applied research. Applied aspects deal with multi-location yield trials to evaluate finished or nearly finished products mainly at various centers of the All India Coordinated Improvement Project. We consolidated the basic and strategic research on drought we were conducting in net work mode and published article in international journal. During this year under basic and strategic research we have collected MS and R lines developed at various centers and developed hybrids. These hybrids were evaluated at multi-locations in two hybrid nursery trials. Following are the details of progress made during this year (2010 to 2011). Following are the details of progress made during this year (2011 to 2012).

- I. Multi-location AICSIP trials
- II. Coordinated sorghum breeding research
- III. Achievements in sorghum breeding at DSR
- IV. Achievements in sorghum breeding at AICSIP centers
- V. Publications

Kharif - 2011

I. Multi-location AICSIP trials

During 2011 kharif, 4 trials were conducted viz. Advanced Hybrid Trial (AHT); Advanced Varietal Trial (AHT), Initial Hybrid Trial (IHT), and Initial Varietal Trial (IVT).

Advanced hybrid Trial (Tables A, 1.A, and 1.B)

In this trial 20 hybrids including 3 checks were evaluated in Zone I (Previous Zone I and III combined) and Zone II. The performance of hybrids in advanced hybrid trial zone wise over 2 years is shown in Table A. Three hybrids were marginally superior to CSH23, however none of the hybrids were superior to the check CSH 16 over 2 years in Zone I. In zone II, SPH 1648 and SPH 1647 showed 11 and 7% increase for grain yield across 2 years over CSH16, Check. An early duration hybrid SPH 1655 showed 12 % increase over an early duration check CSH23 in Zone II.

Table A. Performance of sorghum genotypes in advanced hybrid trial during 2010 and 2011

S. NO	Entry	Grain Yield (kg/ha)			% ± over CSH16	% ± over CSH23	Fodder Yield (kg/ha)			% ± over CSH16	% ± over CSH23
		2010	2011	Mean			2010	2011	Mean		
Zone I											
1	SPH 1641	4015	4271	4143	-9.0	-5.9	13354	15209	14282	-2.7	9.2
2	SPH 1647	3682	5204	4443	-2.4	1.0	14365	15488	14927	1.7	14.2
3	SPH 1648	3416	5306	4361	-4.2	-0.9	14378	16403	15391	4.9	17.7
4	SPH 1651	4193	4824	4508.5	-1.0	2.4	14310	15321	14816	1.0	13.3
5	SPH 1655	3429	5565	4497	-1.2	2.2	12573	15447	14010	-4.5	7.1
6	CSH 16	3794	5311	4552.5	0.0	3.4	13591	15755	14673	0.0	12.2
7	CSH23	3618	5184	4401	-3.3	0.0	12054	14097	13076	-10.9	0.0
Zone II											
1	SPH 1641	4421	4367	4394	-0.9	10.3	15056	15022	15039	14.4	24.0
2	SPH 1647	4736	4781	4758.5	7.3	19.5	14933	14127	14530	10.5	19.8
3	SPH 1648	4728	5113	4920.5	11.0	23.5	14742	14761	14752	12.2	21.6
4	SPH 1651	4283	4528	4405.5	-0.6	10.6	14924	13341	14133	7.5	16.5
5	SPH 1655	4613	4330	4471.5	0.9	12.3	13465	12234	12850	-2.2	5.9
6	CSH 16	4458	4409	4433.5	0.0	11.3	13734	12556	13145	0.0	8.4
7	CSH23	3730	4237	3983.5	-10.1	0.0	12895	11362	12129	-7.7	0.0

Zone I (Table 1.A)

- *Days to flowering*- Flowering in hybrids ranged from 58 to 67 days, SPH 1655 and SPH 1676 being the earliest to mature (days to maturity 96 days).
- *Plant height*- Plant height among hybrids tested varied from 180 to 217 cm.
- *Grain yield*- Three hybrids performed superiorly to the check CSH 16 for grain yield (5% increases). SPH 1674 ranked first by recording 5587 kg/ha which is 5.2 % more than the grain yield of the check,

CSH 16. The hybrid SPH 1680 ranked second by recording grain yield of 5584 kg/ha against 5311 kg/ha of CSH 16, check. Early duration hybrid SPH 1655 recorded 5565 kg/ha of grain against 5184 kg/ha of CSH 23, early duration hybrid check.

- *Fodder yield*- Eight hybrids performed superiorly for fodder yield over the check CSH 16 (15755 kg/ha). The top superior hybrids for fodder yield were SPH 1674 (17205 kg/ha), SPH 1653 (17113 kg/ha), SPH 1683 (16499 kg/ha) and SPH 1685 (16482 kg/ha).
- *Grain size*-Max. grain size of 3.5 g/100 grain was recorded by SPH 1682 as compared to 3.3 of CSH 16.
- *Remarks*- In Zone I, the top hybrid, SPH 1674 (5587 kg/ha) for grain yield showed superior fodder yield (17205 kg/ha) as compared to 5311 kg/ha of grain and 15755 kg/ha of fodder of CSH 16, check.

Table 1.A. Performance of hybrids in advanced hybrid trial (AHT) – Zone I during kharif 2011.

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPH 1635 (2)	Akola	4627	17	-12.9	-10.7	16054	10	1.9	13.9	66	104	197	3.07	51.90	3.8	1.8
2	SPH 1641 (2)	Parbhani	4271	19	-19.6	-17.6	15209	16	-3.5	7.9	65	102	189	3.13	58.50	3.5	1.7
3	SPH 1647 (2)	Nuziveedu	5204	6	-2.0	0.4	15488	13	-1.7	9.9	67	105	190	3.27	55.07	4.1	2.5
4	SPH 1648 (2)	Mahodya	5306	5	-0.1	2.4	16403	7	4.1	16.4	66	104	203	3.20	57.51	4.5	2.8
5	SPH 1651 (2)	Kaveri Seeds	4824	14	-9.2	-6.9	15321	15	-2.8	8.7	64	102	192	3.12	56.19	4.3	3.0
6	SPH 1653	Indore	4861	13	-8.5	-6.2	17113	4	8.6	21.4	65	102	217	3.17	60.26	3.5	2.3
7*	SPH 1655 (2)	DSR	5565	3	4.8	7.3	15447	14	-2.0	9.6	58	96	192	3.18	61.91	4.6	2.9
8	SPH 1674	Devgen	5587	1	5.2	7.8	17205	3	9.2	22.0	65	103	204	3.20	64.24	4.2	2.8
9	SPH 1675	DSR	4959	11	-6.6	-4.3	13777	21	-12.6	-2.3	64	102	180	3.00	58.16	4.1	2.5
10*	SPH 1676	DSR	4888	12	-8.0	-5.7	13971	20	-11.3	-0.9	58	96	193	3.27	62.41	4.1	2.9
11	SPH 1678	DSR	4421	18	-16.8	-14.7	15158	17	-3.8	7.5	60	98	185	3.10	62.70	4.2	3.1
12	SPH 1679	Ganga Kaveri	5121	9	-3.6	-1.2	14950	18	-5.1	6.1	65	103	196	3.40	62.28	4.1	3.0
13	SPH 1680	Ganga Kaveri	5584	2	5.1	7.7	15721	12	-0.2	11.5	66	105	193	3.20	56.14	4.0	2.7
14	SPH 1682	Ganga Kaveri	4978	10	-6.3	-4.0	16375	8	3.9	16.2	63	101	196	3.50	63.20	4.5	3.5
15	SPH 1683	Biostadt Maharashtra	5127	8	-3.5	-1.1	16499	5	4.7	17.0	65	103	206	3.12	57.54	4.1	2.9
16	SPH 1684	Biostadt Maharashtra	4777	15	-10.1	-7.9	16063	9	2.0	13.9	66	103	206	3.22	58.52	4.3	3.0
17	SPH 1685	Parbhani	4665	16	-12.2	-10.0	16482	6	4.6	16.9	66	104	190	3.19	61.42	3.8	2.2
18	CSH 16	Check	5311	4	0.0	2.4	15755	11	0.0	11.8	62	101	195	3.33	62.49	4.4	2.9
19*	CSH 23	Check	5184	7	-2.4	0.0	14097	19	-10.5	0.0	60	97	188	3.15	59.05	4.9	3.5
20	Local chk#	Check	4137	21	-22.1	-20.2	18048	2	14.6	28.0	66	105	209	3.22	48.06	5.3	2.8
	LOC. MEAN		4933				15936				64	102	199	3.21	57.63	4.2	2.7
	C.D. (5%)		1084				2247				2	3	15	0.26	9.04	0.9	NS
	C.D. (1%)		1442				2974				3	4	19	0.34	11.95	-	-
	C.V. (%)		15.54				12.31				3.54	2.49	6.93	7.60	14.85	18.1	30.0

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9); * Early duration Hybrids compared with CSH 23

Zone II (Table 1.B)

- *Days to flowering*- Large variation for flowering was observed which ranged from 63 to 73 days. SPH 1655 (63 days) was 3 days earlier to early check CSH 23 (66 days). The Hybrid SPH 1655 took 101 days to mature as against 103 days of CSH23, Early duration check.
- *Plant height*- Maximum plant height of 239 cm was observed in SPH 1653.
- *Grain yield*-Five hybrids performed significant superiority for grain yield over the check CSH 16. The grain yield increase was 16 to 10% over the check. Among test hybrids, SPH 1648 ranked first by yielding 5113 kg/ha of grain yield as against 4409 kg/ha of CSH 16, check.
- *Fodder yield*- Among hybrids, SPH 1641 (15022 kg/ha) recorded highest stover yield; second highest fodder yield was obtained in the hybrid SPH 1653.
- *Grain size*- SPH 1682 had maximum grain size of 3.25 as compared to 3.04 g/100 grain of CSH 16, check.
- *Remarks*- SPH 1648 recorded high grain (5113 kg/ha) and high fodder yield of 14761 kg/ha against that of CSH 16 (4409 kg/ha of grain and 12556 kg/ha of fodder). The second best
- hybrid SPH 1674 also recorded high grain (5002 kg/ha) and fodder yield (14789 kg/ha).

Table 1.B. Performance of hybrids in advanced hybrid trial (AHT) – Zone II during kharif 2011

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPH 1635 (2)	Akola	4560	10	3.42	7.62	13859	14	10.4	22.0	70	107	211	2.57	51.90	3.8	1.8
2	SPH 1641 (2)	Parbhani	4367	14	-0.95	3.07	15022	2	19.6	32.2	72	107	214	2.81	58.50	3.5	1.7
3	SPH 1647 (2)	Nuziveedu	4781	6	8.44	12.84	14127	11	12.5	24.3	72	108	200	2.88	55.07	4.1	2.5
4	SPH 1648 (2)	Mahodya	5113	1	15.97	20.68	14761	5	17.6	29.9	72	109	219	2.87	57.51	4.5	2.8
5	SPH 1651 (2)	Kaveri Seeds	4528	11	2.70	6.87	13341	15	6.3	17.4	69	106	215	2.73	56.19	4.3	3.0
6	SPH 1653	Indore	4749	7	7.71	12.08	14867	3	18.4	30.8	71	108	239	2.72	60.26	3.5	2.3
7*	SPH 1655 (2)	DSR	4330	15	-1.79	2.19	12234	18	-2.6	7.7	63	101	207	2.78	61.91	4.6	2.9
8	SPH 1674	DSR	5002	2	13.45	18.06	14789	4	17.8	30.2	71	107	223	2.80	64.24	4.2	2.8
9	SPH 1675	DSR	4578	9	3.83	8.05	11098	21	-11.6	-2.3	70	107	191	2.52	58.16	4.1	2.5
10*	SPH 1676	DSR	3984	21	-9.64	-5.97	11299	20	-10.0	-0.6	63	101	211	2.89	62.41	4.1	2.9
11	SPH 1678	Ganga Kaveri	4151	19	-5.85	-2.03	12284	17	-2.2	8.1	67	104	192	2.81	62.70	4.2	3.1
12	SPH 1679	Ganga Kaveri	4890	5	10.91	15.41	14425	10	14.9	27.0	72	108	210	3.10	62.28	4.1	3.0
13	SPH 1680	Ganga Kaveri	4666	8	5.83	10.13	14072	12	12.1	23.9	72	109	207	2.98	56.14	4.0	2.7
14	SPH 1682	Biostadt Maharashtra	4978	3	12.91	17.49	14592	9	16.2	28.4	70	106	217	3.25	63.20	4.5	3.5
15	SPH 1683	Biostadt Maharashtra	4956	4	12.41	16.97	14669	7	16.8	29.1	71	107	216	2.86	57.54	4.1	2.9
16	SPH 1684	Parbhani	4430	12	0.48	4.56	14676	6	16.9	29.2	73	109	230	2.87	58.52	4.3	3.0
17	SPH 1685	Check	4270	17	-3.15	0.78	14668	8	16.8	29.1	72	109	206	2.67	61.42	3.8	2.2
18	CSH 16	Check	4409	13	0.00	4.06	12556	16	0.0	10.5	68	105	206	3.04	62.49	4.4	2.9
19	CSH 23	Check	4237	18	-3.90	0.00	11362	19	-9.5	0.0	66	103	198	2.97	59.05	4.9	3.5
20	Local chk#		4129	20	-6.35	-2.55	13967	13	11.2	22.9	73	109	206	2.89	48.06	5.3	2.8
	LOC. MEAN		4543				13869				70	107	214	2.86	57.63	4.2	2.7
	C.D. (5%)		454				1495				1	2	11	0.18	9.04	0.9	NS
	C.D. (1%)		599				1972				2	2	14	0.23	11.95	-	-
	C.V. (%)		12.94				13.50				2.16	1.89	6.11	7.98	14.85	18.1	30.0

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9); * Early duration Hybrids compared with CSH 23

Advanced Varietal Trial (Tables B, 2.A, and 2.B)

In this trial, 5 test entries and 6 checks were evaluated in each zone. Zone wise results are described below. The performance of varieties in advanced varietal trial zone wise over 2 years is shown in Table B. Two varieties were significantly superior to latest check variety CSV23, however, variety SPV 1999 showed marginal superiority of 2.5% over the check, CSV15 over 2 years in Zone I. In zone II, None of the 2 varieties showed superiority over CSV 15, check. However SPV 1999 showed superiority over CSV 23, latest check by 8.3% for grain yield. The 2 varieties recorded less fodder yield across 2 years as compared to both the checks.

Table B. Performance of sorghum genotypes in advanced varietal trial during 2010 and 2011

S.NO	Entry	Grain Yield			% ± over CSV15	% ± over CSV23	Fodder Yield			% ± over CSV15	% ± over CSV23
		Kg/ha					Kg/ha				
		2010	2011	Mean			2010	2011	Mean		
Zone I											
1	SPV 1999	3385	3858	3622	2.5	18.7	14103	15305	14704	-7.5	-14.3
2	SPV 2000	3642	3313	3478	-1.5	14.0	13571	15846	14709	-7.4	-14.2
3	CSV 15	3340	3723	3532	0.0	15.7	15256	16521	15889	0.0	-7.3
4	CSV 23	2900	3201	3051	-13.6	0.0	15653	18643	17148	7.9	0.0
Zone II											
1	SPV 1999	4215	3618	3917	-4.3	8.3	15474	13333	14404	-14.7	-19.2
2	SPV 2000	3639	3220	3430	-16.2	-5.2	17021	14939	15980	-5.4	-10.3
3	CSV 15	4527	3654	4091	0.0	13.1	17903	15869	16886	0.0	-5.2
4	CSV 23	3902	3332	3617	-11.6	0.0	18392	17250	17821	5.5	0.0

Zone I (Table 2.A.)

- *Days to flowering*- In this trial most of the test varieties flowered between 66 and 72 days. None of the varieties was as early as CSV 17 (57 days).
- *Plant height*- Plant heights in this trial varied from 143-239 cm, tallest being SPV 2061 with 239 cm plant height.
- *Grain yield*- SPV 1999 showed marginal yield improvement (3.6%) over CSV15 and 21% yield improvement over CSV23. SPV 1999 ranked first by yielding 3858 kg/ha of grain against 3723 kg/ha of CSV 15, check.
- *Fodder yield*- SPV 2061 was superior for fodder yield to CSV15 by 11%. None of the test varieties were superior to the check, CSV23 for fodder yield.
- *Grain size*- SPV 2000 recorded 3.29 g test weight against 3.32 of the check CSV20 and 3.18 of CSV15.

- *Remarks-* Variety SPV 1999 showed marginal superiority over CSV 15 and 21% increase for grain yield over the latest check, CSV23, check.

Table 2.A. Performance of varieties in advanced varietal trial (AVT) – Zone I during kharif 2011

S. No	Entry	Centre	GY	R	% over CSV 23	% over CSV 15	FY	R	% over CSV 23	% over CSV 15	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPV 1999 (2)	Udaipur	3858	1	20.5	3.6	15305	9	-17.9	-7.4	66	105	226	3.13	52.2	3.8	2.7
2	SPV 2000 (2)	Udaipur	3313	8	3.5	-11.0	15846	7	-15.0	-4.1	67	106	219	3.29	58.4	3.7	2.4
3	SPV 2079 (2)	Akola	3498	5	9.3	-6.0	16243	6	-12.9	-1.7	67	106	224	3.10	56.1	4.0	2.7
4	SPV 2061	Udaipur	3096	10	-3.3	-16.8	18297	2	-1.9	10.7	69	109	239	3.15	56.8	3.5	2.1
5	SPV 2083	Udaipur	3532	4	10.3	-5.1	17308	4	-7.2	4.8	68	108	229	3.18	55.2	4.0	2.3
6	CSV 20	Check	3361	7	5.0	-9.7	17617	3	-5.5	6.6	68	107	230	3.32	56.0	-	2.5
7	CSV 15	Check	3723	2	16.3	0.0	16521	5	-11.4	0.0	67	107	221	3.18	58.8	3.7	2.9
8	CSV 17	Check	2560	11	-20.0	-31.2	11910	11	-36.1	-27.9	57	97	143	2.80	60.5	4.7	3.1
9	SPV 462	Check	3473	6	8.5	-6.7	15148	10	-18.7	-8.3	68	108	216	3.17	61.1	3.8	2.7
10	CSV 23	Check	3201	9	0.0	-14.0	18643	1	0.0	12.8	72	109	215	3.11	61.9	-	2.2
11	Local chk#	Check	3705	3	15.7	-0.5	15320	8	-17.8	-7.3	67	107	214	3.20	50.7	4.7	2.3
	LOC. MEAN		3393				16196				67	106	216	3.15	54.99	4.0	2.5
	C.D. (5%)		816				2456				2	3	21	0.31	10.02	NS	NS
	C.D. (1%)		1092				3267				3	3	29	0.41	13.29		
	C.V. (%)		18.82				14.18				3.47	2.21	9.30	9.12	17.12	24.7	24.6

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9);

Zone II (Table 2.B.)

- *Days to flowering-* The flowering in varieties ranged from 65 to 77 days. None of the test varieties was as early as the early check variety, CSV 17.
- *Plant height-* Plant height varied from 161 to 249 cm.
- *Grain yield-* SPV 1999 (3618 kg/ha) was superior to CSV 23 (3332 kg/ha) and on par with CSV15 (3654 kg/ha).
- *Fodder yield-* Highest fodder yield was recorded in test variety SPV 2061 (16558 kg/ha), as compared to the check, CSV 1 5 (15869 kg/ha).
- *Grain size-* Maximum grain size of 2.92 g/100 grain was observed in the check, CSV20.
- *Remarks-* SPV 1999 was superior to CSV23, check by 8.6% for grain yield and SPV 2061 for fodder yield by 5% over CSV15.

Table 2.B. Performance of varieties in advanced varietal trial (AVT) – Zone II during kharif 2011.

S. No	Entry	Centre	GY	R	% over CSV 23	% over CSV 15	FY	R	% over CSV 23	% over CSV 15	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPV 1999 (2)	Udaipur	3618	2	8.58	-1.0	13333	10	-22.7	-16.0	72	106	239	2.59	52.2	3.8	2.7
2	SPV 2000 (2)	Udaipur	3220	9	-3.36	-11.9	14939	7	-13.4	-5.9	75	110	244	2.75	58.4	3.7	2.4
3	SPV 2079 (2)	Akola	3361	3	0.87	-8.0	15771	6	-8.6	-0.6	74	108	245	2.58	56.1	4.0	2.7
4	SPV 2061	Udaipur	3155	10	-5.31	-13.7	16588	2	-3.8	4.5	75	110	246	2.79	56.8	3.5	2.1
5	SPV 2083	Udaipur	3242	8	-2.70	-11.3	15980	4	-7.4	0.7	75	109	249	2.76	55.2	4.0	2.3
6	CSV 20	Check	3360	4	0.84	-8.0	16545	3	-4.1	4.3	75	110	249	2.92	56.0	-	2.5
7	CSV 15	Check	3654	1	9.66	0.0	15869	5	-8.0	0.0	75	110	237	2.75	58.8	3.7	2.9
8	CSV 17	Check	2959	11	-11.19	-19.0	8817	11	-48.9	-44.4	65	100	161	2.52	60.5	4.7	3.1
9	SPV 462	Check	3290	6	-1.26	-10.0	14406	8	-16.5	-9.2	76	111	248	2.75	61.1	3.8	2.7
10	CSV 23	Check	3332	5	0.00	-8.8	17250	1	0.0	8.7	77	114	239	2.82	61.9	-	2.2
11	Local chk#	Check	3277	7	-1.65	-10.3	13782	9	-20.1	-13.2	76	110	236	2.81	50.7	4.7	2.3
	LOC. MEAN		3315				14844				74	105	236	2.73	54.99	4.0	2.5
	C.D. (5%)		488				1942				2	6	18	0.18	10.02	NS	NS
	C.D. (1%)		647				2574				2	9	24	0.24	13.29		
	C.V. (%)		15.69				13.49				2.37	3.50	7.37	7.62	17.12	24.7	24.6

Initial Hybrid Trial (Tables 3.A. to 3.B.)

In this trial, 10 hybrids and 3 checks were evaluated in RCBD for grain and fodder yields and other agronomic traits.

Zone I (Table 3.A.)

- *Days to flowering-* Flowering in hybrids ranged from 62-68 days, CSH 23 being the earliest (102 days).
- *Plant height-* Plant height among hybrids tested varied from 167 to 235 cm.
- *Grain yield-* The top yielding hybrids SPH Nos 1703, 1704, 1706, showed 3 to 9% increase for grain yield over the check, CSH 16.

- *Fodder yield*- Among hybrids, SPH 1707 yielded highest fodder of 13591 kg/ha against 10198 kg/ha of CSH16, the check.
- *Remarks*- Hybrids superior for grain and fodder yields were SPH 1703 and SPH 1704. SPH 1703 recorded 4942 kg/ha of grain and 10662 kg/ha of fodder against 4521 kg/ha grain and 10198 kg/ha fodder of CSH 16.

Table 3.A. Performance of hybrids in initial hybrid trial (IHT) – Zone I during kharif 2011.

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPH 1701	Hightec seed	4518	7	-0.1	6.3	13151	4	29.0	37.6	66	104	234	3.44	48.4	3.6	2.4
2	SPH 1702	Hightec seed	4623	4	2.3	8.7	13236	3	29.8	38.5	67	107	205	3.27	43.9	4.2	2.9
3	SPH 1703	Nuziveedu	4942	1	9.3	16.2	10662	10	4.5	11.6	66	105	191	3.02	37.5	4.1	2.5
4	SPH 1704	Devgen seed	4907	2	8.5	15.4	10948	9	7.4	14.5	64	103	208	3.29	48.1	4.4	2.8
5	SPH 1705	Akola	3864	11	-14.5	-9.1	12993	5	27.4	35.9	68	108	235	3.34	36.2	4.2	2.8
6	SPH 1706	Akola	4656	3	3.0	9.5	11453	7	12.3	19.8	65	103	218	3.01	39.0	4.1	2.3
7	SPH 1707	DSR	4552	5	0.7	7.1	13591	1	33.3	42.2	65	103	222	3.45	46.4	3.9	2.3
8	SPH 1708	DSR	3854	12	-14.8	-9.4	9321	13	-8.6	-2.5	64	104	169	2.91	44.3	3.9	2.4
9	SPH 1709	DSR	4403	8	-2.6	3.6	11254	8	10.4	17.7	65	103	167	3.07	39.3	3.6	2.0
10	SPH 1710		3377	13	-25.3	-20.6	13392	2	31.3	40.1	68	107	190	3.64	36.3	4.8	3.3
11	CSH 16	Check	4521	6	0.0	6.3	10198	11	0.0	6.7	63	103	200	3.42	46.8	-	2.8
12	CSH 23	Check	4252	9	-6.0	0.0	9558	12	-6.3	0.0	62	102	194	3.17	47.0	4.5	3.3
13	Local chk#	Check	3992	10	-11.7	-6.1	11883	6	16.5	24.3	66	105	225	3.11	38.6	3.8	2.8
	L. MEAN		4343				11665				65	104	205	3.24	39.31	4.1	2.7
	C.D. (5%)		993				1780				2	3	21	0.38	24.64	NS	NS
	C.D. (1%)		1331				2387				3	4	29	0.51	34.06		
	C.V. (%)		15.94				10.64				2.35	1.82	7.25	8.22	29.4	16.3	25.1

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9)

Zone II (Table 3.B.)

- *Days to flowering*- The flowering in hybrids ranged from 67 to 75 days. SPH 1707 and CSH23 were early and took 105 days to maturity
- *Plant height*- Plant height varied from 185 to 242 cm.
- *Grain yield*-Performance of test hybrid for grain yield was superior. Six out of 10 hybrids performed superiorly (13 to 4% increase over the check, CSH 16). Hybrids, SPH 1702 with 4658 kg/ha; SPH 1704 with 4611 kg/ha were significantly superior to the check, CSH 16 (4133 kg/ha).
- *Fodder yield*- Highest fodder yield was recorded in SPH 1710 (18705 kg/ha) as compared to the check, CSH 16 (14541 kg/ha). Other superior hybrids were SPH 1707; SPH 1701, SPH 1705, & SPH 1702.
- *Grain size*- Maximum grain size of 3.42 g/100 grain was observed in SPH 1710.
- *Remarks*- SPH 1702 and SPH 1705 showed high grain and fodder yields. SPH 1702 recorded grain yield of 4658 kg/ha and fodder yield of 15585 kg/ha as compared to grain yield of 4133 kg/ha and fodder yield of 14541 kg/ha of CSH16.

Table 3.B. Performance of hybrids in initial hybrid trial (IHT) – Zone II during kharif 2011.

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPH 1701	Hightec seed	4416	5	6.8	12.0	16974	3	16.7	50.3	72	110	242	3.13	48.4	3.6	2.4
2	SPH 1702	Hightec seed	4658	1	12.7	18.2	15585	5	7.2	38.0	74	113	210	3.05	43.9	4.2	2.9
3	SPH 1703	Nuziveedu	3970	8	-3.9	0.7	12141	11	-16.5	7.5	70	108	201	2.81	37.5	4.1	2.5
4	SPH 1704	Devgen seed	4611	2	11.6	17.0	14689	9	1.0	30.1	70	107	222	3.04	48.1	4.4	2.8
5	SPH 1705	Akola	4469	3	8.1	13.4	16534	4	13.7	46.4	71	108	222	2.93	36.2	4.2	2.8
6	SPH 1706	Akola	4286	6	3.7	8.7	14905	8	2.5	32.0	71	109	222	2.79	39.0	4.1	2.3
7	SPH 1707	DSR	3793	11	-8.2	-3.8	18643	2	28.2	65.1	69	105	241	3.28	46.4	3.9	2.3
8	SPH 1708	DSR	4444	4	7.5	12.7	11700	12	-19.5	3.6	71	108	185	2.54	44.3	3.9	2.4
9	SPH 1709	DSR	3668	13	-11.3	-7.0	15445	7	6.2	36.8	73	111	197	3.00	39.3	3.6	2.0
10	SPH 1710		3786	12	-8.4	-4.0	18705	1	28.6	65.6	75	113	202	3.42	36.3	4.8	3.3
11	CSH 16	Check	4133	7	0.0	4.8	14541	10	0.0	28.8	69	108	213	3.29	46.8	-	2.8
12	CSH 23	Check	3942	9	-4.6	0.0	11292	13	-22.3	0.0	67	105	215	3.07	47.0	4.5	3.3
13	Local chk#	Check	3837	10	-7.2	-2.7	15488	6	6.5	37.2	74	112	218	3.09	38.6	3.8	2.8
	L. MEAN		4155				15126				71	109	215	3.03	39.31	4.1	2.7
	C.D. (5%)		632				2168				2	3	18	0.26	24.64	NS	NS
	C.D. (1%)		843				2892				3	4	24	0.35	34.06		
	C.V. (%)		11.96				11.27				2.67	1.59	5.10	6.72	29.4	16.3	25.1

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9)

Initial Varietal Trial (Tables 4.A and 4.B)

In this trial, 17 test entries and 5 checks were evaluated in each zone. Zone wise results are described below.

Zone I (Table 4.A)

- *Days to flowering*- Among the varieties tested, flowering ranged from 58 to 73 days, the earliest being the checks, CSV 17(58days).
- *Plant height*- Test varieties varied for plant height from 139 to 276 cm.
- *Grain yield*- One variety SPV2122 was numerically superior to the check CSV15. However 8 varieties have out yielded latest check CSV 23 for grain yield. SPV2122 and SPV 2110 recorded 4432 kg/ha and 4214 kg/ha of grain yield against 3775 kg/ha of the check CSV23.
- *Fodder yield*- Five varieties were superior to the check CSV 23 for fodder yield. Highest fodder yield of 15631 kg/ha of fodder yield was obtained from SPV 2113 as compared to CSV 23 (14460 kg/ha).
- *Grain size*- SPV 2113 had maximum grain size of 3.52 against 3.42 of the check, CSV23. *Remarks*- The variety SPV 2122 yielded highest grain yield of 4431 kg/ha and fodder yield 13507 kg/ha. The check CSV 23 yielded 3775 kg/ha of grain and 14460 kg/ha of fodder yield.

Table 4.A. Performance of varieties in initial varietal trial (IVT) – Zone I during kharif 2011.

S. No	Entry	Centre	GY	R	% over CSV 23	% over CSV 15	FY	R	% over CSV 23	% over CSV 15	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPV 2109	Indore	4061	6	-5.4	7.6	14932	2	0.1	3.3	69	108	266	3.48	62.2	-	2.3
2	SPV 2110	Palem	4214	4	-1.9	11.6	13408	15	-10.1	-7.3	69	107	240	2.87	58.3	4.2	2.7
3	SPV 2111	Mauranipur	3784	11	-11.9	0.2	13140	17	-11.9	-9.1	69	108	232	3.39	60.7	4.2	2.4
4	SPV 2112	Mauranipur	3635	14	-15.3	-3.7	13481	13	-9.7	-6.8	70	107	251	3.25	62.1	-	2.4
5	SPV 2113	DSR	2278	22	-46.9	-39.7	15631	1	4.8	8.1	73	110	276	3.52	61.4	4.1	2.3
6	SPV 2114	DSR	3994	7	-7.0	5.8	13565	10	-9.1	-6.2	70	107	257	3.14	60.1	4.0	2.5
7	SPV 2115	Udaipur	3614	15	-15.8	-4.3	14735	4	-1.3	1.9	68	106	245	3.06	58.6	3.9	2.5
8	SPV 2116	Udaipur	3867	9	-9.9	2.4	13721	9	-8.0	-5.1	68	106	258	3.17	55.1	4.2	2.9
9	SPV 2117	Udaipur	3868	8	-9.9	2.5	13412	14	-10.1	-7.2	69	107	234	2.98	47.3	3.6	2.0
10	SPV 2118	Udaipur	3123	18	-27.3	-17.3	14498	6	-2.8	0.3	69	107	272	3.07	59.1	4.1	2.6
11	SPV 2119	Indore	3038	20	-29.3	-19.5	14494	7	-2.9	0.2	71	110	260	3.12	59.1	4.3	2.6
12	SPV 2120	Indore	3695	13	-13.9	-2.1	12003	20	-19.6	-17.0	71	108	236	3.07	59.7	4.0	2.3
13	SPV 2121	Palem	3863	10	-10.0	2.3	12540	19	-16.0	-13.3	65	105	244	2.82	58.3	4.1	2.5
14	SPV 2122	Palem	4431	1	3.2	17.4	13507	11	-9.5	-6.6	68	106	239	3.05	56.3	3.8	2.5
15	SPV 2123	Surat	3050	19	-29.0	-19.2	13161	16	-11.8	-9.0	70	108	236	2.95	61.7	-	1.9
16	SPV 2124	Surat	2855	21	-33.5	-24.4	13084	18	-12.3	-9.5	70	108	243	2.92	58.0	4.1	2.5
17	SPV 2125	Akola	3368	16	-21.6	-10.8	14506	5	-2.8	0.3	69	108	260	3.13	54.7	3.8	2.3
18	CSV 15	Check	4294	2	0.0	13.7	14922	3	0.0	3.2	68	105	256	3.34	58.4	4.8	3.1
19	CSV 20	Check	4221	3	-1.7	11.8	13505	12	-9.5	-6.6	68	107	241	2.97	57.2	-	2.7
20	CSV 17	Check	3313	17	-22.8	-12.2	8759	22	-41.3	-39.4	58	98	139	2.94	49.8	3.9	2.6
21	CSV 23	Check	3775	12	-12.1	0.0	14460	8	-3.1	0.0	70	109	239	3.42	64.3	3.9	2.4
22	Local chk#	Check	4071	5	-5.2	7.8	11747	21	-21.3	-18.8	67	105	228	2.90	51.2	5.4	2.7
	L. MEAN		3655				13510				69	107	243	3.12	56.86	4.1	2.5
	C.D. (5%)		1034				2037				2	2	26	0.38	7.56	0.8	NS
	C.D. (1%)		1383				2708				3	3	35	0.50	9.99		
	C.V. (%)		17.17				10.67				2.14	1.61	7.58	8.53	12.59	16.0	22.2

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9)

Zone II (Table 4.B)

- *Days to flowering*- The flowering in varieties ranged from 62 to 79 days. None of the test varieties was as early as the early check variety, CSV 17.
- *Plant height*- Plant height varied from 162 to 304 cm.
- *Grain yield*- SPV 2121 (3991 kg/ha), SPV 2114 (3935 kg/ha), SPV2110 (3803 kg/ha), and SPV2122 (3792 kg/ha), were superior to CSV 20 (3569 kg/ha).
- *Fodder yield*- Highest fodder yield was recorded in variety SPV 2113 (22803 kg/ha), SPV 2119 (20719 kg/ha) and SPV 2114 (19390 kg/ha) as compared to the check, CSV 20 (17479 kg/ha).
- *Grain size*- Maximum grain size of 3.2 g/100 grain was observed in SPV 2109.
- *Remarks*- SPV 2114 (GY =3935 kg/ha; FY = 19390 kg/ha) and SPV 2122 (GY =3792 kg/ha; FY = 18860 kg/ha) were superior to CSV 20 (GY =3569 kg/ha; FY = 17479 kg/ha) for grain and fodder yields.

Table 4.B. Performance of varieties in initial varietal trial (IVT) – Zone II during kharif 2011.

S. No	Entry	Centre	GY	R	% over CSV 23	% over CSV 15	FY	R	% over CSV 23	% over CSV 15	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPV 2109	Indore	3669	5	3.1	2.8	16644	16	-5.6	-4.8	74	111	279	3.21	62.2	-	2.3
2	SPV 2110	Palem	3803	3	6.8	6.6	16614	17	-5.8	-4.9	74	110	274	2.93	58.3	4.2	2.7
3	SPV 2111	Mauranipur	3474	10	-2.4	-2.7	15702	18	-10.9	-10.2	73	110	262	2.98	60.7	4.2	2.4
4	SPV 2112	Mauranipur	3101	18	-12.9	-13.1	16812	15	-4.6	-3.8	74	112	276	2.94	62.1	-	2.4
5	SPV 2113	DSR	1964	21	-44.8	-45.0	22803	1	29.3	30.5	77	114	299	3.04	61.4	4.1	2.3
6	SPV 2114	DSR	3935	2	10.5	10.3	19390	3	10.0	10.9	74	110	279	2.83	60.1	4.0	2.5
7	SPV 2115	Udaipur	3435	11	-3.5	-3.8	16901	13	-4.1	-3.3	75	112	285	2.86	58.6	3.9	2.5

S. No	Entry	Centre	GY	R	% over CSV 23	% over CSV 15	FY	R	% over CSV 23	% over CSV 15	DTF	DTM	PH	GW	SF	GM FG	GM TG
8	SPV 2116	Udaipur	3354	13	-5.8	-6.0	17511	10	-0.7	0.2	74	111	281	2.96	55.1	4.2	2.9
9	SPV 2117	Udaipur	3299	14	-7.3	-7.6	17100	12	-3.0	-2.2	74	111	264	2.73	47.3	3.6	2.0
10	SPV 2118	Udaipur	3405	12	-4.4	-4.6	19087	4	8.3	9.2	75	111	304	2.84	59.1	4.1	2.6
11	SPV 2119	Indore	3294	15	-7.5	-7.7	20719	2	17.5	18.5	79	117	289	2.75	59.1	4.3	2.6
12	SPV 2120	Indore	3523	9	-1.0	-1.3	15634	19	-11.3	-10.6	75	113	248	2.80	59.7	4.0	2.3
13	SPV 2121	Palem	3991	1	12.1	11.8	15251	20	-13.5	-12.7	73	108	263	2.55	58.3	4.1	2.5
14	SPV 2122	Palem	3792	4	6.5	6.2	18860	6	7.0	7.9	75	111	272	2.81	56.3	3.8	2.5
15	SPV 2123	Surat	2679	20	-24.7	-24.9	16813	14	-4.6	-3.8	77	114	270	2.76	61.7	-	1.9
16	SPV 2124	Surat	3181	16	-10.6	-10.9	15125	21	-14.2	-13.5	77	113	256	2.88	58.0	4.1	2.5
17	SPV 2125	Akola	3435	11	-3.5	-3.8	17875	8	1.4	2.3	76	112	278	2.83	54.7	3.8	2.3
18	CSV 15	Check	3560	8	0.0	-0.3	17630	9	0.0	0.9	75	112	273	3.04	58.4	4.8	3.1
19	CSV 20	Check	3569	7	0.3	0.0	17479	11	-0.9	0.0	74	111	256	2.80	57.2	-	2.7
20	CSV 17	Check	3181	17	-10.6	-10.9	9337	22	-47.0	-46.6	62	99	162	2.43	49.8	3.9	2.6
21	CSV 23	Check	2943	19	-17.3	-17.5	18991	5	7.7	8.7	76	116	254	3.09	64.3	3.9	2.4
22	Local chk#	Check	3621	6	1.7	1.5	18206	7	3.3	4.2	76	114	256	2.70	51.2	5.4	2.7
	L. MEAN		3373				17295				74	111	267	2.85	56.86	4.1	2.5
	C.D. (5%)		859				3324				2	4	18	0.27	7.56	0.8	NS
	C.D. (1%)		1142				4418				3	5	24	0.36	9.99		
	C.V. (%)		18.02				13.60				2.54	2.00	5.40	7.62	12.59	16.0	22.2

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9);

Advanced Hybrid Trial -Dual Purpose (Table 5A and 5B)

During 2010, only one dual purpose hybrid was advanced in hybrid trial and was evaluated with grain sorghum hybrids for yield and other agronomic traits during 2011.

Zone I (Table 5.A)

- *Days to flowering*- The hybrids SPH 1668 flowered in 70 days.
- *Plant height*- Plant height varied from 191 to 268 cm.
- *Grain yield*- Maximum yield was obtained in the check, CSH16.
- *Fodder yield*- The hybrid SPH 1668 showed superiority for fodder yield over CSH16. SPH 1668 recorded fodder yield of 24448 kg/ha against 17046 kg/ha of CSH16, check.
- *Grain size*- 3.5 g/100 grain was recorded by SPH 1668 which is on par with CSH 16, Check.
- *Remarks*- In Zone I, The hybrid SPH 1668 showed superiority for fodder yield.

Table 5.A. Performance of hybrids in advanced hybrid trial (AHT) DP- Zone I

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPH 1668	DSR	3550	21	-20.8	-17.3	24448	1	43.4	41.0	70	106	268	3.54	55.97	3.7	2.9
2	CSH 16	Check	4480	4	0.0	4.3	17046	19	0.0	-1.7	68	105	198	3.52	62.49	4.4	2.9
3	CSH 23	Check	4295	9	-4.1	0.0	17345	18	1.8	0.0	67	101	191	3.29	59.05	4.9	3.5
4	Local chk#		3668	20	-18.1	-14.6	22668	2	33.0	30.7	76	115	246	3.13	48.06	5.3	2.8
5	L. MEAN		4201				18962				70	105	205	3.32	57.63	4.2	2.7
	C.D. (5%)		721				1978				2	2	9	0.23	9.04	0.9	NS
	C.D. (1%)		955				2612				3	3	11	0.31	11.95	-	-
	C.V. (%)		14.85				11.33				3.25	2.24	4.60	7.52	14.85	18.1	30.0

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9);

Zone II (Table 5.B)

- *Days to flowering*- The hybrids SPH 1668 flowered in 70 days.
- *Plant height*- Plant height varied from 188 to 235 cm.
- *Grain yield*- Maximum yield was obtained in the check, CSH16.
- *Fodder yield*- The hybrid SPH 1668 showed superiority for fodder yield over CSH16. SPH 1668 recorded fodder yield of 14750 kg/ha against 11794 kg/ha of CSH16, check.
- *Grain size*- 3.2 g/ 100 grain was recorded by SPH 1668 which is on par with CSH 16, Check.
- *Remarks*- In Zone I, The hybrid SPH 1668 showed superiority for fodder yield.

Table 5.B. Performance of hybrids in advanced hybrid trial (AHT) DP- Zone II

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPH 1668	Devgen	2678	20	-9.3	-4.4	14750	3	25.1	50.0	70	106	235	3.22	55.97	3.7	2.9
2	CSH 16	Check	2952	15	0.0	5.4	11794	16	0.0	20.0	68	105	209	3.21	62.49	4.4	2.9
3	CSH 23	Check	2800	17	-5.1	0.0	9832	21	-16.6	0.0	65	101	188	2.90	59.05	4.9	3.5
4	Local chk#		3002	13	1.7	7.2	13286	14	12.7	35.1	73	113	201	2.82	48.06	5.3	2.8

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW	SF	GM FG	GM TG
5	L. MEAN		3146				13123				69	105	203	2.91	57.63	4.2	2.7
	C.D. (5%)		569				3039				3	2	20	0.39	9.04	0.9	NS
	C.D. (1%)		761				4067				4	3	27	0.52	11.95	-	-
	C.V. (%)		10.96				14.03				2.79	2.24	5.94	8.02	14.85	18.1	30.0

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9)

Advanced Varietal Trial –Dual Purpose (Table 6.A and 6.B)

During 2010, only one dual purpose Variety SPV 2061 was advanced in varietal trial and was evaluated with grain sorghum varieties for yield and other agronomic traits during 2011.

Zone I (Table 6.A)

- *Days to flowering*- The flowering ranged from 61 to 76 in the trial in Zone I.
- *Plant height*- Plant height varied from 144 to 256 cm.
- *Grain yield*- Maximum yield was obtained in the checks, CSV 15, SPV 462 and CSV 23.
- *Fodder yield*- The variety SPV 2061 showed superiority for fodder yield over CSV23. SPV 2061 recorded fodder yield of 21586 kg/ha against 20796 kg/ha of CSV23, check.
- *Grain size*- Grain size of 3.3 g/100 grain was recorded by SPV2061 which is on par with CSV23, Check.
- *Remarks*- In Zone I, SPV2061 showed superiority for fodder yield.

Table 6.A. Performance of varieties in advanced varietal trial (AVT) DP – Zone I

S. No	Entry	Centre	GY	R	% over CSV 23	% over CSV 15	FY	R	% over CSV 23	% over CSV 15	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPV 2061	Udaipur	2690	10	-18.4	-5.5	21586	1	14.5	3.8	72	110	254	3.31	56.8	3.5	2.1
2	CSV 20	Check	2829	9	-14.2	-0.6	20279	3	7.6	-2.5	70	107	243	3.38	56.0	-	2.5
3	CSV 15	Check	3296	2	0.0	15.8	18855	6	0.0	-9.3	71	109	230	3.26	58.8	3.7	2.9
4	CSV 17	Check	2324	11	-29.5	-18.4	15169	11	-19.5	-27.1	61	99	144	2.72	60.5	4.7	3.1
5	SPV 462	Check	3095	3	-6.1	8.7	18003	9	-4.5	-13.4	73	110	225	3.39	61.1	3.8	2.7
6	CSV 23	Check	2847	8	-13.6	0.0	20796	2	10.3	0.0	76	111	230	3.27	61.9	-	2.2
7	Local chk#	Check	2909	7	-11.7	2.2	18537	8	-1.7	-10.9	74	115	256	2.96	50.7	4.7	2.3
	L. MEAN		2938				19064				70	108	229	3.21	54.99	4.0	2.5
	C.D. (5%)		562				2334				3	3	13	0.22	10.02	NS	NS
	C.D. (1%)		749				3108				3	4	18	0.29	13.29		
	C.V. (%)		17.77				11.44				3.88	2.81	6.32	7.22	17.12	24.7	24.6

Zone II (Table 6.B)

- *Days to flowering*- The flowering ranged from 66 to 82 in the trial in Zone I.
- *Plant height*- Plant height varied from 188 to 250 cm.
- *Grain yield*- SPV 2061 recorded grain yield of 2117 kg/ha against 1695 kg/ha of the check, CSV23.
- *Fodder yield*- The variety SPV 2061 showed superiority for fodder yield over CSV23. SPV 2061 recorded fodder yield of 18719 kg/ha against 18225 kg/ha of CSV23, check.
- *Grain size*- Grain size of 2.7 g/ 100 grain was recorded by SPV2061 which is on par with CSV23, Check.
- *Remarks*- In Zone II, SPV2061 showed superiority for fodder and grain yield.

Table 6.B. Performance of varieties in advanced varietal trial (AVT) DP – Zone II

S. No	Entry	Centre	GY	R	% over CSV 23	% over CSV 15	FY	R	% over CSV 23	% over CSV 15	DTF	DTM	PH	GW	SF	GM FG	GM TG
1	SPV 2061	Udaipur	2117	5	-3.0	24.9	18719	1	26.1	2.7	79	109	231	2.74	56.8	3.5	2.1
2	CSV 20	Check	2059	6	-5.7	21.5	15905	4	7.1	-12.7	77	107	243	2.89	56.0	-	2.5
3	CSV 15	Check	2183	4	0.0	28.8	14844	7	0.0	-18.6	79	109	224	2.63	58.8	3.7	2.9
4	CSV 17	Check	2183	4	0.0	28.8	7784	11	-47.6	-57.3	66	95	188	2.11	60.5	4.7	3.1
5	SPV 462	Check	1859	9	-14.8	9.7	13082	10	-11.9	-28.2	78	109	249	2.70	61.1	3.8	2.7
6	CSV 23	Check	1695	10	-22.4	0.0	18225	2	22.8	0.0	82	118	242	2.73	61.9	-	2.2
7	Local chk#	Check	1871	8	-14.3	10.4	14448	8	-2.7	-20.7	79	109	250	2.76	50.7	4.7	2.3
	L. MEAN		2134				14899				77	107	236	2.63	54.99	4.0	2.5
	C.D. (5%)		796				4378				6	4	52	0.59	10.02	NS	NS
	C.D. (1%)		1086				6227				9	6	74	0.84	13.29		
	C.V. (%)		21.91				13.19				3.58	2.41	9.82	10.09	17.12	24.7	24.6

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed

Late kharif

Advanced Hybrid and Varietal Trial (Table 7.A)

In this trial, 10 hybrids and 4 varieties along with checks were evaluated for grain and fodder yield.

Hybrids

- *Days to flowering*- Flowering in hybrids ranged from 57 to 64 days, CSH 23 being the earliest to flower.
- *Plant height*- Plant height among hybrids tested varied from 183 to 217 cm.
- *Grain yield*- The top yielding hybrids SPH Nos 1648, 1676, 1679, 1680, 1683, showed 7 to 18% increase over the check, CSH 16.
- *Fodder yield*- Among hybrids, SPH 1683 yielded highest fodder of 12071 kg/ha against 9470 kg/ha of CSH16, the check.
- *Remarks*- Hybrids superior for grain and fodder yields were SPH 1648, SPH 1679, SPH 1680 and SPH 1683. SPH1648 recorded 4025 kg/ha of grain and 10713 kg/ha of fodder against 3399 kg/ha grain and 9470 kg/ha fodder of CSH 16.

Varieties

- *Days to flowering*- The varieties flowered between 62 to 65 days.
- *Plant height*- Plant height varied from from198 to 217 cm. Maximum plant height was observed in the check, CSV20.
- *Grain yield*- The test variety SPV 2078 recorded highest grain yield of 3414 kg/ha as compared to 2965 kg/ha of CSV20 and 3212 kg/ha of CSV23.
- *Fodder yield*- Both the checks CSV20 and CSV23 showed superiority for fodder yield.
- *Grain size*- The variety SPV2078 has very bold grain (3.28 g/100 grain)
- *Remarks*- High grain yielding variety SPV 2078 showed less fodder yield as compared to the check, CSV 23.

Initial Varietal Trial- Late kharif (Tables 8A)

In this trial, 17 test entries and 5 checks were evaluated during late kharif. The results are presented below.

- *Days to flowering*- In this trial most of the test varieties flowered between 61 and 67 days. None of the varieties was as early as CSV 17 (60 days).
- *Plant height*- Plant heights in this trial varied from 155 to 238 cm, tallest being SPV 2113 with 238 cm plant height.
- *Grain yield*- Four varieties (SPV 2117, SPV2122, SPV2123, & SPV2124) showed yield improvement over CSV23 by 5 to 16%. SPV 2117 ranked first by yielding 4480 kg/ha of grain against 3865 kg/ha of CSV 23, check.
- *Fodder yield*- SPV 2113 was superior for fodder yield to CSV23 by 33%.
- *Grain size*- SPV 2113 recorded 3.41 g test weight against 3.22 of the check CSV23
- *Remarks*- Variety SPV 2117 recorded grain superiority by yielding 4480 kg/ha of grain yield against 3865 kg/ha of CSV23, check. This variety showed 2% increase for fodder yield over CSV20.

Table 7.A. Performance of hybrids and varieties in advanced hybrid and varietal trial (AVHT) Late kharif

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW
1	SPH 1648	Mahodaya	4025	1	18.4	8.8	10713	6	13.1	32.6	64	101	215	2.77
2	SPH 1676	DSR	3655	6	7.5	-1.2	9191	13	-2.9	13.8	57	96	197	2.80
3	SPH 1677	DSR	3490	9	2.7	-5.7	11961	4	26.3	48.1	62	99	191	2.68
4	SPH 1679	Ganga Kaveri	3951	2	16.2	6.8	9664	11	2.0	19.6	63	101	199	2.94
5	SPH 1680	Ganga Kaveri	3791	3	11.5	2.5	10339	9	9.2	28.0	63	101	200	2.83
6	SPH 1682	Ganga Kaveri	3540	8	4.1	-4.3	10519	8	11.1	30.2	63	101	206	2.90
7	SPH 1683	Biostadt	3662	5	7.7	-1.0	12071	2	27.5	49.4	62	100	206	2.84
8	SPH 1684	Biostadt	3611	7	6.2	-2.4	11381	5	20.2	40.9	62	99	217	2.70
9*	SPV 2078		3414	10	15.1	6.3	10641	7	-11.4	-22.4	62	99	198	3.28
10	CSH 16	Check	3399	11	0.0	-8.1	9470	12	0.0	17.2	61	99	183	3.07
11	CSH 23	Check	3700	4	8.9	0.0	8078	14	-14.7	0.0	60	99	185	2.74
12	CSV 20	Check	2965	14	-12.8	-19.9	12014	3	26.9	48.7	65	100	217	2.89
13	CSV 23	Check	3212	12	-5.5	-13.2	13720	1	44.9	69.8	65	101	216	2.94

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW
14	Local chk#	Check	3085	13	-9.2	-16.6	9863	10	4.1	22.1	61	98	197	2.88
	L. MEAN		3536				10688				62	100	202	2.88
	C.D. (5%)		878				1927				4	3	17	0.36
	C.D. (1%)		1176				2561				5	4	22	0.47
	C.V. (%)		17.37				15.64				4.88	2.50	7.22	10.76

Note: R - Ranking; GY-Grain yield (kg/ha); FY-Fodder yield (kg/ha); DTF-Days to flowering; DTM-Days to maturity; PH-Plant height (cm); GW-100 grain weight (g); SF-Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9); Variety SPV 2078 is compared with Variety checks CSV20 and CSV 23

Table 8.A. Performance of varieties in initial varietal trial (IVT) – Late kharif

S. No	Entry	Centre	GY	R	% over CSV 20	% over CSV 23	FY	R	% over CSV 23	% over CSV 15	DTF	DTM	PH	GW
1	SPV 2109	Indore	3631	15	-15.5	-6.1	7819	18	-22.5	-34.6	61	97	203	3.07
2	SPV 2110	Palem	3636	14	-15.4	-5.9	10180	10	0.9	-14.9	66	100	205	2.87
3	SPV 2111	Mauranipur	3253	20	-24.3	-15.8	7267	20	-28.0	-39.3	61	96	199	3.12
4	SPV 2112	Mauranipur	3558	16	-17.2	-7.9	10392	7	3.0	-13.1	64	99	213	3.03
5	SPV 2113	DSR	2132	22	-50.4	-44.8	15919	1	57.8	33.1	67	100	238	3.41
6	SPV 2114	DSR	3726	12	-13.3	-3.6	9109	15	-9.7	-23.9	64	98	215	3.15
7	SPV 2115	Udaipur	3874	10	-9.8	0.2	8492	17	-15.8	-29.0	64	99	214	3.08
8	SPV 2116	Udaipur	3650	13	-15.1	-5.6	10252	9	1.6	-14.3	64	99	219	2.85
9	SPV 2117	Udaipur	4480	1	4.3	15.9	10288	8	2.0	-14.0	65	101	213	3.04
10	SPV 2118	Udaipur	3915	8	-8.9	1.3	11597	3	14.9	-3.1	64	99	231	2.93
11	SPV 2119	Indore	3960	7	-7.8	2.5	10622	5	5.3	-11.2	65	100	219	3.25
12	SPV 2120	Indore	3321	17	-22.7	-14.1	9253	13	-8.3	-22.7	65	100	217	3.13
13	SPV 2121	Palem	3310	18	-23.0	-14.4	6391	21	-36.7	-46.6	63	98	211	2.88
14	SPV 2122	Palem	4110	4	-4.4	6.3	11057	4	9.6	-7.6	64	98	208	3.15
15	SPV 2123	Surat	4068	5	-5.3	5.3	9209	14	-8.7	-23.0	65	100	218	2.89
16	SPV 2124	Surat	4246	3	-1.2	9.9	8829	16	-12.5	-26.2	66	99	219	3.07
17	SPV 2125	Akola	3911	9	-9.0	1.2	10123	11	0.3	-15.4	65	99	224	3.09
18	CSV 15	Check	3978	6	-7.4	2.9	10542	6	4.5	-11.9	63	99	209	3.14
19	CSV 20	Check	4297	2	0.0	11.2	10089	12	0.0	-15.7	65	98	216	2.83
20	CSV 17	Check	2842	21	-33.9	-26.5	4805	22	-52.4	-59.8	60	97	155	2.90
21	CSV 23	Check	3865	11	-10.1	0.0	11964	2	18.6	0.0	66	99	209	3.22
22	Local chk#	Check	3304	19	-23.1	-14.5	7510	19	-25.6	-37.2	63	98	187	3.20
	L. MEAN		3685				9623				64	99	211	3.06
	C.D. (5%)		1269				3830				4	3	29	0.40
	C.D. (1%)		1728				5120				5	4	38	0.53
	C.V. (%)		16.56				24.15				4.84	2.69	10.7	10.47

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage ; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9)

Initial Hybrid Trial- Late kharif (Tables 9.A)

10 hybrids along with 3 checks were evaluated for grain and fodder yield in this trial.

- *Days to flowering*- Flowering in hybrids ranged 59-64 days, CSH 23 being the earliest to mature (94 days).
- *Plant height*- Plant height among hybrids tested varied from 161 to 200 cm.
- *Grain yield*- The top yielding hybrids SPH Nos 1707, 1706, 1701, and 1705 showed 3 to 11% increase for grain yield over the check, CSH 16.
- *Fodder yield*- Among hybrids, SPH 1710 yielded highest fodder of 12735 kg/ha against 9363 kg/ha of CSH16, the check.
- *Remarks*- Hybrids superior for grain and fodder yields were SPH 1707 & SPH 1706. SPH 1701. SPH 1707 recorded 3854 kg/ha of grain & 12649 kg/ha of fodder against 3482 kg/ha grain & 9363 kg/ha fodder of CSH 16.

Table 9.A. Performance of hybrids in initial hybrid trial (IHT) – during late kharif 2011.

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW
1	SPH 1701	Hightec seed	3810	3	9.4	20.8	11565	3	23.5	41.0	62	97	200	3.02
2	SPH 1702	Hightec seed	3179	9	-8.7	0.8	11271	5	20.4	37.5	64	98	181	2.89
3	SPH 1703	Nuziveedu	3404	6	-2.2	8.0	9536	9	1.8	16.3	63	97	178	2.82
4	SPH 1704	Devgen seed	3359	7	-3.5	6.5	9855	7	5.3	20.2	60	95	185	2.83
5	SPH 1705	Akola	3595	4	3.2	14.0	10669	6	13.9	30.1	61	95	196	2.90
6	SPH 1706	Akola	3833	2	10.1	21.6	11527	4	23.1	40.6	61	96	196	2.88
7	SPH 1707	DSR	3854	1	10.7	22.2	12649	2	35.1	54.3	60	95	193	3.07
8	SPH 1708	DSR	3069	12	-11.9	-2.7	9162	11	-2.1	11.7	62	97	161	2.67
9	SPH 1709	DSR	3178	10	-8.7	0.8	9828	8	5.0	19.9	61	96	163	3.09
10	SPH 1710	Devgen seed	2706	13	-22.3	-14.2	12735	1	36.0	55.3	64	99	175	3.36
11	CSH 16	Check	3482	5	0.0	10.4	9363	10	0.0	14.2	61	96	175	3.00
12	CSH 23	Check	3153	11	-9.4	0.0	8200	13	-12.4	0.0	59	94	174	2.78
13	Local chk#	Check	3206	8	-7.9	1.7	8670	12	-7.4	5.7	59	94	184	3.14
	LOC. MEAN		3371				10387				61	96	182	2.96

S. No	Entry	Centre	GY	R	% over CSH 16	% over CSH 23	FY	R	% over check	% over CSH 23	DTF	DTM	PH	GW
	C.D. (5%)		726				2534				3	3	17	0.46
	C.D. (1%)		984				3398				4	4	23	0.62
	C.V. (%)		12.78				17.01				3.97	2.55	7.33	12.28

Note: R - Ranking; GY - Grain yield (kg/ha); FY - Fodder yield (kg/ha); DTF - Days to flowering; DTM - Days to maturity; PH - Plant height (cm); GW - 100 grain weight (g); SF - Shoot fly dead heart percentage; GMFG - Grain mold field grade (1-9); GMTG - Grain mold threshed grade (1-9)

II. Coordinated sorghum breeding research

During 2011, the coordinated sorghum breeding research comprised of developing hybrids on MS and R lines collected from various centers. The hybrids were evaluated in 2 trials at multi-location. Details of the report is given below.

Inter-institutional hybrid programme

(*Sujay Rakshit, S Audilakshmi, Usha Saxena, RB Ghorade, B Selvi and SP Mehtre,*)

In 2010, four CMS lines were obtained from Indore and DSR, respectively and five from Parbhani. Seeds were provided to four centers, viz., DSR, Parbhani, Indore and Akola for development of inter-institutional hybrids using their own R lines. In the process care was taken not to send CMS lines of the same station. Thirty two inter-institutional hybrids were received from DSR (21), Indore (3), Akola (4) and Parbhani (4). Two trials, viz., Hybrid Nursery I and II with 20 and 12 experimental hybrids, respectively were constituted. HN I was sent to five locations (Hyderabad, Akola, Indore, Parbhani and Coimbatore), while HN II was sent to Hyderabad, Akola and Coimbatore. In HN I check CSH 25 topped across five locations. However, 15 hybrids were at par with CSH 25 with IH 0115 (296A x I 29) closest to CSH 25 (Table 5). In terms of dry fodder yield MAUH 2 (CMS 10-9 x 1005 R) topped followed by (SBC 105 x 106A) x R 139. In HN II CMS 10-2A x NR 486 topped across three locations followed by 70A x AKR 505. Six hybrids performed better than CSH 25 (Table 6). In 2011 17 CMS lines were obtained from Parbhani (2), Indore (4), Akola (2), Dharwad (5) and DSR (4). Seeds were provided to Parbhani, Indore, Akola and DSR for development of new sets of inter-institutional hybrids.

Table. 1. Summary performance of experimental hybrids in Hybrid Nursery I

S. No.	Entry	Contributor	Grain yield (kg/ha)		Fodder yield (kg/ha)		Days to flowering		Plant height (cm)	
			Av.	R	Av.	R	Av.	R	Av.	R
1	(SBC 105 x 106A) x R 139	DSR	3668	12	10373	2	67	14	270	1
2	(SBC 1019 x 1020A) x R 66	DSR	3898	5	7788	14	69	8	177	15
3	(SBC 1107 x 1108A) x R 66	DSR	3484	14	7849	13	68	12	159	20
4	(SBC 111 x 112A) x R 66	DSR	2824	20	8348	9	71	4	172	16
5	(SBC 105 x 106A) x R 148	DSR	3700	10	8628	8	67	16	204	5
6	33A x R 68	DSR	3704	9	7253	17	69	9	162	19
7	56A x R 69	DSR	3669	11	9199	6	66	18	198	7
8	61A x R 66	DSR	3294	17	9255	5	70	7	167	17
9	92A x R 126	DSR	3468	16	6821	20	67	17	195	8
10	CMS 10-3A x C 43	DSR	2292	21	7216	18	71	3	182	13
11	CMS 10-3A x NR 486	DSR	2198	22	7002	19	71	5	178	14
12	CMS 10-7A x C 43	DSR	3778	8	6625	21	65	19	189	9
13	CMS 10-8A x C 43	DSR	3829	6	7587	15	69	10	145	21
14	CMS 10-9A x NR 486	DSR	3181	18	7936	11	68	13	145	22
15	IH 0115 (296A x I 29)	Indore	4082	2	8130	10	68	11	183	12
16	IH 0116 (IMS 10A x I 27)	Indore	3826	7	9135	7	62	21	199	6
17	IH 0117 (IMS 12A x I 12)	Indore	3469	15	7473	16	68	12	162	18
18	MAUH 1 (PMS 28 A X C 43)	Parbhani	3555	13	9845	3	71	6	214	4
19	MAUH 2 (CMS 10-9 x 1005 R)	Parbhani	3957	4	10597	1	72	2	261	2
20	MAUH 4 (PMS 74A X KR 199)	Parbhani	3105	19	9793	4	72	1	220	3
21	CSH 16	Check	4049	3	7883	12	67	15	187	10
22	CSH 25	Check	4086	1	6384	22	63	20	186	11
	MEAN		3590		8233		68		189	
	C.D. (5%)		840		2332		3		14	
	C.D. (1%)		1114		3175		3		19	
	C.V. (%)		18.36		13.62		2.98		6.03	
	F (Probability)		0.21		0.03		0.00		0.00	

Table. 2. Summary performance of experimental hybrids in Hybrid Nursery II

S. No	Entry	Contributor	Grain yield (Kg/ha)		Fodder yield (Kg/ha)		Days to flowering		Plant height (cm)	
			Av.	R	Av.	R		R		R
1	CMS 10-1A x C 43	DSR (SA)	3330	10	9925	8	67	7	189	6
2	CMS 10-2A x C 43	DSR (SA)	3267	12	10395	7	67	6	191	5
3	CMS 10-2A x NR 486	DSR (SA)	4563	1	13278	2	69	3	226	1
4	CMS 10-5A x C 43	DSR (SA)	3326	11	12182	3	69	4	181	10
5	CMS 10-6A x C 43	DSR (SA)	4336	5	10986	4	66	9	183	8

S. No	Entry	Contributor	Grain yield (Kg/ha)		Fodder yield (Kg/ha)		Days to flowering		Plant height (cm)	
			Av.	R	Av.	R		R		R
6	CMS 10-7A x NR 486	DSR (SA)	2961	13	6557	13	66	8	183	7
7	CMS 10-8A x NR 486	DSR (SA)	4395	3	9865	9	69	2	192	3
8	MAUH 3 (CMS 10-9 X KR 13)	Parbhani	2826	14	15255	1	69	1	206	2
9	70A x AKR 505	Akola	4452	2	9284	11	67	5	162	13
10	AKMS 89A x AKR 317	Akola	4310	6	9840	10	59	14	182	9
11	AKMS 89A x AKR 506	Akola	3724	8	10646	5	62	12	191	4
12	AKMS 89A x AKR 456	Akola	4368	4	8949	12	65	10	144	14
13	CSH 16	Check	3677	9	10546	6	64	11	180	11
14	CSH 25	Check	3808	7	6356	14	61	13	172	12
	LOC. MEAN		3810		10290		66		184	
	C.D. (5%)		1558		2636		4		27	
	C.D. (1%)		2173		3564		5		37	
	C.V. (%)		18.93		15.27		3.67		8.81	
	F (Probability)		0.29		0.00		0.00		0.00	
Locations rejected due to High C.V. (i.e. > 25%): HYDERABAD 40.4%										

III. Achievements in sorghum breeding at DSR

Breeding for micronutrient enrichment in sorghum (K Hariprasanna, M Elangovan & R Madhusudhana)

- For the improvement of grain micronutrient contents, about 80 crosses were made using probable donor parents and elite cultivars of sorghum. The F₁s were raised during *kharif* 2011 season and F₂ seeds were collected from about 70 crosses. The F₂ of selected 30 crosses were advanced during *rabi* 2011-12 season and 120 selections were made for further advancement.
- For the development of RILs for grain iron and zinc, four crosses (F₂) were advanced. The F₃ generation of two other crosses were advanced following SSD method for the development of mapping populations for polyphenols and phytates.
- To study the genotype × environment interaction for grain micronutrient contents across growing conditions, 10 selected genotypes were raised in six locations during *kharif* 2011 season and replicated grain samples were collected. The grain analysis for iron and zinc is under progress at ARI, Pune.
- Replicated grain samples of about 240 genotypes comprising parental lines, released cultivars, and selected germplasm accessions were re-analysed for grain iron and zinc contents for confirmation of previous results. The grain iron content ranged from 12 to 75.5 ppm and zinc content from 6.3 to 51.4 ppm. EP 92 and EP 117 had above 75 ppm iron content and EP 127 had the highest zinc content. Significant positive correlation ($r = 0.33$) was observed between grain iron and zinc content among the parental lines and cultivars, while it was non-significant among germplasm accessions and elite breeding lines.
- Effect of external application of iron and zinc fertilizers on grain micronutrient status (Agronomic-fortification) was studied on five cultivars. No significant difference was observed among fertilizer treatments in enhancing grain iron and zinc content.

Identification of molecular markers associated with heterosis and combining ability (Rajendrakumar, K Hariprasanna & R Madhusudhabna)

- During *kharif* 2011, a total of 210 A × R experimental hybrids along with the parental lines (45) and four checks (CSV 20, CSH 16, CSH 23 and CSH 25) were evaluated in a replicated trial to study the extent of heterosis for grain yield and related traits.
- Significant variation was observed for all the traits studied. The days to flowering ranged from 56-73 days. The panicle length also showed wide range (23-36 cm). The average grain yield per plant recorded was 64 g in parents and 84 g in hybrids. A total of 65 hybrids had grain yield higher than the best check, CSH 16, while one hybrid (ICSA 38 × CBR9) exhibited significant superiority of 27%.
- Standard heterosis (over best check) for panicle length ranged from -24 to 20%; panicle weight -43 to 30%; and grain yield it ranged from -46 to 27%. Twenty-five hybrids had significant grain yield heterosis over CSH 23, ranging from 29 to 49%. Compared to CSV 20, the varietal check, 4 hybrids recorded significant grain yield advantage (25-29%).
- A significant, moderate and positive correlation of coefficient of marker polymorphism (30 SSR markers) among the parental lines with mid-parental heterosis ($r = 0.42^*$) and better parent heterosis ($r = 0.56^*$) for grain yield was observed. EST-SSR and QTL-linked markers showed a better correlation (slightly >0.6) as compared to genomic SSR markers. This set of 30 SSR markers (10 each of genomic, EST-based and QTL-linked) exhibiting moderate correlation with grain yield heterosis were validated among new parental lines and are considered to have the potential for the prediction of grain yield heterosis in sorghum.

Parental line development (K Hariprasanna, AV Umakanth, C Aruna & Rajendrakumar)

- About 40 new male sterile lines in the genetic background of promising derivatives from maintainer × maintainer crosses are in different stages of backcrossing. Stable male sterile lines will be subsequently used in hybrid development.
- Superior selections in the advanced generations of restorer × restorer crosses were evaluated along with checks in two separate replicated trials during kharif 2011 to identify promising breeding lines which can be utilised in hybrid development as pollen parents.
- Among the seven advance breeding lines (F8) evaluated, DSR 866 recorded the highest grain yield (7247 kg/ha) with grain yield advantage of 32.5% over the best check, CSV 20 and 49% over CSV 23. The other lines with superior performance were DSR 867 (6379 kg/ha), DSR 861 (6075 kg/ha) and DSR 864 (5940 kg/ha). These lines will be studied for their combining ability for use as restorer lines.
- Among the 100 advance breeding lines (F7) evaluated, 17 lines had more than 100 g/plant grain yield, and one breeding line DSR 982 (RS 627 × AKR 354) had significantly higher grain yield than the best check, CSV 20 (96.4 g/plant), with an advantage of 40%. Twelve advance breeding lines had grain yield advantage of more than 10% over CSV 20, and 20 had more than 10% grain yield advantage over CSV 23. These advance breeding lines will be further evaluated to ascertain the superiority, and to utilize them as parental lines in hybrid development.
- From the segregating generations of maintainer × maintainer or restorer × restorer crosses raised during kharif 2011, about 11 selections were made from F3s, 320 from F4s and 140 from F5s for further advancement and parental line development.

Developing early duration and photoperiod insensitive grain sorghum MS and R lines (Sunil Gomashe, Sujay Rakshit, TG Nageshwar Rao & MY Samdur)

For developing early and photoperiod insensitive MS and R lines, eight lines comprising elite late B lines (296B, 2077B and 27B), elite early B lines (2219B, AKMS 14B and 7B) and early variety CSV 17 and popular restorer CS 3541 were crossed in half diallel design during rabi, 2010-11 for generating F1 hybrids. A total of 28 hybrids along with checks were raised during kharif for evaluation and advancement. Promising early F2s (49) were selected during rabi, 2011-12 for generation advancement to F3. Apart from diallel analysis, a set of 60 elite lines including promising germplasm were raised during kharif, 2011 on three different dates of sowing (30 days interval) at three locations (Hyderabad, Solapur and Deesa) to identify lines with earliness and photoperiod insensitivity. Observations were recorded for flowering and yield attributing traits. Future programme for the next year: early segregants superior for yield will be advanced to F3 and F4 generations. At F4 stage, superior lines will be test-crossed to elite MS lines for testing the fertility reaction. Advanced F4 lines from B x B crosses will be backcrossed to MS lines for developing MS for earliness and superior yield.

Germplasm evaluation: assessing value for cultivation and use (VCU) (Sunil Gomashe, M Elangovan, G Shyam Prasad & IK Das)

In order to enhance utilization of germplasm in sorghum improvement programmes, it is essentially required to characterize and evaluate the sorghum germplasm available with DSR for specific traits. A total of 837 germplasm landraces (collection from Maharashtra state) were raised during rabi, 2011- 12 for multiplication and evaluation for economically important traits along with three checks (M 35-1, CSV 20 and CSV 22). Harvesting is in progress. A set of 500 lines will be evaluated at multilocation (AICSIP Centers- Akola and Deesa) for important agro-morphological characters (Days to 50% flowering, plant height, days to maturity, length of peduncle, panicle length, 100 grain weight, Grain yield per plant).

Development of superior forage sorghum genotypes (C Aruna, BV Bhat, AV Umakanth, VR Bhagwat, G Shyam Prasad & CV Ratnavathi)

30 hybrids based on 11 ms and 6 R lines were sown in RCBD with three replications along with the check, CSH 20MF and CSH 24MF. Data was recorded on days to flower, plant height, green fodder yield and dry fodder yield. Out of 28 hybrids evaluated, 4 hybrids yielded more than 10% over both the checks, CSH 20MF and CSH 24MF for green and dry fodder yields. 417 A x PC 23 recorded about 30% improvement for green fodder yield and 16% improvement for dry fodder yield over the checks. Four hybrids, 417 A x UPMC 503, 417 A x UPMC 512, 3042 A x UPMC 512 and 27 A x UPMC 503 flowered 5 days earlier to CSH 24MF. The quality analysis is being done.

Table 1. Performance of promising forage hybrids

	Hybrid	DF	Plant Height (cm)	GFY (t/ha)	% increase over		DFY (t/ha)	% increase over	
					CSH 20MF	CSH 24MF		CSH 20MF	CSH 24MF
1	417 A x UPMC 503	59.0	334.7	34.89	-28.66	-29.23	9.66	-22.12	-23.96
2	417 A x UPMC 512	59.0	283.7	41.37	-15.40	-16.09	8.90	-28.23	-29.92
3	417 A x PC 23	62.0	330.0	64.18	31.24	30.18	14.71	18.61	15.81
4	417 A x Niz forage	61.7	318.3	41.33	-15.49	-16.17	10.75	-13.28	-15.33
5	283 A x UPMC 512	62.7	255.3	58.16	18.93	17.97	13.79	11.23	8.60

	Hybrid	DF	Plant Height (cm)	GFY (t/ha)	% increase over		DFY (t/ha)	% increase over	
					CSH 20MF	CSH 24MF		CSH 20MF	CSH 24MF
6	3042 A x UPMC 503	63.7	203.0	38.25	-21.77	-22.41	9.02	-27.28	-29.00
7	3042 A x UPMC 512	59.3	283.8	37.16	-24.01	-24.63	9.59	-22.69	-24.51
8	3042 A x PC 23	61.3	276.0	42.42	-13.25	-13.96	9.64	-22.26	-24.09
9	3042 A x BMR 23375R	62.0	167.7	34.38	-29.69	-30.26	7.53	-39.25	-40.69
10	3062 A x UPMC 512	61.3	266.9	49.95	2.15	1.32	13.40	8.08	5.52
11	3062 A x PC 23	61.7	258.7	35.52	-27.37	-27.95	8.78	-29.17	-30.84
12	126 A x SSG 59-3	75.0	251.3	43.94	-10.15	-10.88	10.46	-15.65	-17.64
13	126 A x PC 23	64.7	347.9	55.17	12.82	11.91	14.56	17.39	14.62
14	27 A x UPMC 503	59.0	334.7	40.15	-17.90	-18.56	10.87	-12.36	-14.43
15	27 A x BMR 23375R	64.3	228.0	33.41	-31.67	-32.22	7.63	-38.43	-39.89
16	MR750A2 x UPMC 512	68.0	226.0	45.20	-7.57	-8.32	11.66	-5.95	-8.17
17	MR750A2 x BMR 23375R	66.7	238.7	42.38	-13.34	-14.04	9.39	-24.26	-26.05
18	C43A2 x UPMC 512	67.0	179.3	44.99	-8.00	-8.75	9.37	-24.45	-26.24
19	C43A2 x Niz forage	69.7	159.5	34.00	-30.46	-31.03	7.30	-41.10	-42.49
20	C43A2 x BMR 23375R	69.0	202.0	44.95	-8.09	-8.83	10.23	-17.47	-19.42
21	BMR23149A x UPMC 512	62.3	249.2	42.63	-12.82	-13.53	9.55	-23.00	-24.82
22	BMR23149A x PC 23	64.0	299.2	44.82	-8.35	-9.09	11.36	-8.42	-10.58
23	BMR23157A x UPMC 503	62.3	346.5	42.80	-12.48	-13.19	13.72	10.61	8.00
24	BMR23157A x UPMC 512	67.0	264.0	54.41	11.28	10.37	14.00	12.91	10.24
25	BMR23157A x PC 23	64.0	311.3	52.27	6.89	6.02	13.30	7.22	4.69
26	BMR23157A x BMR23375R	67.7	217.1	37.20	-23.92	-24.54	7.78	-37.26	-38.74
27	CSH 20 MF	59.3	295.3	48.90	0.00	-0.81	12.42	0.17	-2.20
28	CSH 24 MF	65.0	309.3	49.32	0.86	0.04	12.73	2.68	0.26
	Mean	63.9	265.6	44.08			10.79		
	CV (%)	3.6	6.0	23.20			22.26		
	SE	1.3	9.2	2.34			0.55		
	CD (5%)	3.8	26.0	16.72			3.93		
	CD (1%)	5.0	34.7	22.27			5.24		

Expt 2: Evaluation of forage, sweet sorghum, dual purpose and brown midrib genotypes for forage yield and quality: 54 genotypes including 14 local forage genotypes, 15 improved forage sorghum genotypes, 7 sweet sorghum lines, 7 brown midrib lines, two dual purpose lines, 6 high biomass lines, along with 3 forage checks, CSV 21F, HC 308 and SSG 59-3, were sown in RCBD replicated thrice. Significant differences were observed among the genotypes. The forage lines PSC 1, SL 44 and the BMR lines, EC 582508, EC 582504, EC 582510 and the sweet sorghum line, Keller were early compared to the checks used. The genotypes, SSV 74, UPMC 503, PSC 1, Pant Chari 8 were found to exhibit good plant vigour in the early stages. Leaf parameters like leaf number, length and width were good in high biomass lines, SSRG 164, 200, 212, 214 and 222. Sweet sorghum lines, SSV 84, RSSV 9 and SSV 74 were also having good leaf parameters. For brix content, the brown mid rib line, EC 582504 (16.6%) was the best followed by the forage lines, Ramkel (14.6%), SSRG 212 (14.7%), Pant Chari 4 (14.5%) and HC 171 (14.2%) compared to the check, HC 308 (13%). High biomass yield per plant was observed in SSRG 200, HC 136, SSV 84, SSRG 164, Afzalpur local and Pant Chari 5.

Table 2. Performance of forage genotypes for fodder yield attributes

	Days to Flower	Early vigour	Green fodder yield (kg/pl)	Plant Height (cm)	Stem diameter (cm)	Brix	Leaf no.	Leaf length (cm)	Leaf width (cm)
RAMKEL	81.7	3.17	0.50	326.00	1.64	14.63	14.67	93.97	7.55
GFS 5	72.0	3.00	0.76	305.33	1.65	11.35	11.53	96.31	8.71
S 541	76.7	2.33	0.59	333.63	1.42	12.43	12.47	82.15	8.17
Rampur Local	71.0	2.50	0.57	305.33	1.75	12.56	11.90	81.82	8.52
MP CHARI	80.3	2.50	0.54	377.00	1.55	11.98	17.20	94.33	7.24
COFS 29	80.0	1.67	0.28	345.67	1.15	11.43	48.40	81.80	3.65
PSC-1	65.0	3.50	0.54	261.67	1.52	9.12	13.87	78.59	7.68
SL-44	60.0	3.33	0.29	206.00	1.05	12.37	8.27	62.93	6.32
KATAN KHATAV	82.0	3.17	0.69	368.33	1.70	10.33	15.80	93.55	9.43
SANGOLA HUNDI	82.0	3.00	0.55	297.67	1.44	9.57	24.67	78.41	9.39
Niz. FORAGE	66.0	3.33	0.40	297.33	1.31	10.95	15.13	76.89	6.27
KH. YELLOW SORGHUM	82.7	2.67	0.56	369.00	1.66	13.79	17.33	80.97	9.01
KASEGAON	78.3	3.17	0.72	326.33	1.70	7.81	14.87	91.59	8.21
Haljal Dt. Afzal pur local	82.0	3.00	0.86	320.00	1.79	10.53	18.87	84.37	9.65
UP Chari 1	75.0	2.50	0.73	344.44	1.61	12.43	15.82	76.58	9.02
UP Chari 2	78.3	2.83	0.75	310.00	1.71	11.69	14.27	88.69	8.62
Pant Chari 3	81.0	3.00	0.78	297.67	1.76	10.49	12.53	87.51	8.48
Pant Chari 4	73.0	2.50	0.70	339.33	1.66	11.00	18.40	76.62	8.21
Pant Chari 5	70.0	3.00	0.81	368.00	1.78	12.67	14.07	96.08	8.96
Pant Chari 6	67.0	3.17	0.58	307.67	1.40	11.51	12.13	83.20	6.79
Pant Chari 7	68.0	2.83	0.50	339.00	1.58	14.54	12.93	78.99	7.51
Pant Chari 8	82.3	3.50	0.69	349.42	1.56	12.01	14.93	89.35	7.01
HC 171	83.0	2.67	0.55	343.33	1.43	14.25	13.67	76.91	8.25
HC 136	70.0	2.83	0.91	368.33	1.79	12.21	16.87	91.98	8.43
HJ 513	82.0	3.17	0.66	448.00	1.87	13.70	17.27	94.47	7.85
CSV 15	67.3	3.17	0.60	290.33	1.49	10.43	11.80	88.79	8.56
SPV 1616	69.7	3.50	0.61	297.33	1.54	11.77	12.07	87.33	7.77
EC 582510	62.3	2.67	0.38	250.00	1.30	9.98	11.93	80.99	7.81
EC 582508	63.0	2.17	0.40	221.67	1.35	12.08	10.80	72.89	7.64
EC 582504	62.0	2.50	0.36	211.33	1.34	16.62	11.53	67.98	7.31

	Days to Flower	Early vigour	Green fodder yield (kg/pl)	Plant Height (cm)	Stem diameter (cm)	Brix	Leaf no.	Leaf length (cm)	Leaf width (cm)
BMR 23369	73.0	3.00	0.59	202.00	1.70	11.84	11.80	89.33	10.19
BMR 23375	70.7	2.17	0.41	174.67	1.43	9.55	10.87	88.51	8.20
BMR 23150	71.0	2.17	0.41	162.00	1.58	12.37	13.53	85.32	10.33
BMR 23158	71.0	3.17	0.52	171.00	1.68	11.03	11.87	81.15	9.20
HC 308	70.0	3.50	0.82	340.00	1.71	13.05	16.13	82.05	8.58
CSV 21F	72.3	3.50	0.62	366.67	1.47	12.57	16.27	90.08	8.07
SSG 59-3	71.3	3.50	0.30	351.67	1.17	10.79	34.00	79.67	4.21
SSV 84	83.0	3.67	0.89	305.67	2.03	14.33	16.40	100.73	9.66
RSSV 9	71.7	3.33	0.53	335.67	1.65	13.06	16.87	78.65	8.70
SSV 74	83.0	3.67	0.70	357.67	1.69	14.52	15.47	90.14	9.57
KELLER	63.0	3.00	0.52	273.67	1.52	13.99	13.20	86.81	7.71
NSSV 13	82.0	3.17	0.71	344.33	1.72	15.89	12.93	95.79	8.18
URJA	69.0	2.50	0.61	323.67	1.62	12.57	11.20	89.83	7.85
BJ 248	71.0	2.17	0.59	284.33	1.50	13.80	15.87	81.43	8.03
UPMC 503	71.3	3.67	0.42	351.00	1.39	11.63	11.07	82.95	6.75
UPMC 512	68.0	3.00	0.47	170.00	1.54	8.26	8.27	83.53	8.61
PC 23	70.3	2.67	0.47	270.67	1.34	10.21	11.00	76.82	6.56
SEVS 4	72.7	3.33	0.76	374.67	1.68	11.95	18.07	85.09	8.90
SSRG 164	83.0	3.50	0.89	397.67	2.06	7.54	18.07	81.65	8.02
SSRG 200	83.0	3.00	1.10	348.67	2.35	6.57	19.13	91.69	8.95
SSRG 212	83.0	2.50	0.86	337.33	1.78	14.74	17.87	104.22	8.10
SSRG 214	83.0	3.00	0.77	350.67	2.18	6.09	16.20	115.23	7.61
SSRG 222	83.0	2.67	0.73	299.67	2.02	5.61	13.53	92.53	7.13
HJ 260	64.7	3.00	0.38	363.00	1.34	11.90	14.07	76.42	8.59
Mean	74.0	2.95	0.61	310.77	1.60	11.61	15.36	85.66	8.07
C.V.	7.8	11.98	21.05	9.61	9.56	15.24	14.16	6.45	8.16
S.E.	3.3	0.20	0.07	17.23	0.09	1.02	1.26	3.19	0.38
C.D. 5%	9.3	0.57	0.21	48.32	0.25	2.86	3.52	8.94	1.07
C.D. 1%	12.3	0.76	0.28	63.93	0.33	3.79	4.66	11.83	1.41

Expt 3: Evaluation of forage germplasm: 220 forage germplasm lines were evaluated in augmented design using 2 checks, SSG 59-3 and CO(FS) 29. These were grown in 4 blocks. Of 220 germplasm lines, 88 could be evaluated during kharif 2011. Six germplasm lines flowered earlier to SSG 59-3. IS 3447, IS 3267, IS 3277, IS 3289 and IS 3306 flowered earlier in less than 60 days, of which IS 3289 was the earliest flower in 55 days. About 11 lines recorded more than 5 tillers per plant. More number of tillers were observed in the lines ISnos. 697, 704, 722 and IS 698. Twenty seven lines had more than 50 leaves, of which IS 3310, 3341, 3246 and FM 872 were more promising. Longer leaves were observed in FM 654, 677 and 569. IS 3309 and 3223 were promising for all the leaf parameters like leaf number, length and width.

Table 3. Promising forage germplasm lines

IS No.	Plant height (cm)	Leaf no.	Tiller no.	Leaf length (cm)	Leaf width (cm)
IS 697	267.0	88	9.6	64.94	4.28
IS 698	226.0	82.8	6.8	59.94	3.94
IS 704	215.0	40.2	4.4	57.42	3.84
IS 704	204.0	97.8	9	66.28	4.08
IS 705	245.0	99.2	3.6	73.74	5.42
IS 722	146.0	95	7	59.92	3.38
IS 2887	337.0	20.6	0.4	85.7	6.56
IS 3191	374.0	36.25	0.8	79.34	6.1
IS 3192	252.0	66.6	1.6	79.68	4.82
IS 3193	241.0	28	1.4	81.78	6.12
IS 3223	287.0	77.4	4.4	82.7	6.08
IS 3226	229.0	56.4	1.8	70.4	5.26
IS 3234	261.7	88.67	5.00	58.17	3.97
IS 3244	201.0	91.2	6	65.86	4.14
IS 3246	234.0	116.6	8.8	62.66	4.76
IS 3266	295.0	41.6	1.2	82.56	5.26
IS 3279	237.0	70	2	80.22	4.04
IS 3289	193.0	86.4	4.6	71.9	3.34
IS 3309	274.0	93.8	5.2	77.42	5.1
IS 3310	201.0	126	6.8	67.14	3.98
IS 3314	209.0	66	3.2	70.02	5.26
IS 3337	261.0	55.8	2.2	81.6	4.44
IS 3341	216.7	120	6.67	64.6	4.3
FM 1	327.5	24.5	0	80.5	7
FM 158	175.0	19	1	85	6.7
FM 219	237.3	26.33	1	81.33	6.5
FM 237	270.8	13	0.5	84	6.1
FM 552	258.3	21.67	0.33	81.67	5.7
FM 562	330.0	16.8	0	84.2	5.64
FM 569	357.0	20.8	0.8	92.3	6.8
FM 577	339.0	17.6	0.6	86.2	6.02
FM 593	225.0	17.5	0.33	88	6.85
FM 612	248.7	13.67	0	84.67	7.23
FM 654	318.0	15.2	0	95.2	8.7
FM 677	367.0	14.6	0	93.4	6.6
FM 872	180.0	105	0	82	4.5

IS No.	Plant height (cm)	Leaf no.	Tiller no.	Leaf length (cm)	Leaf width (cm)
DUGGI	270.0	14	0	88.5	8
FM 1223	162.5	14	3.5	88.75	9
FM 1356	175.0	6	0	84	8
SSG 59-3	338.5	45.15	2.75	78.285	3.97
CoFS 29	329.3	122	7.05	77.7	3.915
SE	63.6	35.4733	2.5113	15.6221	0.5058
CD 5%	202.3	112.8918	7.9921	49.7164	1.6096

Expt 4: Breeding nursery, and advancement of F₁ and F₂: 1250 lines comprising of material from restorer development, shoot pest resistance and forage improvement. F₂ population of 53 crosses and 45 F₁s were also grown. Based on the performance of breeding nursery lines, selections were made in the field for forage and grain sorghum restorer development. 216 selections were made in 53 F₂ crosses.

Studies on sucrose accumulation for efficient ethanol production from Sweet sorghum- National Fund project (CV Ratnavathi, C Aruna & Visarada)

57 sweet sorghum genotypes, including both indigenous and exotic genotypes were grown in RCBD with two replications during kharif 2011. Each plot consists of 2 rows of 5 mt length in each replication. Days to 50% flowering ranged from 58 to 82 days, the earliest being Keller, a genotype from USA. Plant height varied from 196 to 405 cm and the panicle length from 9 to 25.4 cm. RSSV 261 is very tall with 4mt plant height.

Studying the therapeutic properties and establishing sorghum grain as a functional food- DBT project (CV Ratnavathi & C Aruna)

168 sorghum genotypes were evaluated in augmented design during kharif 2011. The material was sown in four blocks, each with 42 entries. Two elite genotypes, 296 B and C 43 were used as checks in each block. Each genotype was grown in a single line of 5mt length. Field data was recorded on days to flower, plant height, panicle length and seed traits like seed colour, seed size and 100 seed weight. The data was recorded on ten plants in each row. Out of 168 genotypes sown only 97 genotypes flowered during kharif season. The days to 50% flowering ranged from 46 to 78 days, IS 20697 a germplasm line from USA was the earliest to flower. The plant height varied from 102 to 412 cm. IS 2413 a germplasm line from Iran was the tallest genotype among all. The same genotype was having the longest panicles of 55 cm length. The 100 seed weight of the genotypes ranged from 1.24 to 3.64g. Six genotypes were found to have 100 seed weight more than 3g. SPV 1471 was having highest 100 seed weight of 3.64g

Genetic variation among mini core collections and elite lines for yield and quality traits (Ganapathy, S Audilakshmi, Sujay Rakshit & K Hariprasana)

A set of 195 mini-core accessions along with 48 elite lines were evaluated for various grain yield and quality traits. Wide variability was observed for flowering and yield and grain quality attributing traits. Accessions viz., IS 15744, IS 19153, IS 23514, IS 23586, IS 23579, IS 23891, IS 31706, ISA 4360, IS 4698 were promising for grain weight and grain yield. Grain hardness an important criteria for accessing the grain quality was also accessed among 242 diverse set of lines. Among the elite cultivars, the lines RS 627 (62.96 sec.) followed by RSSGV 44 (52.96 sec), Indore 12 (52.96 sec), RS 673 (52.96 sec), CSV 13 (49.96 sec) were harder indicating that these genotypes are more suitable for specific end-products like semolina. DNA from all these lines has been isolated and genotyping with SSR markers are in progress to study the genetic structure and thereby to identify genomic regions associated with grain yield and grain quality traits.

Combining ability studies in sweet sorghum (AV Umakanth, BV Bhat, G Shyam Prasad & SS Rao)

During Kharif 2011, combining ability studies in sweet sorghum were carried out for brix, stalk yield and juice characters. The material included 20 hybrids their corresponding parents viz., Five lines (DMS No's 8, 10, 24, 26 and 30) and four testers (SSV 84, CSV 19SS, SSV 74 and RSSV 76) and the check CSH 22SS. Observations on days to flower, days to maturity, plant height, stem girth, no.of nodes, total biomass, fresh stalk yield, brix (%), TSS, juice yield, juice extraction, total sugar content and computed ethanol yields were recorded.

- The analysis of variance for combining ability revealed significant mean sum of squares due to line x tester interaction for almost all the important characters like total biomass, fresh stalk yield, juice yield, TSS, Total sugar content and computed ethanol yield.
- Line effect was significant for plant height, brix (%), TSS while the testers showed significance for plant height, total biomass, fresh stalk yield. This indicates that the variation in hybrids in terms of the characters studied is largely influenced by the interaction between lines and testers.
- Among lines DMS 10B and DMS 8B exhibited significant and positive GCA effects for total biomass and juice yields while for brix content, DMS 30B was promising (Fig. 1)
- Among testers, SSV 74 and CSV 19SS were promising general combiners for fresh stalk yield while SSV 84 and the former two testers were promising for total sugar content and computed ethanol yields (Fig. 2)

- The cross DMS 8A x RSSV 76 exhibited significant and positive SCA effects for important traits like total biomass, juice yield, total sugar content and computed ethanol contents
- The same hybrid also exhibited significant standard heterosis over the check CSH 22SS (Table 1) for juice yield (23%), total sugar content (17%) and computed ethanol yield (43%). DMS 30A x SSV 74 exhibited significant heterosis (21%) for total sugar content and computed ethanol yields.

Table 4: Standard heterosis for quality traits in sweet sorghum hybrids

Hybrid	Juice yield	Total sugars	Ethanol yield
DMS8A x SSV84	-6.82	0.73	-5.74
DMS8A x CSV19SS	-28.21 *	21.40 **	-13.73
DMS 8A x SSV 74	-5.18	2.61	-2.51
DMS 8A x RSSV76	23.72*	16.88 *	43.26 **
DMS 10A x SSV 84	-10.62	-13.32 *	-22.55
DMS 10A x RSSV 9	21.65*	-8.54	9.96
DMS 10A x SSV 74	12.72	-0.24	12.14
DMS 10A x RSSV 76	-40.55 **	-10.47	-46.57 **
DMS 24A x SSV 84	-36.48 **	7.37	-31.78 *
DMS 24A x RSSV 9	-1.52	13.32 *	10.96
DMS 24A x SSV 74	-20.07	15.23 *	-7.72
DMS 24A x RSSV 76	-49.08 **	3.32	-47.09 **
DMS 26A x SSV 84	-17.89	3.07	-15.05
DMS 26A x RSSV 9	-29.05 *	15.93 *	-17.7
DMS 26A x SSV 74	26.13 *	-3.81	21.72**
DMS 26A x RSSV 76	-36.24 **	11.17	-28.82
DMS 30A x SSV 84	-28.00 *	16.88 *	-15.52
DMS 30A x RSSV 9	-1.58	19.28 **	18.02
DMS 30A x SSV 74	0.99	21.18 **	21.13**
DMS 30A x RSSV 76	-49.24 **	8.08	-44.73 **

Creating new variability for developing varieties and hybrid parents in rabi sorghum (*Sorghum bicolor* (L.) Moench) for medium to deep soils (P. Sanjana, JV Patil, Prabhakar, Sujay Rakshit, Subbarayudu & Sunil Gomashe)

Genetic diversification of varieties and B-lines: For genetic diversification of rabi varieties and B-lines, about 213 crosses were made involving germplasm lines which included 104 crosses between varieties/R-lines x exotic germplasm lines, 32 crosses between B-lines and exotic germplasm lines, 53 crosses between varieties/R-lines x indigenous germplasm lines, 24 crosses between B-lines and indigenous germplasm lines. For pooling the yield genes among the existing rabi varieties and also for studying the gene action for rabi yield and contributing traits, 227 crosses were made between varieties and 33 crosses were made between varieties and B-lines. Stigma receptivity and pollen viability of rabi genotypes: A total of 186 crosses were made between 20 genotypes that include 16 rabi varieties, 2 rabi restorers (AKR 354, RS 585), 1 kharif restorer (C 43) and 1 stay green source (E 36-1). The seed set data was recorded as % seed set. The temperature during the entire crossing period recorded below 15°C. Seed set was low in E 36-1, C 43, AKR 354 when used as both male and female parents indicating their susceptibility to cool temperatures. The seed set was good in CSV 8R, Phule Anuradha, Phule Chitra, Phule Vasudha, PKV Kranti, SPV 1595 when used as both male and female parents indicating their tolerance to cold stress. Seed set was moderate in DSV 4, DSV 5, M 35-1, SPV 1411, Phule Maulee, Phule Revati when used as both male and female parents. Seed set was good in CSV 14R and RS 585 when used as pollen parent indicating poorly receptive stigmas may be one of the factor while it was good in CSV 18R, CSV 216R was good when used only as seed parent indicating poor pollen viability in these genotypes (Table 5).

Table 5. Seed set in crosses made involving 20 genotypes of sorghum during 2011-12 postrainy season

Variety	As seed parent	As pollen parent
CSV 8R	89 (7)	87 (6)
CSV 14R	45 (4)	83 (8)
CSV 18R	80 (13)	66 (13)
CSV 1829	90 (3)	90 (2)
CSV 216R	94 (8)	53 (11)
DSV 4	76 (15)	62 (10)
DSV 5	67 (9)	69 (8)
M 35-1	66 (8)	70 (10)
SPV 1411	74 (10)	78 (14)
Phule Anuradha	93 (12)	84 (9)
Phule Chitra	81 (12)	78 (10)
Phule Vasudha	82 (11)	78 (11)
Phule Maulee	72 (10)	73 (14)
Phule Revati	60 (7)	77 (10)
PKV Kranti	87 (10)	81 (12)
SPV 1595	88 (7)	78 (9)
E 36-1	21 (8)	50 (6)
C 43	48 (13)	33 (3)
RS 585	50 (7)	80 (11)
AKR 354	46 (12)	36 (10)

Figures in parenthesis indicate the number of crosses involving the parent

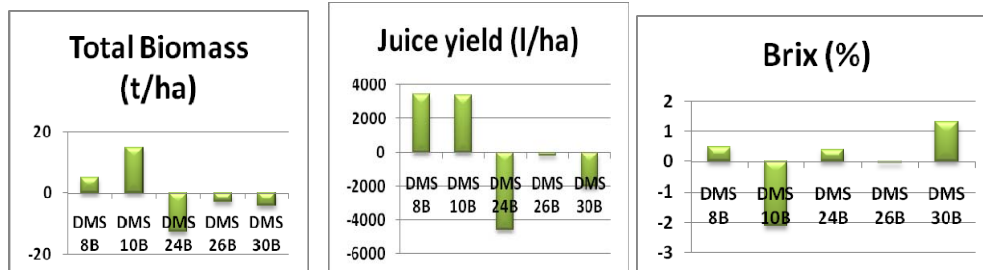


Fig.1: GCA effects of lines for various characters

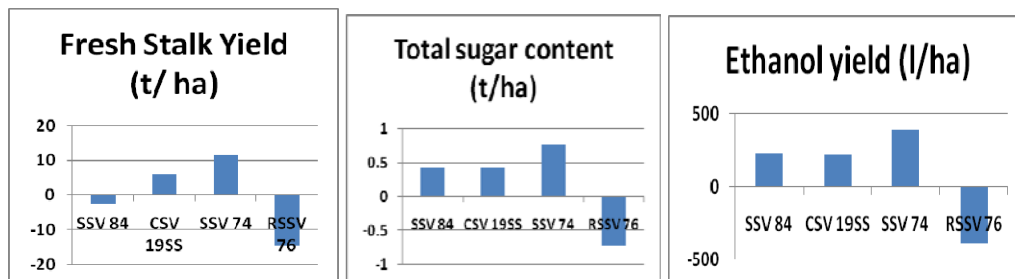


Fig.2: GCA effects of testers for various characters

Genetic modification of sorghum for improving sorghum grain quality (S Audilakshmi, IK Das, C Aruna & Ganapathi)

Expt 1: Evaluation of hybrids based on new MS lines for grain yield : Seventy six hybrids based on 30 MS and 6 R lines along with 2 checks, one medium maturing (CSH 16) and one early maturing (CSH 23) checks, were grown in RCBD with three replications in two trials. Observations were recorded on plant height, panicle length, days to flower and grain yield. Fourteen medium duration hybrids performed superiorly for grain yield over the check, CSH16 and 19 early duration hybrids recorded superior yield over the check, CSH23. The hybrids, R55 x R69, R57 x R69, R2295 x CB 25, R94 x CB111, R43 x R70, and R94 x CB115 recorded 29, 24, 21, 20, 19 and 15% superiority over the check, CSH16 (Table 6). Early duration hybrids, R57 X R69 (7047 kg/ha), R43 X R68 (6818 kg/ha) and R28 X R67 (6256kg/ha) were superior for grain yield in comparison to the check, CSH23 (5131 kg/ha) (Table 7).

Table 6. Performance of superior hybrids (medium duration) for grain yield

Hybrid	Plant height (cm)	Days to flowering	Panicle length (cm)	Grain yield (kg/ha)	% increase over check, CSH16
R36 X R68	178.3	65.3	29.1	6173	8.4
R53 X R68	186.7	65.3	29.6	5943	4.4
R61 X R68	186.4	65.7	27.3	6159	8.2
R33 X R69	263.9	66.3	30.1	6159	8.2
R36 X R69	238.9	66.3	28.8	6430	12.9
R50 X R69	231.7	65.0	31.4	6270	10.1
R55 X R69	227.2	65.7	31.8	7360	29.3
R57 X R69	227.4	63.7	28.6	7047	23.8
R29 X R70	222.8	64.7	35.7	5812	2.1
R43 X R70	218.3	63.7	32.8	6749	18.5
R65 X R70	188.9	69.7	30.2	5923	4.0
2295A X CB25	200.6	68.3	25.9	6853	20.4
R94 X CB111	234.6	65.7	35.8	6860	20.5
R94 X CB115	230.6	64.0	34.1	6561	15.2
CSH 16	198.3	64.0	31.6	5694	0
Mean	211.9	65.1	30.3	5495	
C.V.	5.8	2.7738	10.3	21	
C.D. 5%	19.9	2.936	5.1	1851	

Table 7. Performance of superior hybrids (early duration) for grain yield

Hybrid	Plant height (cm)	Days to flowering	Panicle length (cm)	Grain yield (kg/ha)	% increase over check, CSH16
R28 X R67	214.3	63.0	29.6	6256	21.9
R43 X R67	171.3	63.7	30.1	5555	8.3
R51 X R67	157.6	62.3	26.2	4201	-18.1
R54 X R67	164.2	61.0	27.2	5062	-1.4
R43 X R68	225.6	63.0	33.0	6818	32.9
R44 X R68	208.6	63.7	38.9	5548	8.1

Hybrid	Plant height (cm)	Days to flowering	Panicle length (cm)	Grain yield (kg/ha)	% increase over check, CSH16
R48 X R68	201.7	59.0	29.8	5589	8.9
R51 X R68	179.0	61.3	31.1	5034	-1.9
R48 X R69	273.8889	61.0	29.1111	5860.1	14.2
R51 X R69	223.5556	61.0	31.5556	5644.9	10.0
R56 X R69	252.4444	63.3	34.5556	5776.8	12.6
R57 X R69	227.4444	63.7	28.5556	7047.4	37.3
R48 X R70	203.8889	59.3	28.6667	5533.9	7.9
R51 X R70	191.1111	62.3	28.1111	5131.1	0.0
R54 X R70	214.6667	62.3	28	5644.9	10.0
R55 X R70	187	63.7	28.5556	5026.9	-2.0
415A X CB33(SPH 1655)	207.7778	60.0	32.6667	5790.7	12.9
415A X CB29(SPH 1676)	194.7778	59.7	33.2222	4534.1	-11.6
151A X CB25(SPH 1678)	180.8889	63.3	29.3333	5110.2	-0.4
CSH 23	210.5556	60.7	28.8889	5131.0	0.0
Mean	211.8918	65.1	30.3246	5494.5	
C.V.	5.7719	2.7738	10.2952	21	
C.D. 5%	19.8974	2.936	5.0792	1860.0	

Expt 2: Identifying superior B lines for yield and grain quality: Thirty two B lines including 2 checks, 27 B and 296 B were grown in RCBD with two replications. Observations were recorded on plant height, panicle length, days to flower and grain yield. There was large variation among B lines evaluated for flowering (58 to 70 days) and plant height (125 to 180cm). Panicle length also varied from 22.3 to 32.8 cm. Two B lines, SBC 1174 (58 days) and SBC 1170 (59 days) were of early duration as compared to the check, 296B (67 days). Out of 32 B lines, 23 showed numerical superiority for grain yield as compared to the check, 296B (Table 8. Four MS lines, SBC 1170 (82.5 g/plant), BX 456 (84.5 g/plant), BX474 (80 g/plant) and SBC1184 (84 g/plant) were significantly superior to the check, 296B (57.5 g/plant).

Table 8. Performance of promising MS (B) lines

B line	Date of flowering	Plant height (cm)	Panicle length (cm)	Grain yield (g/plant)
SBC 1152	62.5	148.0	30.7	74.5
SBC 1154	64	143.8	26.8	72
BX 300	66.5	162.2	27.7	67
SBC 1166	63.5	151.3	27.5	71
SBC 1114	70	168.7	22.3	62
SBC 1174	58	168.3	26.2	64
BX 522	65	165.8	30.2	72
SBC 1172	63.5	155.3	25.5	71.5
SBC1170	59	158.3	25.0	82.5
BX452	70	163.7	28.0	71.5
BX456,	66	136.7	25.3	84.5
SBC1176	61.5	166.7	30.8	63.5
BX474	61.5	161.8	30.0	80
SBC1190	64.5	132.5	29.7	62
SBC1192	62	167.0	23.7	64.5
SBC1196	66.5	156.2	24.2	77
SBC1184	65	171.2	30.7	84.5
296 B- check	67	135.0	27.2	57.5
Mean	64.2419	153.8	27.5	64.6
CV %	2.3739	9.5	6.8	20.84
CD 5%	3.1146	29.8	3.8	18.2

Expt 3: Evaluation of grain sorghum restorers: 40 restorers were grown in RCBD with 3 replications. Observations were recorded on plant height, panicle length, days to flower and grain yield. Six restorers, CB 122, 124, 127, 129, 136 and 137 were found promising with grain yield more than 100g per plant, where as C 43 yielded 76.5g/pl. Nine restorers had panicle length more than 25 cms of which CB 111 recorded panicle length of 31.7 cm.

Table 9. Promising restorers

	Days to flower	Plant height (cm)	Panicle lt (cm)	Seed yield/pl (g)
CB 111	67	215.0	31.7	97.5
CB 112	68	151.7	23.0	83.0
CB 113	72	164.2	22.7	71.5
CB 114	75.5	201.7	29.5	67.5
CB115	69.5	183.3	25.7	81.5
CB 116	68	157.5	25.2	78.5
CB 117	69.5	175.0	20.0	45.0
CB 118	67	141.7	24.7	77.0
CB 119	73.5	155.3	24.2	68.0
CB 120	68	154.0	23.0	73.5
CB 121	72	176.7	28.7	86.0
CB 122	66.5	156.2	28.7	110.5
CB 123	66	176.2	24.5	96.0
CB 124	68.5	186.7	21.8	124.5
CB 126	66	190.8	21.0	87.5

	Days to flower	Plant height (cm)	Panicle lt (cm)	Seed yield/pl (g)
CB 127	70	185.0	23.0	112.0
CB 128	67.5	163.8	24.3	79.0
CB 129	72	170.8	22.0	102.0
CB 130	69.5	179.7	25.3	59.0
CB 131	64.5	147.5	22.3	82.0
CB 132	68.5	197.0	24.3	99.0
CB 133	66	217.5	30.0	99.0
CB 134	69	227.5	25.2	88.5
CB 135	67.5	214.2	27.0	99.5
CB 136	67.5	220.0	35.0	113.0
CB 137	66	203.7	25.3	115.0
CB 138	71	154.5	24.8	71.5
CB 139	67.5	187.5	22.0	76.5
CB 140	67	156.2	24.5	95.5
CB 141	70.5	174.2	26.0	88.5
CB 142	71	149.2	23.5	22.0
CB 143	66	202.5	22.2	72.5
CB 144	71	168.7	29.0	94.5
CB 145	67	165.0	28.0	67.5
CB 146	72.5	244.2	22.8	75.0
CB 147	69	185.8	21.2	84.0
CB-148	66.5	200.0	21.3	63.0
C 43	69.5	173.3	24.8	76.5
C 85	65.5	154.7	21.8	59.0
Mean	67.8	178.0	25.3	84.0
C.V.	11.7	17.39	33.10	24.99
S.E.	5.63	21.89	5.92	14.85
C.D. 5%	-	62.56	-	42.44
C.D. 1%	-	83.72	-	56.79

Expt 4: Evaluation of breeding nursery (1000 lines), advancing and making selections in segregating population (F₃-F₆): One thousand two hundred twenty breeding nursery lines (F₃-F₆) were grown one row each with 2 checks, checks being repeated in every bed. Agronomic performance was recorded on a scale of 1 to 5 where 1 is highly desirable and 5 least desirable. Superior selections (score 1-3) were advanced. Nine hundred and eighty lines having agronomic score of 1-3 were advanced to next generation. About 250 lines which were having height more than 130 cm were rejected. About 100 sweet sorghum derivatives which were having high brix (14-20) were advanced.

Expt 5: Advancing back crosses: Four hundred and sixty four A & B of male sterile and maintainer lines for grain sorghum were grown along with 2 checks. General agronomic performance was ascertained and superior lines were advanced. Out of 464 pairs, 100 pairs were not advanced as they scored 4-5 agronomic score. The best performing lines were BX96, BX122, BX156 with high agronomic score of 1. Fourteen MS lines were selected for using in crossing block for development of experimental hybrid trial.

Expt 6: Evaluation of grain sorghum hybrids: 76 hybrids based on 13 ms and 32 R lines along with 3 checks, two medium maturing (CSH 16 and Devgen) and one early maturing (CSH 23) checks, were grown in RCBD with 3 replications in two trials. Observations were recorded on plant height, panicle length, days to flower and grain yield. Four medium maturing hybrids recorded more than 10% improvement over both the checks for grain yield. The hybrid, 3216A x CB133 showed more than 20% improvement over the checks. Among the early hybrids, 8 hybrids showed more than 10% improvement over the early check, CSH 23. The hybrids, 3183A x CB 141 and 318A x CB 115 were the best early hybrids with about 20% improvement over CSH 23.

Table 10. Promising hybrids in the hybrid trial

	DF	Plant ht	Pan lt	GY (kg/ha)	% increase over CSH 16	% increase over Devgen	% increase over CSH 23
Medium maturing hybrids							
3183 A x CB124	61.3	198.6	25.7	6623.9	9.6	5.5	29.1
3183A x CB 133	61.0	231.7	24.0	7123.9	17.9	13.5	38.8
3183A x CB 134	60.7	257.2	30.8	6353.2	5.2	1.2	23.8
3216A x CB 131	64.0	185.4	26.3	6269.8	3.8	-0.1	22.2
3216A x CB 132	65.0	214.3	28.5	7068.2	17.0	12.6	37.8
3216A x CB 133	62.3	185.8	24.4	7734.8	28.0	23.2	50.7
1154A x C 43	63.0	194.4	31.4	6783.7	12.3	8.1	32.2
1158A x C 43	60.7	176.3	30.6	7408.6	22.6	18.0	44.4
447A x C 43	66.0	179.8	26.3	6255.9	3.6	-0.3	21.9
234 A x CB 136	64.0	224.4	30.4	6651.6	10.1	6.0	29.6
234 A x CB 142	68.7	201.3	24.2	6318.4	4.6	0.7	23.1
2299 A x CB 140	63.0	179.1	27.8	6367.1	5.4	1.4	24.1
3060A x CB 111	68.0	210.4	31.1	6221.3	3.0	-0.9	21.2
3060A x CB 122	67.7	189.0	31.7	6134.4	1.5	-2.3	19.6
Early hybrids							
3183A x CB 118	62.0	189.8	27.8	5443.5	-9.9	-13.3	6.1
3183A x CB 121	60.3	215.2	27.6	6071.9	0.5	-3.3	18.3

	DF	Plant ht	Pan It	GY (kg/ha)	% increase over CSH 16	% increase over Devgen	% increase over CSH 23
3183A x CB 123	58.7	207.2	26.7	5398.5	-10.6	-14.0	5.2
3183A x CB 141	62.0	221.3	28.3	6214.2	2.9	-1.0	21.1
318A x CB 115	61.7	196.7	28.7	6193.4	2.5	-1.3	20.7
318A x CB 137	62.3	213.3	25.0	6089.2	0.8	-3.0	18.7
1173A x C 43	61.3	160.8	25.7	5735.1	-5.1	-8.6	11.8
447A x C 43	63.0	161.2	27.6	5776.8	-4.4	-8.0	12.6
2299A x CB 147	58.0	209.4	30.7	5846.4	-3.2	-6.9	13.9
27A x CB 95	58.3	206.2	29.8	5714.3	-5.4	-9.0	11.4
CSH23	60.0	195.6	29.8	5131.1			
DEVGEN	67.0	216.9	31.3	6277.0			
CSH 16	64.7	205.1	30.3	6040.7			
Mean	63.2	194.6	27.9	5597.374			
CV	2.3	21.8	9.3	15.5521			
CD 5%	2.3	69.0	4.2	1415.022			
CD 1%	3.1	91.5	5.6	1876.665			

Expt 7. Semolina recovery studies among elite sorghum genotypes: An experiment was conducted to study the semolina recovery from a set of 48 elite genotypes. The experiment was conducted during 2010- 11 under randomized block design with three replications. From ANOVA, the variance due to genotypes for semolina recovery was observed to be highly significant indicating significant differences among the genotypes. The R² which explains extent of variation also revealed high variation among the genotypes studied. In general, high semolina recovery was observed in breeding nursery lines with a mean of 42.16, followed by restorer lines (40.11), varieties (38.73), germplasm lines (33.95) and the lowest recovery in maintainer lines with a mean of 32.16. Among the breeding nursery lines, the recovery ranged from 36.27 (Elite BN-5) to 47.83 (Elite BN-3) while, among the R lines the recovery ranged from 34.30 (Elite R-2) to 44.70 (Elite R-6). In varieties, the recovery ranged from 31.0 (SPV 462) to CSV 15 (44.30). In maintainer lines, the recovery ranged from 22.50 (Elite B-4) to 41.47 (Elite B-5). Maximum variation was observed among the germplasm lines, ranging from 20.43 (Elite GP-9) to 42.93 (Elite GP-6).

Collation, evaluation, documentation and utilization of sorghum genetic stocks (Sujay Rakshit, Sunil Gomashe, KN Ganapathy, VR Bhagwat & IK Das)

During kharif 2011 45 A-B pairs and 116 R lines were evaluated. Out of these 27 B lines and 31 R lines were promising. Some of promising B lines are: 7B, 11B2, 279B, AKMS 30B, AKMS 36B, 9B, 206B, RS 74B2, RS 97 B2, RS 127B2, RS 179B2, RS 301B2, RS 924B2, RS 1096B2, RS 1100B2, RS 1103B2, RS 1126B2, RS 1182B2, RS 1223B2, RS 1253B2, RS 1255B2, RS 2308B2, RS 2309B2, RS 2313B2, RS 2322B2, RS 2326B2 and RS 2329 B2. Promising R lines found in the study are: CB 10, RS 4001 to 4007, RS 29, RS 627, RS 629, RS 703, AKR 436, AKR 492, AKR 73, I-23, I-27, I-29, NRCSH 09, RS 29, RS 673, SP 55666-1, SP 55671-1, AKR 150, AKR 354, NR-11-R07 (CB 11), KR 191, KR 196, KR 199, C 43, FS 32, KR 192 x 25017, ICSB 324, SPV 1696, SPV 1333, SPV 1474, CB 95-1, E 12, IS 23521 and RS 772. The lines need to be evaluated further. Towards development of promising B and R lines 25 out of 47 B × B crosses and × R crosses have been selected and being advanced. Efforts are being made to develop early B lines and in that direction 45 crosses have been advanced from F₂ to F₃ generation. Towards grain mold tolerant line development from F₂ generation of three crosses, viz., 296B × RIL 98, GMN55 × RIL 98 and GMN 58 × RIL 13 selections have been made. Five out of 108 experimental hybrids found to be significantly superior to the checks, CSH 16 and CSH 23 (Table 11). Four out of the five hybrids are A2 cytoplasm-based. During the period seeds of 250 genetic stocks and germplasm lines have been multiplied and handed over to germplasm curator.

Table 11: Performance of superior experimental hybrids

Hybrids	Days to flowering	Plant yield (g)
27A × RS 4001	72	89.2
RS 74A2 × I-26	73	98.4
RS 127A2 × IS 15448	76	94.1
RS 301A2 × RS 4004	64	95.6
RS 2308-1A2 × IS 15448	74	93.2
CSH 23	57	73.6
CSH 16	62	80.3
CD 5% CI-CJ	3.3	5.79
CD 5% CI-VI	7.3	12.80

Twelve genetic stocks tested with susceptible check, DJ 6514 and resistant check, IS 18551. Six (viz., NRCSFR 06-1, NRCSFR 06-2, SPV 1870, SUENT 9, PGN 111 and PGN 39) found to be at par with the resistant check, IS 18551 (Table 12). Thirty three coloured lines and 11 advanced lines in F₅ generation were evaluated against grain mold. Five coloured lines (viz., IS20831, IS25104, 2219B, SPV1411 and EG-42) and two advanced generations from IS 18522 × M 35-1 and IS 24996 × IS 23585 found to be promising.

Table 12. Dead heart percentage among genetic stocks and checks 28 days after emergence

Genetic stock	DH% 28 DAE	Genetic stock	DH% 28 DAE
NRCSFR 06-1	32.7	PGN 111	34.4
NRCSFR 06-2	34.7	PGN 39	32.8
SFRIL 206	47.4	DJ 6514 (S)	76.2
SFRIL 342	52.8	IS 18551 (R)	29.4
SFRIL 374	48.0	Mean	42.0
SFRIL 47	48.4	C.V.	8.8
SFRIL 75	41.7	C.D. 5%	6.2
SPV 1870	36.0	C.D. 1%	8.4
SPV 1871	40.1		
SUENT 9	34.0		

Diversity analysis was performed among 82 sorghum genotypes comprising varieties, maintainers, restorers, and germplasm lines which represent the major component of the rainy (*kharif*) and post-rainy (*rabi*) breeding programme in India. These 82 genotypes also included few promising lines from international programmes. A set of 35 SSRs distributed throughout all linkage groups were selected from sorghum diversity kit and used for the study. All the 35 SSRs were polymorphic, generating a total of 198 alleles with an average of 5.71 per primer pair. The polymorphism information content (PIC) values ranged from 0.024 (Xisep 0310) to 0.859 (sb5-206) with an average of 0.49 indicating high discriminating ability of the SSRs used in the study. Cluster analysis revealed substantial diversity among the parental lines and elite genotypes as also evidenced from the Jaccard's genetic similarity values (Fig. 3). A very high estimate of fixation index ($F_{ST} = 0.35$, $P = 0.001$) were obtained when genotypes were structured as rainy and post-rainy, a much higher estimate ($F_{ST} = 0.40$, $P = 0.001$) were obtained when classified as varieties, maintainers, restorers and germplasm lines indicating strong distinction based on usage groups (Table 13). Pairwise F_{ST} values based on usage groups matched well with the results of the Nei's genetic distance. More importantly, we could distinguish parental lines of hybrids based on their fertility groups, especially lines from *kharif* sorghum using SSR markers. In contrast to the earlier studies, this is the first report wherein, we were able to classify the lines based on their fertility groups. Our results have significant implications for classifying the parental lines into heterotic groups for its use in Heterosis breeding. Apart from that, the divergent parental pairs identified based on Jaccard's similarity coefficients could be effective to be used as candidates for hybrid development.

Table 13: Pairwise F_{ST} estimates (above diagonal) and Nei's genetic distance (below diagonal) among *Kharif* and *Rabi* genotypes

Type	<i>Kharif</i> -germplasm	<i>Kharif</i> -maintainer	<i>Kharif</i> -restorer	<i>Kharif</i> -variety	<i>Rabi</i> -maintainer	<i>Rabi</i> -restorer	<i>Rabi</i> -variety
<i>Kharif</i> -germplasm		0.068	0.088*	0.140*	0.388*	0.418*	0.382*
<i>Kharif</i> -maintainer	0.210		0.128*	0.104*	0.297*	0.336*	0.313*
<i>Kharif</i> -restorer	0.269	0.164		0.274	0.537*	0.524*	0.506*
<i>Kharif</i> -variety	0.251	0.170	0.139		0.297*	0.345*	0.319*
<i>Rabi</i> -maintainer	0.356	0.356	0.553	0.433		0.022	0.051
<i>Rabi</i> -restorer	0.318	0.301	0.456	0.366	0.097		0.007
<i>Rabi</i> -variety	0.330	0.313	0.441	0.367	0.124	0.056	

* $P < 0.05$

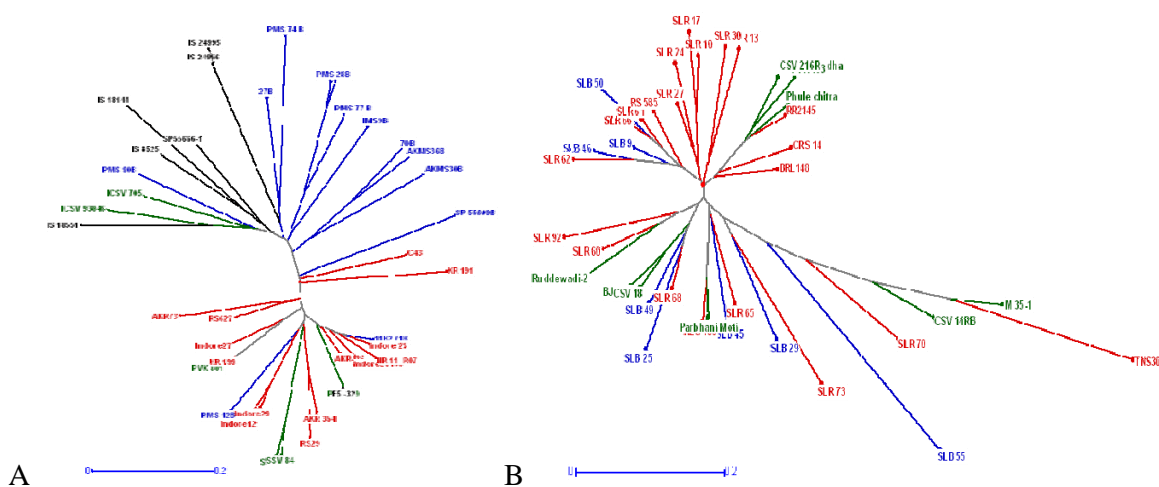


Fig. 3. Unrooted neighbor joining tree showing genetic relationship among *kharif* (A) and *rabi* (B) genotypes

Development of rabi parental lines and varieties with rabi adaptability (Prabhakar, HS Talwar, VR Bhagwat, Gadewar & MY Samdur)

Varietal improvement

a) **Identification of Rabi sorghum variety SPV-1829 for All India release for cultivation under shallow soils:** The variety SPV-1829 was identified in the 41st Annual Group Meeting of Sorghum project for All India release by Varietal identification Committee for cultivation under shallow soils of rabi growing regions of Maharashtra and Karnataka. The performance of the variety SPV-1829 at All India level under shallow soils from Rabi 2007-08 to 2010-11 are as follows.

i) **Yield superiority:** At National level, the variety SPV-1829 exhibited superiority over the checks Mauli and M35-1 for grain and fodder yields under shallow soils from Rabi 2007-08 to 2010-11.

- In grain yield, the variety SPV-1829 (1209 kg/ha) was superior to checks Mauli and M35-1 by 22.50% and 27.35%, respectively.
- For fodder yield, it (4244 kg/ha) gave 12.87% and 31.23% more yield than the checks Mauli and M35-1, respectively.

Summary grain yield data of SPV-1829 in AICSIP Trials (Rabi 2007-08 to 2010-11)

Trait	Year of Testing	No. of Trials	Proposed Variety SPV-1829	Check Var. 1 Mauli	Check Var. 2 M35-1	Qual. Var. 1 SPV-1830	Qual. Var. 2 SPV-1831	CD at 5%	C.V (%)
Mean Grain yield (kg/ha)	1st Year 2007-08 - IVHT	3	739	628	853	712	793	232	18.39
	2nd Year 2008-09-AVHT	4	1209	846	756	1118	1020	259.8	15.8
	3rd Year 2009-10-AVHT	4	1024	982	848	1003	1012	--	23.94
	4th Year 2010-11-AVHT	6	953	714	792	1019	857	--	27.3
	Weighted Mean	17	1029	840	808	1012	952		
Percentage increase or decrease over the checks and qualifying varieties	1st Year 2007-08 - IVHT	--	--	+ 17.6	- 13.3	+ 3.79	- 6.8		
	2nd Year 2008-09-AVHT	--	--	+ 42.9	+ 59.9	+ 8.1	+ 18.5		
	3rd Year 2009-10-AVHT	--	--	+ 4.28	+ 20.75	+ 2.09	+ 1.18		
	4th Year 2010-11-AVHT			+ 33.4	+ 20.3	- 6.4	+ 11.2		
	Mean	--	--	22.50	27.35	1.67	8.08		

Summary fodder yield data of SPV-1829 in AICSIP Trials (Rabi 2007-08 to 2010-11)

Trait	Year of Testing	No. of Trials	Proposed Variety SPV-1829	Check Var. 1 Mauli	Check Var. 2 M35-1	Qual. Var. 1 SPV-1830	Qual. Var. 2 SPV-1831	CD at 5%	C.V (%)
Mean fodder yield (kg/ha)	1st Year 2007-08 - IVHT	3	1844	1562	1779	1817	1809	520	14.5
	2nd Year 2008-09-AVHT	4	3455	3526	3069	3501	3457	NS	13.9
	3rd Year 2009-10-AVHT	4	3740	3355	3087	3500	3956	--	19.42
	4th Year 2010-11-AVHT	6	5905	4920	3927	5215	5536		22.2
	Weighted Mean	17	4244	3760	3234	3933	4155		
Percentage increase or decrease over the checks and qualifying varieties	1st Year 2007-08 - IVHT	--	--	+ 18.05	+ 3.65	+ 1.48	+ 1.93		
	2nd Year 2008-09-AVHT	--	--	- 2.01	+ 12.57	- 1.31	0.00		
	3rd Year 2009-10-AVHT	--	--	+ 11.47	+ 21.15	+ 6.85	- 5.46		
	4th Year 2010-11-AVHT			+ 20.00	+ 50.36	+ 13.23	+ 6.66		
	Mean	--	--	12.87	31.23	7.90	2.14		

ii) **Superior performance in States:** At States level, the variety SPV-1829 showed superiority over the checks Mauli and M35-1 for grain and fodder yields in both Maharashtra and Karnataka under shallow soils from Rabi 2007-08 to 2010-11.

- Grain yield: SPV-1829 producing 983 kg/ha and 1003 kg/ha grain yield in Maharashtra and Karnataka, was superior by 23.64% and 13.07% to check Mauli. Similarly, it performed better than the check M35-1 by 25.54% and 8.19% in Maharashtra and Karnataka, respectively.
- Fodder yield: SPV-1829 was superior (3734 kg/ha and 4468 kg/ha) in Maharashtra and Karnataka to check Mauli, by 18.99% and 6.08%, respectively. It was superior to check M35-1 by 18.57% and 55.51% in Maharashtra and Karnataka, respectively.

iii) **Physiologically more efficient:** At National level, the variety SPV-1829 showed distinct superiority for grain and fodder yields and physiological parameters in both shallow and medium soils. Besides, the SPV-1829 was on par with the checks for leaf area index (LAI) %, chlorophyll stability index (CSI) % at flowering, RWC at 50% flowering and 100 grain weight (g) in both shallow and medium soils.

iv) **Resistance to insect-pests and diseases:** The variety SPV-1829 was on par with checks Mauli and M35-1 for reactions to insect-pests/diseases. For diseases, it was tolerant to charcoal rot (31.5%), mean length of spread of charcoal rot (18.9 cm), rust (4.2%) and downy mildew (13.5%). And for insects-pests, it was tolerant to shoot fly (dead heart at 28 DAE - 38.0%), stem borer damage at 45 DAE (10.4%), shoot bug damage (14.6%) and sugarcane aphid (4.1).

v) **Nutritional and roti quality:** The variety SPV-1829 was tested for nutritional and *Roti* quality parameters in 2008-09 and 2009-10 at MPKV, Rahuri. For nutritional characters, SPV-1829 was superior to M35-1 for total sugars (1.84%), starch (64.67%) and free amino acids (8260mg/100g) and was on par with checks Mauli and M35-1 for other nutritional characters. SPV-1829 had better texture and flavor than M35-1 but was on par with checks for organoleptic parameters (color, taste and overall acceptability), kneading quality, spreading quality and rank by DMRT.

vi) **Fodder quality analysis:** The fodder quality of the variety SPV-1829 was superior to the checks Mauli and M35-1 for nitrogen content, crude protein and IVDMD. The variety SPV-1829 had higher nitrogen content (0.96 %), crude protein (6%) and was more digestible (IVDMD 53.46%) compared to Mauli (0.80%- N, crude protein- 5.0% and 51.14%-IVDMD) and M35-1 (0.87%- N, crude protein-5.4% and 50.91%- IVDMD).

b) **Performance of hybrids and varieties contributed from Solapur in AICSIP trials of Rabi 2011-12:** The performance of 4 varieties and 5 hybrids contributed from CRS, Solapur (Shallow soil: CRS-31, 32, Deep soil: CRS-29, 30, 33, 34 in IVHT and SPH-1663, 1689 and 1690 in AVHT) are to be received from AICSIP Rabi centres and it will be updated once it appears in PC Report.

c) **Evaluation of improved breeding lines in shallow-medium and deep soils** separately, indicated that 28 promising varieties (10 in shallow-medium and 18 in deep soil) were significantly superior to checks M35-1/Mauli and CSV-22 for grain and fodder yields and grain quality with resistance to insect-pests and diseases.

Selected varieties for shallow soils were SLV-15, 34, 40, 43, 60, 80, 91, 97, 101 and 135 and for deep soil, the varieties were SLV-15, 34, 40, 43, 50, 60, 81, 97, 98, 105, 118, 125 and 130.

2. **Development of new male sterile lines using exotic and indigenous lines and diversification of rabi material:** Conversion programme was continued for 110 pairs in various backcross generations (indigenous and exotic) and out of them, a total of 60 pairs were selected and characterized for 23 traits. The main characters considered for selection were grain color, quality, size, luster and sterility/fertility reactions.

Backcross generations	No. of pairs	Sterile/Fertile	Selected pairs
BC 5 (A/B)	13 pairs	Fully sterile	6
BC 4 (A/B)	8 pairs	Fully sterile	3
BC 3 (A/B)	5 pairs	Fully sterile	3
BC 2 (A/B)	16 pairs	Fully sterile	10
BC 1 (A/B)	21 pairs	Fully sterile	12
BC 4 (A/B) Best St/F	18 pairs	Sterile/fertile	9
BC 6 (A/B)	17 pairs	Fully sterile	10
BC 7 (A/B)	12 pairs	Fully sterile	7
Total	110		60

3: **B line improvement:** B line improvement for diversifying genetic base led to selection of 16 B lines out of 82 lines with rabi traits. Ten test hybrids, superior to CSH-15R for grain and fodder yields were selected. Selected B lines were SLB-9, 10, 12, 19, 22, 27, 45, 46, 56, 59, 60, 73, 82, 96, 101 and 104.

4. **R line improvement:** R line improvement for diversifying genetic base led to selection of 21 R lines out of 63 lines with rabi traits. Selected R lines were SLR-10, 13, 17, 24, 30, 31, 47, 57, 60, 67, 70, 72, 75, 87, 89, 90, 91, 97, 130, 136 and 143.

5: Evaluation of Experimental Hybrids (EHT)

a) *Evaluation of newly developed experimental hybrids under team efforts:* A total of 40 newly developed experimental hybrids were evaluated in 2 trials at 3 locations (Solapur, Bijapur and Rahuri). The results are to be received from AICSIP Rabi centres and it will be updated once it appears in PC Report. Promising hybrids in station trial were 104 A x SLR-31, 104 A x SLR-57, 104 A x SLR-70, 104 A x SLR-126, 104 A x SLR-67, 104 A x SLR-72, 104 A x SLR-75, SL-19A x SLR-57, SLA-56 x SLR-72 and SLA-45 x SLR-57. Six hybrids tested in deep soil at Dharwad indicated that the hybrids SPH-1663, CRS-29 and CRS-30 gave 13.5%, 2.5% and 5.3% more grain yield, respectively, than the check CSH-15R.

6. **Evaluation of breeding materials in breeding nursery:** Evaluation of 616 breeding materials in breeding nursery was carried out for desirable rabi traits and out of them, a total of 304 entries were selected.

Segregating generations	No. of entries	Selected entries
F4 Advancement of generation	12 entries	6
F3 Advancement of generation	18 entries	7
F2 (R X R)	32 entries	16
F2 (V X V)	21 entries	6
F2s evaluation	22 crosses	9
F2 (B X B)	154 entries	27
Breeding nursery	23 entries	12
F4 Advancement of generation	12 entries	5
F3 Advancement of generation	18 entries	8
Total	312	96

7. **Identification of donors for insect-pests and diseases:** The improved breeding lines were screened for insect-pests and diseases at multi-locations under AICSIP. The results are to be received from AICSIP Rabi centres and it will be updated once it appears in PC Report.

8: **Nucleus and breeder seed production of parental lines of CSH-15R:** Nucleus and Breeder seed production of parental lines (104A, 104B and RS-585) of rabi hybrid CSH-15R have been produced and the targets are met. There was proper synchronization of flowering and perfect seed setting in plots of A/B and A/R lines. The quantities of seed of 104A, 104B, RS-585 and the hybrid were 100 kg, 120 kg, 150 kg and 160 kg, respectively. Under mega seed project, seed multiplication of rabi cultivars namely M35-1, Phule Revati, Phule Vasudha, Phule Anuradha, RS-585 and SPV-1829 have been made in farmers fields. About 160kg of hybrid seed of Rabi hybrid CSH-15R has been produced at the centre.

IV. Achievements in sorghum breeding at AICSIP centers

1. Akola

Research theme – Development of genotypes of different crops Resistant/tolerant to various Pest/disease.

Under grain mold resistance breeding, following material under new male sterile line development programme is listed below.

Table 1: List of material in different BC generations

Sr. No.	BC generations	No of pairs
1	BC I	6
2	BC II	9
3	BC III	15
4	BC IV	13
5	BC V	11
6	BC VI	19
Total		73

Table 2: Development of male sterile lines

Generation	Crosses	Progenies planted	No. of selections made
F ₆ (B x B)	(ms 296B x B 58586)	1	1
Total		1	1

Table 3: Development of male sterile lines

Following B X R crosses advanced under the programme

Generation	Crosses	Progenies planted	No. of selections made
F ₆ (B X R)	1 SVD 9601 x 70 B	3	1
	2 GM 9219 x IMS 9 B	5	2
	3 IMS 9 B x GMPR 65	3	1
	4 IMS 9 B x IS 14384	1	-
	5 Ms 296 B x GMPR 65	2	1
	6 Ms 27 B x IS 14384	2	2
	7 70 B x GMPR 65	1	-
	8 SVD 9601 x 296 B	7	4
	9 GM 9219 x 70 B	3	2
	10 IS 14332 x 27 B	2	1
	11 IS 14332 x 296 B	1	-
Total		30	14

2: **Development of Restorer lines:** In grain mould resistance breeding restorer development programme is going on and following material have been advance to succeeding generation.

Table 4: Development of Restorer lines

Generation	Crosses		Progenies planted	No. of selections made
F ₆ (R x R)	1	SVD 9601 x GM 9219	1	-
	2	SVD 9601 x GMPR 65	8	3
	3	AKR 422 x ICSR 89058	1	-
	4	STR 293 x AKR 436	8	5
	5	STR 293 x ICSR 89058	5	2
	6	RS 673 x ICSR 89058	1	-
	7	AKR 426.2 x AKR 436	4	2
	8	AKR 436 x RS 673	8	7
	9	STR 293 x AKR 426-2	14	9
	10	STR 293 x RS 673	5	2
	11	ICSR 89058 x RS 673	9	4
	12	AKR 426-2 x ICSR 89058	7	3
Total			71	37

Development of genotypes Resistant/tolerant to various pests/ diseases

1) *Development of male sterile lines* : In shootfly resistance breeding programme, following material under new male sterile development programme have been advanced.

Table 5: List of material in different BC generations

Sr. No.	BC generations	No of pairs
1	BC I	4
2	BC II	10
3	BC III	8
4	BC IV	10
5	BC V	11
6	BC VI	16
Total		59

2) *Development of Restorer lines*: In shootfly resistance breeding programme development of new restorer lines have been advanced for succeeding generation.

Table 6: Development of Restorer line

Generation	Crosses	Progenies planted	No. of selections made
F ₁₀ (R x R)	Kharif/local x SPV-1404	1	1
	PVK-801 x AKR-150	1	1
	(AKR-73 x B-58581) x SPV-881	2	1
	Total	4	3
F ₈ (R x R)	SPV 669 x IS 2205	1	-
	SPV 669 x SPV 504	1	1
	Total	2	1

Development of genotypes of different crops for special traits (quality & quantity): Development of new male sterile lines- In kharif grain breeding programme, the list of material under new ms line development programme is as below.

Table 7: List of material in different BC generations

Sr. No.	BC generations	No of pairs
1	BC I	10
2	BC II	12
3	BC III	10
4	BC IV	15
5	BC V	13
6	BC VI	21
7	BC VII	33
Total		114

Table 8: Development of new Male sterile lines

Generation	Crosses	No. of selections made
F ₃ (B x B)	296 B x 70 B	8
	14 B x 70 B	12
	27 B x 9 B	7
	Total	27

Table 9: Development of new Male sterile lines

Generation	Crosses	Progenies planted	No. of selections made
F ₆ (B x B)	Akms-14 B x ms 27 B	3	1
	Akms-14 B x ms 70 B	11	6
	Akms-14 B x lms 9 B	1	-
	70 B x ms 27 B	4	1
	ms 2219 B x 70 B	1	-
	ms 2219 B x Akms 30 B	7	3
	Akms 30 B x 70 B	18	8
	Total	45	19

Table 10: Development of new Male sterile lines

Generation	Crosses	Progenies planted	No. of elections made
F ₇ (B x B)	(SPA 3B x Akms 69B)	33	10
	(ms 2219B x Akms 42B)	6	3
	(Akms 28B x Akms 69B)	15	5
Total		54	18

Table 11: Development of new Male sterile lines

Generation	Crosses	Progenies planted	No. of selections made
F ₆ (B x R)	RS673 x AKMS 42 B	5	2
	AKR 426 - 2 x 70 B	17	7
	AKR 426-2 x 30B	17	5
	RS 673 x 30 B	6	2
	AKR 436 x 42 B	1	-
	AKMS 14 B x RS 673	4	2
	2219 B x STR 293	4	1
	AKR 426-2 x 42B	4	2
	2219 B x AKR 426-2	3	1
	AKR 422 x 70 B	6	4
Total		67	26

Restorer development: Restorer development programme for development of potential hybrid alongwith good grain quality is the objective of programme and following material is listed in the programme during Kharif 2011-12.

Table 12: Restorer development

Generation	Crosses	Progenies planted	No. of selections made
F ₆ (R x R)	AKR 426-2 x ICSR 89058	1	1
Total		1	1

Table 13: Restorer development

Generation	Crosses	No. of selections made
F ₃ (R x R)	SPV- 1616 x ICSR 43911 - 3	1
	CSV - 17 x AKR 456	5
	SPV - 1616 x ICSR 43407	1
	ART- 1023 x ICSR 43911-3	12
	ART- 1019 x ICSR 43689	9
	AKR 150 x ICSR 89058	4
Total		32

Breeding material from project (Group efforts on sharing of breeding material): Under group efforts at project level, it was decided to share the breeding material in early stages. Accordingly, the following grain mold resistance / tolerance breeding materials in early stage (breeding material) were received by this centre from NRCS, Hyderabad. Similarly, the material also includes the crosses for higher yield and better grain quality.

Table 14: Breeding material from group efforts on sharing of breeding material

Sr. No.	Crosses	No. of Progenies Planted	No. of selections made	Remarks
YIELD: F8-F9				
1.	(GMPR 13 x SR 2458)	2	1	Selections were made on the basis of yield and yield contributing traits i.e. more no. of primaries, secondaries, head length, bold and desirable grains
2.	(KR 199 x PVK 809)	2	1	
DROUGHT: F7 -F8				
4.	(SPV 772 x S 35)	6	1	Selections were made for earliness and stay green traits.
5.	(SPV 772 x ICSV 272)	4	2	
GRAIN MOLD: F8 -F9				
6.	(I 12 x PMS 28)	1	-	Selections were made on the basis of threshed grain mould rating (TGMR) score, visual assessment and grain hardness
7.	(RS 29 x IS 25017)	11	4	
8.	(296B x SRT 18)	5	7	
GRAIN MOLD: F8 -F9				
1.	(I 12 x IS 25017)	11	10	Selections were made on the basis of threshed grain mould rating (TGMR) score, visual assessment and grain hardness
2.	(27B x IS 25017)	1	2	
3.	(9B x B 58586)	1	-	
4.	(MR 836 x B 58586)	2	3	
5.	(SRT 18 x MR 836)	1	-	
6.	(Akms 14B x MR 836)	1	-	
7.	(SRT 18 x Akms 14B)	2	1	
8.	(C 43 x B 58586)	1	1	
GRAIN MOLD: F5-F6				
1	IS 73210 x SPV 1428 x E 112	8	3	

Rabi Sorghum Breeding

Development of male sterile lines: In this programme 23 pairs in BC II, 30 pairs in BC III, 20 pairs in BC IV, 35 pairs in BC V & 19 pairs in BC VI generation have been harvested for further testing. Following material under new male sterile development programme is advanced during Rabi 2011-12

Table 1: Rabi breeding material planted during rabi 2011 (B x B Programme)

Sr. No.	Generation	Crosses	No. of progenies planted	No. of selections made
1	F ₁₀ (B x B)	1) (296B x 104B) x (117B x 23B)	5	2
		2) [(296B x 104B) x (104 B x 23B)] x (422B x 296B)	1	-
		Total	6	2

Table : 2 Development of male sterile lines

Sr No.	Generation	Crosses	No. of progenies planted	No. of selections made
1.	F ₆ (B x B)	(104B x 422B x 296B x 104B) X (422B x 296B) 9.1	4	1
2.		(Akms 68.1B x 104B x 23B) X (422B x 296B) 10.3	2	-
3.		(Akms 68.1B x 422B x 296B) X (104B x 296B x 23B)	5	3
4.		(Akms 14.9B x 104B)	1	-
5.		(Akms 45B x 296B x 1409B)	1	1
6.		(Akms 45.1B x AKRms 46.2B)	1	-
7.		(Akms 69B x AKRms 75B)	3	2
8.		(Akms 69B x AKRms 66B)	2	1
	Total		19	8

Table : 3 Development of male sterile lines

Sr No.	Generation	Crosses	No. of progenies planted	No. of selections made
1.	F ₁₀ (BXR)	ms 104B x CSV-216R	2	1
2.		ms 104B x AKENT 8-2	1	-
3.		(104B x 23B) x (SPV504 x STR-263 x Raichur x AKR-150)	4	2
4.		AKENT 8-3 x ms 104B	6	2
	Total		13	5

Development of restorer lines: Under this programme new restorer lines have been developed for use in hybrid seed production programme is listed below.

Table 4 : Rabi breeding material planted during rabi 2011

Generation	Crosses	No. of progenies planted	No. of selections made
F ₁₀ (R x R)	1) (Rb-275 x 105R) x (SPV-1201 x Ringani) x (IS-18551 x ICSR-89022)	8	3
	2) (AKENT8-3 x SPV-504 10KR) x (SPV-1201 x Ringani)	4	1
	3) (SPV-1380 x RS-647)	5	2
	Total	17	6

Table 5 : Rabi breeding material planted during rabi 2011

Generation	Crosses	No. of progenies planted	No. of selections made
F ₉ (R x R)	1) (AKRb 354 x CSV 216R)	3	1
	2) (48365 A3R x SPV 1457) x (SPV 1201 x Ringani)	10	5
	3) (AKSV 13R x SPV 1404) x ICSR 3607	2	1
	4) (AKSV 13R x RS 673)	4	2
	Total	19	9

Table 6 : Rabi breeding material planted during rabi 2011

Generation	Crosses	No. of progenies planted	No. of selections made
F ₉ (R x R)	1) (AKSV 13R x SPV 1404 x SPV-9601)	2	1
	2) (AKRb 354 x CSV-216R)	1	-
	3) (SPV-1380 x Ringani)	7	4
	Total	10	5

Table 7 : Rabi breeding material planted during rabi 2011

Generation	Crosses	No. of progenies planted	No. of selections made
F ₈ (R x R)	1) AKR-354 x CS-3541	1	-
	Total	1	-

Table 8 : Rabi breeding material planted during rabi 2011.

Generation	Crosses	No. of progenies planted	No. of selections made
F ₇ (R x R)	1) SPV-1380 x Ringani x M35-1	4	1
	2) SPV-1595 x M35-1	7	2
	3) SPV-504 x AKR-354	12	4
	4) SPV-504 x Raichur	7	2
	Total	30	9

Table 9 : Rabi breeding material planted during Rabi 2011.

Generation	Crosses	No. of progenies planted	No. of selections made
F ₅ (R x R)	1) SPV-504 x SPV-1595	2	1
	2) P. moti x Sind-23	2	1
	3) P. moti x AKSV-13 R	1	1
	Total	5	3

Table 10 : Rabi breeding material planted during Rabi 2011.

Generation	Crosses	No. of selections made
F ₃	P. Moti x SPV 504	4
	P. Moti x CSV 216 R	7
	P. Moti x AKSV- 13 R	11
	CSV- 18 R x M 35-1	8
	M35-1 x CSV – 18 R	9
	CSV – 216 R x CSV – 18 R	4
	SPV- 504 x Raichour	2
	SPV- 504 x P. Moti	5
	Total	50

Rabi Breeding material planted at Ekarjuna : Following material planted at Ekarjuna during rabi 2011 & promising selection have been made.

Table 11 : Rabi breeding material planted at Ekarjuna during Rabi 2011.

Sr. No.	Generation	Crosses	No. of progenies planted	No. of selections made
1.	F ₅ (B x B)	1409 x 104 B	5	2
		104 B 23 B	1	-
	F ₆ (B x B)	69 B x 75 B	4	1
		14.09 B x 104 B	3	1
		(68.1B x 422 B x 296B) (104 B x 296B x 23 B)	2	1
		(68.1 B x 104 B x 23 B) ((422 B x 27 B) - 5	1	-
		(68.1 B 422 B x 296 B) (296 B x 104 B x 296 B) (23 B x 422 B x 296 B)	1	1
2	F ₃ (R x R)	M 35-1 x CSV – 216 R	5	2
		CSV – 216 R x CSV – 218 R	5	3
		P. Moti x CSV – 216 R)	1	-
	F ₅ (R x R)	(P. Moti x Sind- 23)	5	2
		(P.Mothi x AKR 301-1)	1	-
		(RS 585 x AKENT 8.3 x APV 504 x SPV 1201 x Ringni)	1	1
		(SPV 839 x Sind 23)	5	2
		(SPV 504 x SPV 1595)	3	1
	F ₇ (R x R)	(P. Moti x AKSV 13 R)	1	-
		(SPV 1595 x M 35-1)	3	-
		(SPV 1380 x Ringni x M 35-1)	2	1
		(SPV 504 x Richur)	1	-

2. Indore

Major Achievements (3-4 bullets):

- Four entries contributed in coordinated trials (one in AHT, 3 in IVT)
- Evaluation of kharif germplasm 121 for DUS, 56 for high grain yield and 50 Gird for DUS .

State/station trials conducted and highlights in 2-3 bullets/ each trial - *Breeding : station Trials*

1	SVT I 20 entries	1. (Rs 673x 93001) 845-1-1(6172kg/ha) 2. CSV1862(6018kg/ha) 3. (422B X 348B) 84-1-2(6018kg/ha) 4. (I-12 X 73210X1428XE112)30-4-5-2(5941kg/ha) 5. (I-12X ICSSR 165) 774-1-2(5758(kg/ha)
	SVT II 20 entries	1. SPV1041(4321kg/ha) 2. CSH-18(4321 kg/ha) 3. (199X809)4-2-2-1-3-7 (4166.7 kg/ha) 4. (MR 31x ICSR 143)842-1(4089.5kg/ha) 5. (GMRP-84X I-12)(I-0113)(4089.5kg/ha 6. SPV1862(4089.5kg/ha)
	SHT I 64 Exp. hybrids	1. 296A X I-29(107g) 2. IMS9A X 20-1-1-2-1(102g) 3. IMS9AX 3-1-3-4(97g) 4. IMS9AX I-27(96g) 5. 296A X 2-2-3-1-3(97g)

Seed Production achievements - Breeder Seed Production at AICSIP Indore

Variety	Year of production	Seed production (q)	Lifting (q)	Balance (q)
IMS 9A	2010 kh	2.15	0.15	2.0
IMS 9B	2010 kh	1.58	0.08	1.50
I-12	2010 kh	3.00	0.07	2.93
JJ 938	2010 kh	3.70	1.05	2.65
JJ 1041	2010 kh	3.00	not lifted	3.00

Seed Production Position during 2011 Kharif

Varieties	Nucleus seed production	Breeder seed production	Certified seed production
JJ 1041	3 kg	JJ 1041 was allotted Sehore centre by DRS, RVSKVV, Gwalior	-
JJ 938	3 kg	1.0 q	-
IMS9A	3 kg	(Seed production fail due to heavy rains	-
IMS9B	2 kg	(Seed production fail due to heavy rains	-
I-12	2 kg	0.30	-
MP chari		Not sown (Nu seed was not available	

Germplasm evaluation - Germplasm maintained, evaluated, distributed (to whom) and registered

Genetic Resources Experiments	Objective	No. of germplasm evaluated
Experiment I	Evaluation of Kharif landraces	121
Experiment II	Evaluation of higher grain yield kharif germplasm	56
Experiment III	Maintenance and evaluation of gird regions germplasm for DUS	50

Experiment-I

	range	promising
Grain Yield /plant(g)	10-85	E 109 (85g), GGUB 27 (60g), GGUB 48 (70 g)
1000 Grain weight (g)	15-45	40 g and above:- GGUB 25, GGUB 59, E 246, E 249, GGUB 40, GGUB 23, GGUB 32, GGUB 40, GGUB 43, GGUB 61, GGUB 62, GGUB 64. E 109, E 186, E 203, E 210, E 213
Days to flowering	55-108	Early(55 to 66 days) :- E.JN 11, E 158, E 159, E 161, GGUB 27, GGUB 39, E 161
Plant height	(120-382cm)	dwarf:- E 161 (120cm), EA 11(142cm)

Experiment -II

	range	promising
Grain Yield /plant(g)	18-143g	IS 26871(143), IS 25071(138), IS 2834(133),IS 27875 (126),IS 26866(110),E 236(108)
1000 Grain weight (g)	15-38	IS 9664 (35),IS 25071(33.5),IS 26866(31),E 213(31),VKG 34/35 (31)
Days to flowering	62-106 days	IS 3073 (63),Raj 36 (66),IS 8330 (68) E 171 (69)
Plant height	132-438 cm	IS 13437(132),IS 25097(150),IS 13479(167),RAJ 35 (191) IS 8330(191), Raj 36(203
Cob length cm	6-42 cm	IS 1433(42),IS 27874(38),VKG 34/49(37), ELG 19(36.3)

Gird Region Germplasm:-

	range	promising
Grain Yield /plant(g)	17-105g	Gird-7(105g), Gird-24(105), Gird 48(95), Gird-2(95), Gird 3(95)
1000 Grain weight (g)	10-47.5g	Gird 8(47.5), Gird 35(46.5), Gird 2(41), Gird 3(40)
Days to flowering	68-101 days	Gird 21(68), Gird 22(71), Gird 27 (71), Gird 24 (73)
Plant height	191-425cm	Gird 22(191), Gird 33(236), Gird 25(241), Gird 23(242, Gird 9(253) gird 13(256)
Cob length cm	11-39	Gird 1(39), Gird 3(30) gird 48 (30), Gird 43 (30)

Experimental hybrids :22 experimental hybrids made with CMS lines provided by DSR and Indore bred restorers
Advanced generations maintained and lines selected

Segregating population	selection planted	selection made
F1	3	
f3	17	19
f3(Indore)	17	19
F3 germplasm (F2 from DSR)	60	38
F3 (F2 from DSR)	28	31
F4 (F2 from DSR)	5	11
F5	27	38

Number of MS, R and Varieties in pipe line - Restorers- Seven

Any new experiment conceptualized, if so give details

- Improvement of existing MS line for plant height and day to flowering :-
- CSH 18 was released during 1999 using IMS9A and I-12. IMS 9A & B were developed during 1985-1993 by crossing M 9B x Vidisha 60-1 . V 60-1 is improved local cultivar with plant height more than 300 cm . In 13 years IMS9A and B became taller and deterioration in uniformity Hence an experiment was initiated to improve IMS 9A and B for height and Flowering
- Twenty five individual plants of IMS9A were selected with plant height 185-195cm. and maintained with IMS9B having approximately same in height and slightly lesser than IMS9A . Resultant 35 paired rows were grown this year and BC1 was given.

No. of entries contributed to AICSIP and state trials

- SPH 1653 tested in AHT
- Three entries tested in IVT
 - 0111= (I-12x 809) 2-2-1-3-2
 - I-0112= IS 73210x SPV 1428) 3-3-1-3-6
 - 0113=GMRP84x I-12) 3-1-1-2-6-3
- Three hybrids tested in Hybrid Nursery trial
 - IH-0115= 296Ax I-29
 - IH- 0116= 24-6-6-5-3-Ax I-27
 - IH- 13-1-3-6-3-Ax I-12

v). Development and Evaluation of Restorers

- Restorers(Indore):- Twenty restorers developed at Indore and 13 restorers from ICRISAT were evaluated with established national restores viz:I-12, RS673 and C43. Among these twenty,I-28, I-26, I-27, I-29, I-16, 20-1-1-2-1, 2-2-3-1-3, ICSR 25001, ICSR 93001 found good for grain yield.
- ICRISAT elite lines:- One hundred forty one elite lines supplied from ICRISAT were evaluated for agronomical traits namely plant height, days to 50% flowering and grain yield /plant. All lines are medium to late in maturity. The grain of PRT 30147 very bold and round. Some lines found good for grain yield with be evaluated during 2012 kh for their combining ability.

vi). MS development and evaluation and maintenance

MS Maintenance:- IMS9A, AKMS22A, 27A, 296A, 13-1-3-6-3-1A, 24-6-6-5-3A, 13-1-4-6-1-4A, 6-1-1-1-3-1-3A

New ICRISAT MS lines: 46 MS lines supplied during 2010-11 were grown and evaluated for days to 50% flowering and % sterility. Fourteen MS lines found 100 % sterile were maintained for future evaluation.

MS developmental Programme:-

New MS Programme: 61 pairs were grown and BC2 was given

Old MS programme: 26 Pairs were grown and BC4 was given

Details of Segregating population:

Segregating Population	Crosses	Selection sown	Selection made	Remark
F1				
1	(1439x SPV 65) X (CSV 20X E253)			ca
2	AKMS 22Bx IMS 9B			ms
3	I-12X (CSV 23x E 219)			r/v
F3		17	19	
1	SPV 1439x I-6)	3	5	R
2	SPV 1439 x SPV 65)	1	2	R
3	I-12x RSV 20	4	1	R/value addition
4	SPV 1439x SPV 1358)	4	6	R/V
5	I-12x RSV 9	1	1	R/value addition
6	I-12x EP 60	2	1	R/SB
7	I-12x EP 57	2	3	SB
F3		28	31	
1	622=(C43x RS 585)	2	2	ca
2	1169=(475B x 449bB)	1	1	
3	1087=(CB 26x CB 11)	2	2	
4	619=(C43x CSV 17)	1	2	
5	661=(IMS9B x 2295B)	3	3	
6	1186=(CB 26x CB 10)	2	4	
7	1088=(CB 26x KR 199)	3	4	
8	1089=(CB26x NR 486)	2	3	
9	1085=(ICSB85x 296B)	1	2	
10	660=(IMS 9B x 296B)	3	2	
11	616=(C43 x B 23)	2	2	
12	620=(C43x CS 3541)	1	1	
13	1168=(475B x NR 37)	2	2	
14	1086=(CB 26x CB11)	3	1	
F3 Germ)		60	38	
1	CSV8X E214	1		V/R/Seed quality
2	E216XCSV8R	1	1	
3	CSV17 X E214	1	1	
4	CSV20XE228	3	1	
5	CSV 20 X E 213	2	2	
6	CSV 20 X CSV 17R	3	4	
7	CSV 23 X E 234	1		
8	CSV 23 X E 240	3	2	
9	M35-1 X E 219	2	1	
10	CSV 23 X E220	1		
11	CSV 23 X E219	2	1	
12	CSV 20X E 254	2	2	
13	I-12 X E 212	1		
14	E 216 X CSV 17	3	1	
15	CSV 19 X E 254	1		
16	CSV 20X CSV 23	2	1	
17	2219B X E 254	1		
18	CSV 17 X CSV 23	2	3	
19	CSV16XCSV8R	1	2	
20	2000 x 253	1	1	
20	CSV 23 X CSV 8R	1	1	
21	E 216 X CSV 23	2	1	
22	CSV 17 X CSV 20	1	1	
23	E216XE220	1	1	
24	E216 XCSV20	2	4	
25	SSV 84 X E220	1	1	
26	CSV20X E216	2		

Segregating Population	Crosses	Selection sown	Selection made	Remark
27	CSV20 X E 240	3		
28	I-12 X E 253	1		
29	RS 29 X E254	1		
30	C 43 X E 254	1		
31	CSV23 X E 213	1		
32	ELG 25 X E 212	1		
33	CSV 23 X E 212	1	1	
34	RS 29 X E 225	1	1	
35	CSV 20X CSV 23	1		
36	C 43 X E 213	2		
37	CSV23 X E 214	2		
38	CSV 20 XE253	1	4	
F\$		5	11	
F4	185=(RS29 X ICSR9)	1	3	ca
	221= (1616 x ICSR 194)	1	2	
	243= (1616X MR 34)	1	3	
	207= 1616X CB 87	1	0	
	244=I-12 X RS 627 X RS 627 X ICSR 160)	1	3	
F5		27	38	
	18 X 836X NO 531	2	4	Agro
	GMN 41-1	1	1	Gm
	APK 1 X I-12	1	3	Agro
	IS 22557 X I-12	4	7	ca
	APK 1 X S 35	3	4	agro
	1616 X 73210X 1428 X I-12	2	8	agro
	IMS9B X I-12	3	2	agro
	530B X IMS9B	1	2	ms
	TNS30 X I-12	3	2	ca/agro
	46B X GGUB 52	1		
	14B X 14332	3	2	ms
	CSV15 X S 35	1		
	717B X 3B	1	1	
	DSV 4 X SOMAPUR	1	2	seed quality (round)

3. Surat

Breeding material: The segregating generations were evaluated during kharif, 2011 as under:

Generation	No. of lines / crosses sown			Selection made			
	Project	State		IPS		Bulk	
		Grain	Fodder	Grain	Fodder	Grain	Fodder
F ₁	-	101	-	80	-	-	-
F ₄	NCB	27	-	95+27	11	0+1	-
F ₅	SRT	84	-	497+115	8	17+27	1
F ₆	SRT	506	-	490+522	-	59+30	-
F ₇	-	145	-	0+145	-	0+7	-
F ₈	-	66	-	0+66	-	0+25	-
Bulk	-	52	-	-	-	52	-

Hybridization: Hybridization programme was taken during kharif at Surat by using five male sterile line and 20 diverse type R-lines and seed of 54 hybrids were obtained.

Male Sterile Lines		R- Lines	
1. AKMS -30A	1. GJ -9	11. AKR -150	
2. AKMS -87A	2. GJ -35	12. GFS -3	
3. AKMS -103A	3. GJ -36	13. GFS -4	
4. AKMS -70A	4. GJ -37	14. GFS-5	
5. AKMS- 33-105A	5. GJ -38	15. CSV 21F	
	6. GJ -39	16. BP -53	
	7. GJ -40	17. Wani Bhilwada	
	8. GJ -41	18. Wani Local	
	9. GJ -42	19. SR -1115-1	
	10. SRT -1	20. HC-308	

Collection, evaluation and maintenance of germplasm:

Type of sorghum	No. of germplasm lines maintained
Grain sorghum	491
Fodder sorghum	72
Rabi sorghum	40
Sweet sorghum	144

Sorghum Demonstration (TSP): Under AICSIP, 120 rabi sorghum demonstrations were conducted in three districts (Navsari, Dang and Narmada) of South Gujarat during the year 2011-12.

Farm Demonstration: 21 different released varieties (grain as well as fodder type) including local types were undertaken Main Sorghum Research Station, Farm at Surat.

Maintenance of CMS lines, restorers, etc... 42 IPS of CMS Set I and 48 IPS of CSM Set-II were sown and tried to maintain for future use. However, pollen shedding was observed in most of the lines.

Maintenance breeding by Head to row progenies: Panicles in 30 different varieties / advance lines were selected for further evaluation for maintaining the purity of these lines/varieties. Specially progenies of GJ-38 were grown on large scale for further purification.

Seed multiplication:

Sr. No.	Season	Name of variety	Area (ha)	Centre
1	Kharif	GJ 42	0.50	Polytechnic Bharuch
2		GJ 38	2.00	Surat
3	Rabi/Summer	GJ 38	1.20	Dediapada, Paria
4		CSV 21F	1.00	Mangrol, Vyara
5		GJ 38	0.50	Surat
6		CSV 21F	0.50	Vyara
7		GJ 42	0.50	Surat
8		GFS 5	0.50	Mangrol

4. Coimbatore

a. Hybrids released: TNAU Sorghum Hbrid Co 5

Sorghum hybrid culture, TNSH 482 is a hybrid derived from the cross , ICSA 51 x TNS 30 recorded an average grain yield of 2769 Kg/ha which is 13.16 per cent and 17.03 per cent increase over Co H 4 and MSH 51 respectively. Under irrigated situation, its average grain yield is 4338 Kg/ha which is 17.18 per cent and 13.32 per cent increase over Co H 4 and MSH 51 respectively. It matures in 95-100 days, possesses a tan plant type and the plant remains green at maturity and it is non-lodging. Grains are highly acceptable, white in colour, borne on medium cylindrical semi-loose earheads. Grain contains high nutritional and cooking qualities than Co H 4. This culture has been released as TNAU sorghum hybrid Co 5 during the year 2011 which is resistant to shootfly and grain mould

b. AISCIP trials organized: During Kharif four grain sorghum trials viz., IAVHT, AVHT, IHT and IVT trials on grain sorghum, Hybrid nursery I & II and stability of micronutrient trials were conducted and data sent. The grain sorghum pathology and entomology trials also were raised by this centre and screened by the pathologist from UAS, Dharwad and Entomology trial by scientist from Coimbatore centre. In addition to this this year late Kharif trials on AVHT (14), IVT (22) , and IHT (13) were organized and data sent in time.

c. Station trials conducted

Trial	Progress of work																		
MLT (kharif 2011)	Four cultures along with three checks were tested. in four locations. Among them TNS 623 and TNS 624 recorded highest yield of 2655 and 2622 kg/ha respectively by registering 6.76 and 5.42 percent increased yield over Co 30 (Check).																		
MLT (Rabi 2011)	Four cultures along with three checks were tested in four locations. The culture TNS623 and TNS618 out yielded the check variety CO 30 by recording 3668 and 3636 kg/ha with increased yield of 7.98 and 7.04 percent over Co 30.																		
University Varietal Trial-set I	Eleven entries were tested in RBD and the culture TNS 631 recorded highest grain yield (3441) with the increased yield of 9.4 % over TNAU sorghum variety CO 30 followed by TN630(3171) with increased yield of 0.8 % .																		
Replicated Row yield trial (RRYT)	Six promising entries from F6 generation were tested for grain and dry fodder yield and only one entry KR 199x PMS 8B-1-2-1-1-1 out yielded check Co 30 by registering 12.56 per cent increased grain yield. Further evaluation will be done in RBD along with check.																		
Evaluation of grain sorghum hybrid	Fifty newly synthesized crosses were raised and evaluated for grain yield and eleven crosses viz., yield. 2219A x TNS 611, 2219A x TNS 612, 2219A x TKS 0816, 2219A x TKS 0820, 2219A x TKS 0820, ICS 90001 A x TNS 30 x MS 5-1-1-2, ICS 90001 A x ICSR 89020, ICS 90001 A x ICSR 89020, ICS 12 A x CO 30, ICS 70 A x CO 30, ICS 90001 A x CO 30 were found to be promising for grain yield and fodder traits were raised in UHT for further evaluation.																		
Segregating generations	The following segregating materials were evaluated during 2011 and the selection details are given. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Generation</th> <th>No. of families studied</th> <th>No. of plants selected</th> </tr> </thead> <tbody> <tr> <td>F1</td> <td>15</td> <td>15</td> </tr> <tr> <td>F3</td> <td>90</td> <td>19</td> </tr> <tr> <td>F4</td> <td>155</td> <td>25</td> </tr> <tr> <td>F5</td> <td>224</td> <td>17</td> </tr> <tr> <td>F6</td> <td>85</td> <td>16</td> </tr> </tbody> </table>	Generation	No. of families studied	No. of plants selected	F1	15	15	F3	90	19	F4	155	25	F5	224	17	F6	85	16
Generation	No. of families studied	No. of plants selected																	
F1	15	15																	
F3	90	19																	
F4	155	25																	
F5	224	17																	
F6	85	16																	
Seed production	The following quantity of seeds has been produced and supplied. TFL seeds produced and supplied Co (S) 28 : 154 Co 30 : 429 Co 5 hybrid : 15 Breeder seed- CO26 : 25 kg SPV 462 : 70 kg produced and kept ready for lifting (DSR indent)																		

5. Palem

- PSV-56, a high yielding dual purpose sorghum variety completed 3 years minikit testing. This variety is having an yield potential of 25-30 q/ha Grain; 55-60 q/ha Fodder. The release proposal of the variety is submitted to State Varietal Release Committee of Andhra Pradesh during March 2012.
- Three dual purpose sorghum entries viz., PSVDP-210, PSVGS-105 and PSVGS-106 of AICSIP, Palem were included for evaluation in IVT coordinated trial during Kharif 2011. Among the 22 entries, PSVGS-105 (5.97 kg/plot) and PSVGS-106 (5.72 kg/plot) shown superior performance and ranked 2nd and 3rd position at RARS, Palem.
- In Sweet Sorghum, 12 cultures were evaluated in station level Advanced Varietal Trial. Among the 12 entries, PSSV-43 (Stalk weight: 14.54 kg, Juice volume: 5.90 L and Brix: 19.7%), PSSV-42 (Stalk weight: 15.72 kg, Juice volume: 5.08 L and Brix: 17.3%) and PSSV-35 (Stalk weight: 18.55 kg, Juice volume: 8.47 L and Brix: 14.3%) shown superior performance compared to the Check SSV-74 (Stalk weight: 13.80 kg, Juice volume: 5.00 L and Brix: 14.7%). These sweet sorghum cultures will be nominated for testing in IVT during Kharif 2012.
- In Improvement of yellow pericarp sorghum research project, after 4 generations of selfing, 5 cultures viz., PYPS-2 (203.0g), PYPS-11(311.0 g), PYPS-13 (244.0 g) PYPS-22 (359.0 g) and PYPS-28 (360.0 g) were found to be promising for grain and fodder quality characters. These cultures were tested for roti making quality and nutrient characters. The results are yet to be received from Quality Control Lab, Hyderabad.
- Further, these cultures were also crossed with 296-A and found partial fertility.
- [The value mentioned in parenthesis is the seed weight of 10 panicles]
- Since grain mold is one of major production constraints in Kharif sorghum, 17 male sterile lines and 11 restorer lines were tested under controlled conditions. Among the A lines, PGMRS-102A, PGMRS-109A, PGMRS-113A and PGMRS-116A; in R lines, PSR-194, PSR-202 and PSR-204 were observed to be least infected with grain mold fungi. These cultures will be further evaluated in the ensuing Kharif season and hybridization programme between promising A and R lines will be attempted in rabi 2012.
- In development of grain mold tolerant sorghum varieties, 42 F3 progenies were advanced to next generation. Further, 18 fresh crosses were attempted involving CSV-15, SPV-462, CSV-20, PSV-56, PSV-2, PVK-801, PSVGS-105, PSVGS-106.

6. Parbhani

Development of new experimental hybrids by pooling A and R line available in the project under National collaborative Breeding programme: In national crossing block to sets of male sterile lines and restorers were planted in first fortnight of Oct.2012.

- 15 CMS lines & 21 restorers were utilized in crossing blocks and effected 146 hybrids (F1's), out of which, 13 hybrids (F1's) having 150-300 gm cross seeds will contribute in national hybrid trial.
- 22 CMS lines were crossed with 20 restorers and developed 155 hybrids. Amongst which 24 hybrids will be contributed to HNT. Remaining crosses will be evaluated at station in next year for both Kharif & Rabi season 2012-13.
- Evaluation of germplasm lines: The promising germplasm lines for agronomic performance, grain quality and yield will be selected on visual basis.
- Evaluation of F1s for grain quality parameters & yield attributing traits.
- 17 B x B, 8 B x R and 40 crosses between indigenous Rabi genotypes developed through emasculation and crossing, were evaluated in rabi 2011-12 with object to improve grain quality, agronomic performance and yield attributing traits, amongst these 14 best cross selected on visual basis.
- Recording post harvest observations are in progress and the details will be presented in group meeting.

State multilocation hybrid cum varietal trial (Kharif – 2011-12) : Twenty genotypes including 8 hybrids and 12 varieties were evaluated on the basis of mean of 8 location. The highest grain yield was recorded by CSH-25 (43.18 q/ha) followed by MLSH-29 (42.33 q/ha) and CSH-16 (40.26 q/ha), among varieties AKSV 181 and AKSV 221 recorded highest grain yield of 38.30 q/ha and 36.67 q/ha respectively. For fodder yield AKSV 222 recorded highest fodder yield of (237.07 q/ha) followed by 1037 R (183.37 q/ha) and AKSV 221 (182.12 q/ha)

State multi location trail (Rainfed) Rabi – 2011-12 : Twenty genotypes evaluated for grain, fodder yield in rabi 2011-12 under rainfed condition at Parbhani, indicated that genotype code 3 recorded the highest grain Yield (38.93 q/ha) followed by code 18 (38.81 q/ha) and code 20 (34.28 q/ha) while genotypes 10 and 6 recorded highest fodder yield of (129.63 q/ha) and (117.28 q/ha) respectively.

State multi location trail (Irrigated) Rabi 2011-12: Twenty genotypes were evaluated for grain and fodder yield in rabi 2011-12 under irrigated condition at Parbhani. The result showed that genotype code 11 recorded highest grain yield of (76.46 q/ha) followed by code 14 (71.26 q/ha) and code 17 (64.94 q/ha), for fodder yield genotype code 5 recorded significantly higher fodder yield of (172.84 q/ha) followed by genotype code 3 (116.05 q/ha) and genotype code 10 (112.35 q/ha).

Marker assisted breeding for grain yield and shootfly tolerance (rabi 2011-12) : In generation advancement one hundred eighty four, marker assisted plant to row progenies derived from five crosses and check variety (Parbhani Moti, (SPV 1411), Parbhani Joyti (CSV-18) were evaluated in rabi 2010-11. Each progeny (F3's) each progeny was grown in four rows of four meter length. Based on seed, fodder yield and its attributes, morphological traits like grain colour, size and tolerance to shootfly 42 superior progenies were selected, these progenies will be evaluate in next rainy and post rainy season.

Maintenance breeding: 10 Rabi based MS pairs and 16 Kharif MS pairs are maintained along with 40 rabi and 18 kharif restorers. Targeted quantity of nucleus, and breeder seed of Kharif varieties viz. PVK 400, PVK 801, 809, PMS 28B, 28A, C-43 and Rabi varieties viz, SPV-1411, SPV-1595, SGS 8-4 are produced.

7. Dharwad

I. Major achievements

- SVD-0105, SVD-710, SVD-1103 were promising compared to DSV-6 check in multilocation testing trial in Karnataka. SVD-0720 (3797 kg/ha), SVD-0740 (3606 kg/ha) and SVD-0742 (3574 kg/ha) were promising entries for grain yield over check variety DSV-6 (3228 kg/ha) in station trials.
- SVD-0203 (4371 kg/ha) recorded significantly superior grain yield over DSV-6 (3569 kg/ha) check variety.
- In Advance hybrid trial six hybrids viz., SPH-1683 (7621 kg/ha) , SPH-1653 (7503 kg/ha), SPH-1674 (7224 kg/ha), SPH-1647 (7208 kg/ha), SPH-1682 (7196 kg/ha) and SPH-1648 (7088 kg/ha) were superior for grain yield compared to high yielding check DSV-6 (6180 kg/ha).

II. Detailed Report

(a) Highlights of AICSIP trials conducted.

- Advance Hybrid Trial: SPH-1683 (7621 kg/ha) and SPH-1653 (7503 kg/ha) were top superior performing hybrids based on grain yield compared to check DSV-6 (6180 kg/ha).
- Advance Varietal Trial : Local check DSV-6 recorded highest grain yield of 6285 kg/ha compared to any of test entries.
- Initial Hybrid Trial : SPH-1705 was best dual purpose hybrid compared to CSH-16 check hybrid. (6835 kg/ha and 21.77 ton/ha).

(b) State /station trials conducted and highlights in 2-3 bullet points.

- *Private sector hybrid testing:* Among private hybrids tested: SJH-99 (6469 kg/ha) was superior over both check hybrids CSH-16 (4968 kg/ha) and CSH-14 (4552 kg/ha) and another hybrid SJH-1 (6004 kg/ha) was superior over only CSH-14 check hybrid.
- *Multilocation Varietal Trial:* SVD-0105, SVD-710 and SVD-1103 were found promising across locations compared to DSV-6 check variety.
- *Station Varietal trials –* Among 82 varieties tested in five station trials, SVD-0203 (4371 kg/ha) recorded significantly superior grain yield over DSV-6 (3569 kg/ha). However SVD-0729, SVD-0740 and SVD 742 were also promising compared to check variety.

(c) Seed production achievements

Sl.No.	Variety	Target Nucleus	Achievement	Progenies grown	Progenies retained
1	DSV-1	3.00 kg	3.00 kg	70	55
2	DSV-6	5.00 kg	5.00 kg	200	150
3	CSV-15	4.00 kg	4.00 kg	90	75
Breeder					
4	AKMS 14 A	5.0	5.0		
5	AKMS 14B	5.0	5.0		
6	C-43	5.0	5.0		
7	27 A	5.0	4.0		
8	27 B	5.0	4.0		
8	AKR-150	5.0	5.0		

(d) *Germplasm evaluation:* 85 germplasm lines along with 100 kharif land races and 18 sweet Sorghum lines from DSR Hyderabad were evaluated. The M1 progenies of DSV-6 and CSV-15 were raised with objective to enhance. Grain size and grain mold tolerance. (Gamma irradiated). The mini core collection is being evaluated for grain quality and productivity related traits.

(f) *No. of crosses made:* One hundred fresh crosses involving diverse parents tolerant to Grain mold, shoot fly tolerant, sweet sorghum and good agronomic lines like DSV-6, CSV-15, M 35-1, C-43, SSV-74, RSSV-9, GMN-41, GMN-46, IS-18551 and EC -582508. (Brown mid rib) were made.

No. of entries contributed to AICSIP trials : SVD-1101, SPV-2023, SPV-2022, SVD-1102 and SVD-1103.

Advance generation maintained and lines selected:

F3 material: 19 progenies – 23 selected, **F4 material:** shoot fly: 9 progenies -12 selected, **Grain mold tolerance:** 7 progenies – 11 selected. **Agronomic superiority:** 7 progenies – 8 selected. **Grain quality:** 2 progenies-3 selected. **Leaf disease resistance:** 3 progenies – 4 selected. **F5 material:** 33 progenies – 41 selected.

8. Udaipur

Major Achievements: This year 10 entries were contributed by Udaipur center in AVT/IVT/IHT pertaining to Grain / Dual purpose / Forage sorghum trials. In grain and dual purpose sorghum trials the center has contributed 8 entries at national level viz. SPV 1999, 2000, 2061, 2083, 2115, 2116, 2117 and 2118. In forage sorghum trials the center has contributed 2 entries at national level viz. SPV 2131 and 2132 in IVT-SC.

Note: National data of kharif 2011 awaited to assess performance of above genotype at National level. Dual purpose sorghum genotype CSV 28 (SPV 1822) released at national level in the year 2011. Proposal for notification is submitted.

AICSIP trials conducted and highlights

SN	Trial	Promising entries
1.	AHT-GS & DP	On the basis of grain yield: SPH 1648 (7478 kg/ ha), SPH 1647 (6933 kg/ha), SPH 1680 (6933 kg/ha) over best check CSH 16 (6354 kg/ha). On the basis of dry fodder yield: SPH 1668 (15756 kg/ ha), SPH 1683 (13285 kg/ha) SPH 1648 (13032 kg/ha) over best check CSH 16 (10112 kg/ha).
2.	AVT-GS & DP	None of the experimental varieties could out yield best check CSV 15 (for grain yield) and CSV 23 (for dry fodder yield) neither in terms of grain yield nor dry fodder yield.
3.	IHT-GS & DP	On the basis of grain yield: SPH 1704 (6337 kg/ha), SPH 1706 (6185 kg/ha), SPH 1703 (6054 kg/ha) over best check CSH 16 (5684 kg/ha). On the basis of dry fodder yield: SPH 1701 (17128 kg/ ha), SPH 1702 (15567 kg/ha) SPH 1710 (15268 kg/ha) check CSH 23 (11405 kg/ha).
4.	IVT-GS & DP	On the basis of grain yield: SPV 2117 (3637 kg/ ha), SPV 2110 (3316 kg/ha) over best check CSV 15 (3256 kg/ha). On the basis of dry fodder yield: SPV 2115 (16916 kg/ ha), SPV 2109 (16901 kg/ha), SPV 2118 (16289 kg/ha), SPV 2113 (16211 kg/ha) over best check CSV 15 (15133 kg/ha).
5.	IAVHT-SC	None of the experimental varieties could out yield local check PC 1080 (GFY 50833 kg. /ha, DFY 12652 kg/ha) neither in terms of GFY nor in DFY. However, yield level of SPV 2132 was numerically close to local check PC 1080 for GFY (50333 kg/ha) and DFY (12583 kg. /ha).
6.	IAVHT-MC	On the basis of total of two cuts for GFY: None of the experimental genotypes could numerically out yield best check CSH 24 MF (1138 q/ha). On the basis of total of two cuts for DFY: SPV 1698 (234.72 q/ha) out yielded best check CSH 20 MF (225.11 q/ha).

State/station trials conducted and highlights

1.	SVT-GS & DP	On the basis of grain yield: SU 1404 (4867 kg/ha), SU 1402 (4267 kg/ha), SU 1385 (4033 kg/ ha) over best check CSV 15 (3967 kg/ha). On the basis of dry fodder yield: SU 1400 (26900 kg/ha), SU 1394 (23600 kg/ha), SU 1392 (22967 kg/ha) check CSV 23 (18300 kg/ha).
2.	RVT-GS & DP	On the basis of grain yield: None of the entries were better than best check CSV 15 (3667 kg/ha). On the basis of dry fodder yield: SPV 2006 (19100 kg/ ha), SPV 1847 (17767 kg/ha) over best check CSH 23 (15533 kg/ha).
3.	SFT- SC	On the basis of green fodder yield: SU 1414 (606 q/ha), SU 1412 (555 q/ha) over best check PC 1080 (535.50 q/ha). On the basis of dry fodder yield: SU 1412 (366.50 q/ha), SU 1405 (363.00 q/ha) over best check Raj Chari 2 (342.00 q/ha).

Seed Production achievements - Breeder seed - Nucleus seed of CSV 10, CSV 15, CSV 17, PJ 1430, CSV 23 was produced as desired.

S No	Variety	Quantity (kg)
1.	CSV 15	335
2.	CSV 17	615
3.	CSV 23	505
4.	PJ 1430	800
5.	PC 1080	Nil
6.	SPV 1822	1350

Germplasm evaluation: This year one set of germplasm lines received from DSR, Hyderabad and one set of germplasm lines of Udaipur centre were evaluated in augmented design. The first set consisting of 500 germplasm lines. Promising lines for earliness and regeneration ability were identified. Second set consisting of 80 germplasm lines were evaluated for their yielding ability.

Objectives of breeding programme

- Development of early maturing dual-purpose genotypes
- Incorporation of proper resistance to common insect pests
- Incorporation of proper resistance for major diseases
- Development of production technology for newly developed genotypes

No. of crosses trait based successfully made (with pedigree): This year 28 fresh crosses and back crosses for shoot fly resistance were attempted.

*Advanced generations maintained and lines selected:*The 28 f1s were planted to obtain seeds for their f2 and back crosses. Selections were made for early, dual purpose plant types with insect/ disease resistance from 20 crosses in f2, 21 crosses in f3, 35 crosses in f4, 19 crosses in f5, 5 crosses in f6 and 11 crosses in f7 generations.

Number of MS, R and Varieties in pipe line: SPV 1999 AVT II-Grain kharif; SPV 2000 AVT II-Grain kharif; SPV 2061 AVT I-Grain kharif; SPV 2083 AVT I-Grain kharif; SPV 2115 IVT -Grain kharif; SPV 2116 IVT -Grain kharif; SPV 2117 IVT -Grain kharif; SPV 2118 IVT -Grain kharif; SPV 2131 IAVT-Fodder SC; SPV 2132 IAVT-Fodder SC;

Any new experiment conceptualized, if so give details: The F2 and back crosses were obtained for a 8 x 8 diallel between parents selected on the basis of shoot fly resistance and susceptibility (27B, AKMS 14B, DJ 6514, IS 2312, IS 2205, SUENT 11, CSV 17 and CSV 23) to study the SSR markers. There was significant positive correlation between early vigour, glossiness and trichome density. The 21 SSR markers were studied in parents and F1s of 8 x 8 diallel. Out of 21 markers 6 were amplified and produced 12 bands. The 5 bands were polymorphic. The genotypes with 250bp band of 88xtp marker were having significantly less glossiness and trichome density than the genotypes without this band. This band was negatively correlated with glossiness and trichome density and explained 33.20 and 14.70 percent variability of glossiness and trichome density. No other SSR marker was related to these characters.

Professional achievements (2010-11):

Varieties / hybrids identified / released at state level: Pratap Chari 1080 released at state level and notified. Vide Gazette Notification no. REGD No D. L. -33004/99 dated 07-02-2011.

No. of entries contributed to AICSIP and state trials: AICSIP: 10; Station: 50

No. of entries promoted to next level in AICSIP and state trials: Four in grain trials

Workshops / conference / meetings attended: Workshop: 1; Conference: 2; Meetings at state and University level: 2

9. Bijapur

Major Achievements: One variety BJV 44 (SPV2034), suitable for deep soil (having good grain & fodder yield, and grain quality) is undergoing testing in farmer's fields. This entry is also undergoing Agronomic testing in 2nd year of AVHT. A total of four special food purpose varieties viz., AKJ-1 (for flaking), SMJ-1 & RSJ-1 (for hurda purpose) and KMJ-1 (for pop purpose) were notified by University for further release at state level for commercial cultivation. A total of three entries contributed to AVHT and six entries to IVHT. The entries were SPV 2033, SPV 2034 and SPV 2035 under AVHT (DBS); BJV 67, BJV 69, BJV119, BJV 102 under IVHT (DBS); BJV 95 and BJV 13 under IVHT (SS). Three new B lines on maldandi under different nuclear backgrounds were developed. Five lines on milo source with apparent grain quality are under final stages of conversion. Two varieties for special food purpose viz., RSJ-1 for hurda and KMJ-1 for pop purpose were submitted to NBPGR for registration.

AICSIP trials conducted: 5 ICAR trials, AVHT(DBS), AVHT(SS), IVHT(DBS), IVHT(SS) & Hybrid trial(DSR) were conducted.

State/station trials conducted and highlights: MLVHT: Out of 17 entries tested, the genotypes viz., BJV44 and BRJ204 were found promising.

Preliminary varietal trial (PVT) A total of 18 lines derived from double cross (CSV 216R x 104B) (GM x 401B) were evaluated along with four checks. Among these five entries were promising. A total of 20 varieties were evaluated along with three checks. Six entries were found promising. A total of 16 varieties were evaluated. Four entries were found promising.

R line trial (RLT): A total of 24 lines derived from 6 crosses were evaluated. Among these four entries were selected. A total of 6 promising lines (Back cross derived) introgressed with shoot fly resistance QTLs (derived from cross R 354 x IS 18551) were evaluated along with parental checks.

B line trial (BLT): A total of 19 lines derived from double cross (CSV 216R x 104B) (GM x 401B) were evaluated. Among these six entries were found promising for grain yield and quality.

Varietal Improvement:

Shoot fly resistance and charcoal rot resistance: A total of 13 derived lines (F5 & F6) from 7 crosses (straight and three way crosses) were evaluated. Four entries were found promising.

High yielding with maldandi maturity: A total of 22 derived lines (F5 & F6) from 3 crosses (straight and three way crosses) were evaluated. Four entries were found promising.

Terminal drought tolerance (stay-green): i) A total of 10 entries (F6, BC1F5) derived from four crosses were evaluated. Three entries were found promising. ii) A total of 11 lines (BC1F5) introgressed with at least two stay-green QTLs, stg1 & stg2 (derived from cross CSV 216R x RSG 03123) were evaluated along with five checks.

The genotypes recorded high spad values and maintained green at physiological maturity.

Evaluation for Axillary branching: An axillary branched mutant SbABM was evaluated along with its parent A-1, popular variety M 35-1 and four other checks for axillary branching, grain yield and yield components. The data analysis is under process.

Evaluation of genotypes for fluctuating weather conditions: Seven entries were evaluated at 2 dates of sowing with 10 days interval. The data analysis is under process.

Evaluation of hybrids:

- A total of 28 crosses obtained from 8 x 8 half diallel were evaluated along with eight checks. The data analysis for yield and yield components is under process.
- A total of 13 crosses involving 13 A lines (both milo and maldandi cytoplasm) and SbABM, an axillary branched mutant were evaluated along with parents and checks. It was observed that very poor or no restoration on milo and no restoration on maldandi cytoplasm, indicating the mutant needs conversion into restorer.
- A total of ten crosses were evaluated along with 11 parents. Data analysis is under process.

Evaluation of MAS derived hybrids (Shoot fly): A total of 36 crosses derived from LxT (6 x 6) design were evaluated along with parents, checks for yield and resistance/susceptibility were evaluated for resistance components, yield and yield components. With respect to leaf glossiness, it was observed that hybrids were shown leaf glossiness when both the parents were glossy. Heterotic hybrids were identified.

Seed Production achievements: *Nucleus seed:* M 35-1 (30 kg), DSV 4 (2 kg), DSV 5 (2 kg), 5-4-1 (2 kg), AKJ-1 (10 kg), SMJ-1 (15 kg), RSJ-1 (5 kg) and KMJ-1 (10 kg) was produced. *Breeder seed:* M 35-1 (10 q) was produced.

Germplasm evaluation

- A total of 586 diverse germplasm entries were characterized and maintained.
- A total of twenty new landraces (including pop sorghum and kharif types) collected from North Karnataka were evaluated in replicated trial and were maintained.
- A set of 500 entries received from DSR were planted and evaluated.
- Another set of 272 entries received from DSR were evaluated for shoot fly susceptibility, stay-green character, yield and yield components. Data analysis is under process.

Objectives of breeding program: No. of crosses trait based successfully made (with pedigree)

Sl.No.	Cross	Purpose
VARIETAL IMPROVEMENT		
1	(DSV 4 x CSV 216R) x CSV 216R	To develop high yielding varieties for deep black soils
2	(DSV 5 x CSV 216R) x CSV 216R	-.
3	(DSV 4 x P. Vasudha) x P Vasudha	-.
4	(DSV 5 x P. Vasudha) x P Vasudha	-.
5	(DSV 4 x P. Revati) x P. Revati	-.
6	(DSV 5 x P. Revati) x P. Revati	-.
7	(CSG 17 x CSV 216R) x CSV 216R	To develop high yielding and drought tolerant (stay-green) varieties
8	(CSG 17 x CSV 216R) x CSG 17	-.
9	CSG 17 x CSV 216R	-.
10	(DSV 4 x CSG 17) x DSV 4	To develop high yielding, charcoal rot and drought tolerant (stay-green) varieties
11	(DSV 5 x DSV 4) x E 36-1	-.
12	(CSV 216R x E 36-1) x CSV 216R]	To develop high yielding, charcoal rot
13	DSV 4 x E 36-1	-.
14	CSV 216R x E 36-1	-.
15	(GM x CSV 216R) x CSV 216R	To reduce height in CSV 216R background
16	(CSV 216R x 401B) x CSV 216R] x CSV 216R	-.
17	CSV 216R x CSG 803	To improve CSV 216R for terminal drought tolerance (stay-green trait)
18	CSV 216R x CSG 0806	-.
19	CSV 216R x CSG 0816	-.
20	CSV 216R x CSG 0818	-.
21	M 35-1 x CSG 803	To improve M 35-1 for terminal drought tolerance (stay-green trait) and genetic analysis of Charcoal rot and stay-green
22	M 35-1 x CSG 0806	-.
23	M 35-1 x CSG 0816	-.
24	M 35-1 x CSG 0818	-.
25	(M 35-1 x CSG 803) x M 35-1	-.
26	(M 35-1 x CSG 0806) x M 35-1	-.
27	(M 35-1 x CSG 0816) x M 35-1	-.
28	(M 35-1 x CSG 0818) x M 35-1	-.
29	(M 35-1 x CSG 0803) x CSG 0803	To study genetic association between charcoal rot and stay-green traits
30	(M 35-1 x CSG 0806) x CSG 0806	-.

Sl.No.	Cross	Purpose
31	(M 35-1 x CSG 0816) x CSG 0816	-.
32	(M 35-1 x CSG 0818) x CSG 0818	-.
33	M 35-1 x B 35	To study inheritance of Stay-green
34	M 35-1 x CSG 0818	-.
35	M 35-1 x SbABM	-.
36	M 35-1 x RSG 03123	-.
37	M 35-1 x E 36-1	Improvement of M 35-1 for charcoal rot resistance and genetic analysis of charcoal rot resistance
38	M 35-1 x DSV 4	-.
39	M 35-1 x DSV 5	-.
40	(CSG 0803 x CSV 216R) x CSG 0803	To improve stay-green introgressed CSG lines for grain threshability
41	(CSG 0806 x CSV 216R) x CSG 0806	-.
42	(CSG 0816 x CSV 216R) x CSG 0816	-.
43	(CSG 0818 x CSV 216R) x CSG 0818	-.
HYBRID BREEDING		
1	(RS 29 x IS 18551) x RS 29	To improve restorers for shoot fly resistance
2	AKR 150 x IS 18551	-.
3	C 43 x IS 18551	-.
4	DSV 4 x 401B	To derive high yielding B lines
5	CSV 216R x 401B	-.

Advanced generations maintained and lines selected

Varietal Improvement - Charcoal rot resistance: Development of high yielding and charcoal resistant varieties

Cross	Generation	No. evaluated	No. selected	Purpose
[(CSV 216R x E 36-1) x E 36-1] x RSV 458	BC1F1 x RSV 458	1	14	To derive charcoal rot resistant early lines
(CSV 216R x E 36-1) x CSV 216R	BC1F2	14	12	To derive charcoal rot resistant high yielding lines
CSV 22 x DSV 5	F3	1	6	To derive charcoal rot resistance and high yielding lines
CSV 216R x E 36-1	F3	1	5	-do-
[(CSV 216R (CSV 216R x E 36-1)]	BC1F2	14	62	To derive CR resistant CSV 216R
[(CSV 216R x E 36-1) x E 36-1]	BC1F2	8	12	To derive CR resistant CSV 216R

Yield and early maturity:

Cross	Generation	No. of lines evaluated	No. of plants selected	Purpose
(401B x 204B)	F3	2	8	Development of extra maldandi maturity lines
(104B x 204B)	F3	3	5	-do-
RSV 458 x 204B	F3	3	4	-do-
DSV 4 x 204B	F3	2	4	Development of early maturing varieties
DSV 5 x 204B	F3	2	10	-do-
[(RS 29 x DSV 5) x DSV 5] x DSV 5	BC2F3	6	12	To derive tan versions of DSV 5 with more no. of grains
[(B 35 x DSV 5) x DSV 5] x DSV 5	BC2F3	6	12	To develop stay-green & juicy stemmed versions of DSV 5
[(401B x DSV 5) x DSV 5] x DSV 5	BC2F3	8	10	To develop early maturing versions of DSV 5
[(AKR 150 x CSV 216R) x CSV 216R] x CSV 216R	BC2F3	15	15	To develop bolder grain version of dwarf and bold grains derivatives resembling AKR 150
(CSV 216R x 401B) x CSV 216R	BC1F2	10	70	To derive early versions of CSV 216R
(SPV 489 X R 354) X SPV 489	BC1F2	8	4	To derive high yielding R lines

High grain and fodder yield

Cross	Generation	Purpose	No. of lines evaluated	No. of plants selected
RSV266 x Phule Vasudha	DSR F3	High grain and fodder yield	5	5
RR9836 x SPV 1626	DSR F3	-do-	1	2
SPV 1626 x CSV22	DSR F3	-do-	1	2
RR9836 x RSV 1006	DSR F3	-do-	1	2

Terminal drought tolerance (stay-green)

Cross	Generation	Purpose	No. of lines	No. of plants selected
[(B 35 x DSV 5) x DSV 5] x DSV 5	BC2F3	To develop stay-green & juicy stemmed versions of DSV 5	7	8
CSV 216R x RSG 03123)	BC1F5 (stg QTL introgressed lines)	To select segregants for good threshability	4	5

Speciality traits: F1 (Sakkari Mukkari x Raosab) was advanced to F2 to improve for yield and bold grains.

Hybrid breeding - i) B line development

S.No.	Entry name	Generation	Purpose
1	104B x 204B	F1 to F2	To derive bold seeded early maturing B lines
2	401B x BRJ204B	-do-	-do-
3	204B x 104B	-do-	-do-
4	204B x 401B	-do-	-do-
5	204B x CSV 216R	-do-	To derive bold seeded and high yielding B lines
6	GM x CSV 216R	-do-	-do-

Cross	Generation	No. evaluated	No. of plants selected	Purpose
(401B x 204B)	F3	1	2	Development of early maturing lines
(104B x 204B)	F3	1	2	-do-
RSV 458 x 204B	F3	1	2	-do-
BRJ 356 x SL 88	DSR F3	3	6	Development of new B lines

1409B x BRJ 356	DSR F3	3	6	-do-
1409B x PMS 20B	DSR F3	4	4	-do-
PMS 20B x AKR 823	DSR F3	3	3	-do-
127B x SL-56	DSR F3	2	2	-do-
(101B x CSV 216R) x CSV 216R x CSV 216R	BC2F3	10	12	To develop B lines with good grain quality

R line development

S.No.	Entry name	Generation	Purpose
1	IS 18662 x CSV 216R	F1 to F2	To derive high yielding R lines
2	RR-9825 x CSV 216R	F1 to F2	-do-

Cross	Generation	No. of lines evaluated	No. of plants selected	Purpose
[(AKR150 x CSV 216R) x CSV 216R] x CSV 216R	BC2F3	15	13	To develop bolder grain version of dwarf & bold grain derivatives resembling AKR 150
RR 9836 x SPV 1626	DSR F3	1	2	To derive high yielding R lines
R354 x 204B	F3	1	4	Improvement for early maturity, grain quality and SF resistance
C 43 x 204B	F3	1	5	Improvement for early maturity, grain quality and SF resistance
C43 x DSV 5	BC2F3	8	8	Improvement grain quality

Cross	Generation	No. evaluated	No. of progenies rejected	No. of plants selected	Purpose
(AKR 150 x IS 18551) x AKR 150	BC1F2	2	-	8	Improvement for shoot fly resistance
(C43 x IS 18551) x C43	BC1F1	3	-	2	-do-
	BC1F2	14	1	54	-do-
(RS 29 x IS 18551) x RS 29	BC1F1	2	-	7	-do-
	BC1F2	9	2	34	-do-

Number of MS, R and Varieties in pipe line

- Five MS lines are under final stages of conversion
- One variety is under final stages of testing.
- A total of four special food purpose varieties viz., AKJ-1 (for flaking), SMJ-1 & RSJ-1 (for hurda purpose) and KMJ-1 (for pop purpose) were notified by University for release at state level.
- Two R354-shoot fly resistance QTL introgressed lines (RSF 0810 and RSF 0833) were found promising in hybrid combinations with 104A for shoot fly resistance components.

Any new experiment conceptualized: Improvement of M 35-1 for charcoal rot tolerance through breeding for delayed senescence (stay-green).

Concept: Breeding for stay-green, a secondary plant trait: As incidence of charcoal rot is associated with terminal moisture stress, breeding programme should address resistance to both the stresses simultaneously. Currently both are handled independently. However, stay-green, a secondary plant trait that interlinks both the stresses, confers yield advantage. Use of stay-green QTL introgressed lines of post rainy sorghum varieties as donors: B35, a widely used stay-green donor is poor yielder (grain and stover) with inferior grain quality. It will take longer time to break undesirable linkage drag. The currently available stay-green QTLs introgressed lines like RSG 03123 (from ICRISAT) and CSG0818 (from UASD) are recorded with acceptable yield levels (grain and stover) and grain quality except pericarp pigmentation in the former and poor threshability in the latter. RSG 03123 is derivative of R16, the pedigree of which involves M 35-1 as one of its parents. CSG0818 a derivative of CSV 216R, a landrace selection of rabi sorghum with farmer preferred grain traits. Therefore, these lines could serve a better source of stay-green for speedy recovery of segregants with many desirable features of M 35-1 with improved resistance to charcoal rot.

Test material: M 35-1 (recipient parent) and RSG 03123 & CSG 0818 (donors for terminal drought tolerance), E 36-1 and B 35 as checks for charcoal resistance and stay-green, respectively.

Professional achievements (2011-12):

- Varieties / hybrids identified / released at state level:** A total of four special food purpose varieties viz., AKJ-1 (for flaking), SMJ-1 & RSJ-1 (for hurda purpose) and KMJ-1 (for pop purpose) were notified by University for release at state level.
- No. of entries contributed to AICSIP and state trials:** A total of three entries contributed to AVHT and six entries to IVHT. The entries were SPV 2033, SPV 2034 and SPV 2035 under AVHT (DBS); BJV 67, BJV 69, BJV119, BJV 102 under IVHT (DBS); BJV 95 and BJV 13 under IVHT (SS).
- No. of entries promoted to next level in AICSIP and state trials** Three entries SPV 2033, SPV 2034 and SPV 2035 were promoted to Agronomic testing. The variety BJV 44 (SPV 2034) was promoted to farmers field testing at state level.
- Number of genetic stocks registered:** Two varieties for special food purpose viz., RSJ-1 for hurda and KMJ-1 for pop purposes were submitted to NBPGR for registration.

10. Rahuri

Name of the Breeder and Designation	Dr. S.R. Gadakh, Senior Sorghum Breeder, MPKV., Rahuri.
Major Achievement	<ul style="list-style-type: none"> ▪ Identified the rabi sorghum genotype RSV 1098 (SPV 2048) for medium type of soil. ▪ Developed new CMS line 2010-24A. ▪ Identified RSV 1130, RSV 1209, RSV 1226, RSV 1145, RSV 11188, RSV 1199, RSV 1338, RSV 1412, RSV 1408 and RSV 1173 as a Shootfly tolerant donar. ▪ Identified the donar viz., RSV 1455, RSV 1460, RSV 1461 and RSV 1458 for drought. ▪ Identified the sweet sorghum genotypes viz.,RSSV 263,RSSV 197,RSSV 168 and RSSV 247 for high biomass during rabi season. ▪ Development of genetic stock: The three (3) genetic stock viz., RPOSV 3 (<i>popping</i>), RPASV 3 (<i>Pappad</i>), RSSGV 46 (<i>Hurda</i>) have been developed and registered with NBPGR vide No IC 573123,IC 0585928 and IC 0585929 respectively.
a. AICSIP trial conducted	<ul style="list-style-type: none"> ▪ AVHT deep soil and IVHT Deep soil are conducted .
b. State/ Station trial conducted	<ul style="list-style-type: none"> ▪ The two State level trial viz., State MLT rainfed and irrigated are conducted during rabi season. ▪ The genotypes RSV 1098 and RSV 1186 in State MLT rainfed and RSV 1237 and Phule Revati in State MLT irrigated were observed to be promising for grain and fodder yield. ▪ The three University MLT trial on deep, medium and shallow soil are conducted during rabi season. The genotype RSV 1199 and RSV 1201 for grain yield and RSV 1130 and RSV 1186 for fodder yield in deep soil, RSV 1098 and MSV 93 for grain yield and RSV 1130 and RSV 1098 for fodder yield in medium soil and MSV 80 and RSV 1226 for grain and fodder yield respectively in shallow soil were observed. ▪ The Thirteen station trials are conducted during rabi season. The genotypes RSV 1149, RSV 1381, RSV 1427, RSV 1448, RSV 1512, RSV 1530, RSV 1542, RSV 1552 and RSSGV 46 were observed to be promising for grain yield. For fodder yield the genotypes viz., RSV 1462,RSV 1407,RSV 1448,RSV 1408,RSV 1503,RSV 1522,RSV 1540,RSV 1554 and RSV 1571 were observed promising.

Seed production Achievements

Sr.No	Varieties	National Indent	
		Targeted	Achieved
A	Nucleus	Kg	Kg
1	Swati	10	10
2	Sel 3	5	5
3	CSV 216	10	10
4	CSV 19 SS	15	15
5	SSV 84	15	15
		Targeted	Achieved
B	Breeder	Qtls	Qtls
1	CSV 216	1.0	1.0
2	Phule Vasudha	7.0	7.0
3	Phule Chitra	2.0	2.0

Germplasm Evaluation: Total 952 (DSR 500 and Rahuri 452) germplasm were evaluated during rabi season.

No. of crosses trait based successfully made : a. Deep Soil : 19 crosses

Sr. No.	Name of cross	Traits	Sr. No.	Name of cross	Traits
1	Karnataka Local x AKSV 151	Fodder quality	11	AKSV 151 x DSV 5	High Yield
2	Karnataka Local x DSV 5	High Yield	12	AKSV 151 x RSLG 2332	Drought
3	Karnataka Local x RSLG 2332	Drought	13	AKSV 151 x SSRG 411	High Yield
4	Karnataka Local x SSRG 411	High Yield	14	AKSV 151 x IS 18551	SFR
5	Karnataka Local x IS 18551	SFR	15	DSV 5 x RSLG 2332	High Yield
6	SPV 1830 x AKSV 151	High Yield	16	DSV 5 x SSRG 411	Early
7	SPV 1830 x DSV 5	High Yield	17	DSV 5 x IS 18551	SFR
8	SPV 1830 x RSLG 2332	Early	18	RSLG 2332 x SSRG 411	Drought
9	SPV 1830 x SSRG 411	High Yield	19	SSRG 411 x IS 18551	SFR
10	SPV 1830 x IS 18551	SFR			

b., Medium to Shallow soil : 20 crosses

Sr. No.	Name of cross	Traits	Sr. No.	Name of cross	Traits
1	RSLG 2367 x SPV 2048	Fodder quality	11	SPV 1829 X RSLG 2291	Drought
2	RSLG 2367 x SPV 1829	Drought	12	SPV 1829 X AKSV 204	Early
3	RSLG 2367 x SSRG 373	High yield	13	SPV 1829 X SSRG 373	Drought
4	RSLG 2367 x DSV 4	Fodder quality	14	SPV 1829 X DSV 4	High yield
5	RSLG 2367 x RSLG 2291	Drought	15	SSRG 373 X AKSV 204	High yield
6	SPV 2048 x SPV 1829	Early	16	SSRG 373 X RSLG 2291	SFR
7	SPV 2048 x RSLG 2291	High yield	17	SSRG 373 X DSV 4	SFR
8	SPV 2048 x SSRG 373	SFR	18	DSV 4 X AKSV 204	High yield
9	SPV 2048 x DSV 4	Early	19	DSV 4 X RSLG 2291	High yield
10	SPV 2048 x AKSV 204	Drought	20	ASKV 204 X RSLG 2291	Drought

C. :R X R : 29 crosses

Sr. No.	Name of cross	Traits	Sr. No.	Name of cross	Traits
1	RHRR 20 X IS 17972	Restorer	16	RSV 1006 X RSV 1093	Restorer
2	RHRR 20 X RSLG 2366	Restorer	17	RSR 2145 X SPV 1704	Restorer
3	RSR 2123 X RSLG 2366	Restorer	18	RSR 2145 X CSV 22	Restorer
4	RSR 2123 X RSV 1098	Restorer	19	RSV 1076 X RSV 1006	Restorer
5	RSR 2123 X RR 06-3	Restorer	20	RSV 1076 X RSV 1098	Restorer
6	RSV 1093 X CSV 22	Restorer	21	RSV 1076 X RR 2145	Restorer
7	RSV 1093 X CSV 216	Restorer	22	PLT 1221 X CSV 22	Restorer
8	RSV 1093 X RSV 1006	Restorer	23	PLT 1221 X RR 06-3	Restorer
9	RSV 1093 X Swati	Restorer	24	PLT 1221 X RSV 1006	Restorer
10	RSV 1093 X RSV 1098	Restorer	25	RHRR 20 XRSV 1076	Restorer
11	RSV 1093 X SPV 1704	Restorer	26	RSV 1076 X RSR 2145	Restorer
12	RSV 1006 X CSV 22	Restorer	27	RSR 2145 X RHRR 20	Restorer
13	RSV 1006 X Swati	Restorer	28	RR 06-3 X RSV 1076	Restorer
14	RSV 1006 X PLT 1221	Restorer	29	RR 06-3 X RR 2145	Restorer
15	RSV 1006 X RR 2145	Restorer			

D: B X B : 11 Crosses

Sr. No.	Name of cross	Traits	Sr. No.	Name of cross	Traits
1	185 B x 411 B	Male Sterile	7	42 B x RMS 2010-10B	Male Sterile
2	185 B x RMS 2010-16 B	Male Sterile	8	42 B x RMS 2010-16 B	Male Sterile
3	185 B x RMS 2010-10 B	Male Sterile	9	RMS 2010-10 B x RMS 2010-16 B	Male Sterile
4	185 B x 42 B	Male Sterile	10	RMS 2010-16 B x 4111 B	Male Sterile
5	42 B x 185 B	Male Sterile	11	4111 B x RMS 2010-16 B	Male Sterile
6	42 B x 4111 B	Male Sterile			

E: B x B (A2 cytoplasm):2Crosses

1	8603 B2 x RMS 2010-10B	Diversification of cytoplasm
2	8603 B2 x RMS 2010-16B	Diversification of cytoplasm

Advanced generation maintained and line selected : A: Varietal Improvement: Rahuri Center

Sr. No.	Generations	No. of crosses	Lines evaluated	Lines Selected
1	F ₁	58	--	--
2	F ₂	18	18	270
3	F ₃	6	120	116
4	F ₄	15	85	85
5	F ₅	10	45	45
6	F ₆	15	49	49

B: Varietal Improvement: Material developed at Mohol and evaluated and selected at Rahuri Center

Sr. No.	Generations	No. of crosses	Lines evaluated	Lines Selected
1	F ₃	12	240	164
2	F ₄	25	162	85
3	F ₅	8	18	15

C: Varietal Improvement: Team Efforts

Sr. No.	Generations	No. of crosses	Lines evaluated	Lines Selected
1	F ₃	10	180	180
2	F ₄	11	58	58
3	F ₅	15	38	38
4	F ₆	4	10	10

D: B and R line development

Sr. No.	Generations	No. of crosses	Lines evaluated	Lines Selected
1	F ₁ (R x R)	33	--	--
2	F ₁ (B x B)	7	--	--
3	F ₂ (B x B)	7	--	70
4	F ₂ (R x R)	6	--	60
5	F ₃ (B x B)	15	15	15
6	F ₄ (B x B)	15	15	10
7	F ₄ (B x R)	3	36	36
8	F ₄ (R x R)	18	18	18
9	F ₅ (R x R)	6	43	43
10	F ₅ (B x B)	6	22	22
11	F ₆ (R x R)	8	20	20
12	F ₆ (B x B)	5	14	14

No. of MS, R and varieties in pipelines: 1. Male sterile: 5; 2. Varieties: 4; 3. R lines: 20;

g. Professional Achievements (2011-12)

i. Publication from AICSIP work: Popular articles: 15 popular articles

Varieties / hybrids identified / released at state level: 1

No. of entries contributed to AICSIP and state trials:

Kharif : IVAHT Sweet Sorghum: 5; Kharif Single cut trial: 4;
Rabi: AVHT (Deep Soil):2; AVHT (Shallow Soil):2; IVHT (Deep Soil):4; IVHT (Shallow Soil):2; PLT (Breeding):2; AVHT (Agronomy):9; Shootfly pest nursery trial :10; Charcoal rot nursery trial:3; Physiological trials:29;

No. of entries contributed to state trials: State MLT:Rabi sorghum (Rainfed) :7; State MLT:Rabi sorghum(Irrigated):9

No. of entries promoted to next level in AICSIP and state trials: AICSIP trials : 12; State trials: 8

Workshops / conference / meetings attended: 1; *Number of genetic stocks registered*:3

Awards / rewards: All India Sorghum Improvement Project,MPKV,Rahuri awarded with *Best Performing Rabi Center* for 2010-2011 in 41st Annual Group Meeting held at University of Agriculture, Dharwad on 17th April, 2011.

11. Tandur

Introduction: In India sorghum is grown in an area of 47 lakh hectares with a production of 880 kg/ha. In A.P., it is grown in an area of 2.7 lakh hectares in the districts of Kurnool, Adilabad, Ananthapur, Mahabubnagar, Medak and Ranga Reddy with a productivity of 952 kg/ha.

Research highlights:

Germplasm maintenance and evaluation: A total of 160 germplasm lines comprising of the accessions from various parts of India, Africa and USA are being maintained and catalogued at ARS, Tandur.

Generation and study of breeding material: The breeding material comprised of 169 lines in F4, F5 and F6 generation was evaluated and single plant selection of uniform plants was carried out based on plant type, ear head and other characters with an effort to improve grain and fodder yields. During rabi 2011-12, an entry TNDS -1 (PV 15 x CSV 216 R) was given for minikit testing in Ranga Reddy, Nalgonda, Kurnool, Adilabad, Khammam and Mahabubnagar districts. The entry topped in grain (3178 kg/ha) and fodder yields in multilocation testing at Nandyal, Palem, Madhira and Tandur centres for the state. During rabi 2011-12, four entries viz., SVT 22 (M-35-1 x PSV 1), SVT 27 (M-35-1 x SPV 1411), SVT 30 (M-35-1 x NTJ 3) and SVT 33 (M-35-1 x CSV 216 R) were given for IVT testing. A total of 23 uniform true breeding lines were evaluated in PYT (9) and AYT (14) during rabi 2011for grain and fodder yields. Out of these, SVT 54 (3162 kg/ha) and SVT 108 (3101 kg/ha) were found promising for yield and could withstand terminal moisture stress. These entries will be proposed for IVT testing during rabi 2012 from ARS, Tandur. A set of 11 A lines and their corresponding B lines and 18 R lines were also maintained during the season and five experimental hybrids were produced for evaluation during the next season.

List of trials conducted during rabi 2011:

- Initial varietal hybrid trial – Deep soil
- Advanced varietal hybrid trial – Deep soil
- Preliminary evaluation of diverse germplasm lines for rabi adaptation
- Advanced drought adaptation germplasm trial – Deep soil
- Collection, cataloguing, maintenance and evaluation of germplasm
- Trial on drought stress and under irrigated conditions
- Preliminary yield trial (station trial)
- Advanced yield trial (station trial)
- Private hybrid trial (from SRTC, Rajendranagar)
- A, B, R lines maintenance and crossing

12. Pantnagar

Major Achievements: Identification of multicut forage sorghum variety UPMC 539 for release from Uttarakhand State Variety Release Committee. Notification of single cut forage sorghum variety Pant Chari 7 and multicut forage sorghum variety Pant Chari 8 by "Central Sub-Committee on Crop Standards, Notification & Release of Varieties in Agricultural Crops". Experimental hybrid SPH 1697 (UTMCH 1310) has been promoted from IHT to AHT I.

a. AICSIP trials conducted and highlights

Nine Trials (4 on forage + 4 on dual purpose and 1 on sweet sorghum) - Best entries in Different Trials

Trial No.	Name of Trial	No. of entries tested	Name of best entries in the trial
Trial 1	IAVT Single cut Forage Sorghum	14	SPV 2127 and SPV 2130 (based on green and dry fodder yield)
Trial 2	IAVHT Multicut Forage Sorghum	12	SPH 1697, SPH 1700 and SPH 1696 (based on green and dry fodder yield)
Trial 3	Advance Seed Yield Trial	8	SPV 2056 and SPV 2058 (based on stover yield and grain yield)
Trial 4	Screening and making selection in F ₄ progenies developed for specific trait (BMR and forage yield)	-	43 single plant progenies from 20 crosses were selected on the basis of forage yield traits, seed producing ability in multicut types, seed quality, sweetness of stem, disease resistance and brown midrib colour.

Trial No.	Name of Trial	No. of entries tested	Name of best entries in the trial
Trial 5	Evaluation of local checks used in forage trial for their yield and quality	19	CO (FS)29, Rampur Local, SSG 59-3, SSV 84 (based on green fodder yield) CO(FS) 29, SSG 59 -3, SL 44, PSC 1 (on the basis of dry fodder yield)
-	AVT Grain Sorghum & Dual Purpose Trial	11	CSV 15, SPV 1999, SPV 2079 (based on grain yield) SPV 462, CSV 17, SPV 2079 (based on grain and fodder yield)
-	IVT Grain Sorghum & Dual Purpose Trial	22	SPV 2110, SPV 2120, SPV 2112, SPV 2125 (based on grain yield) SPV 2115, SPV 2112, SPV 2125, CSV 17 (based on grain and fodder yield)
-	AHT Grain Sorghum & Dual Purpose Trial	21	SPH 1680, SPH 1684, SPH 1674, SPH 1653 (based on grain yield) SPH 1684, SPH 1674, CSH 16, SPH 1648 (based on grain and fodder yield)
-	IHT Grain Sorghum & Dual Purpose Trial	13	SPH 1704, SPH 1702, SPH 1706 (based on grain yield) SPH 1704, SPH 1707, SPH 1709 (based on grain and fodder yield)
-	IAVHT Sweet Sorghum Trial	21	SPV 2076, SPV 2075, SPV 2068 (based on fresh stalk yield and Brix %)

State/Station trials conducted and highlights: Two State trials (1 on multicut + 1 on single cut forage sorghum)

Highlight of the trials

Name of Trial	Name of best entries in the trial
State Varietal/Hybrid Trial on multicut forage sorghum	UTMCH 1308 (H), UTMCH 1309 (H), UTM 539 (V), UTM 543 (V)
State Varietal Trial on single cut forage sorghum	UTFS 63, UTFS 68

Seed Production achievements

Breeder Seed Production (g)			Nucleus Seed Production (Kg)		
Name of Variety/Parental line	Allocation	Production	Name of Variety/Parental line	Allocation	Production
Pant Chari 5	3.0	3.0	Pant Chari 5	-	25.0
Pant Chari 6/ UPMC 503	4.0	3.0	Pant Chari 6	10.0	35.0
			(UPMC 503)	10.0	25.0
2219 A*	0.20	-	2219 A	10.0	20.0
2219 B*	0.10	-	2219 B	05.0	15.0
ICSA 467*	0.20	-	ICSA 467	10.0	15.0
ICSB 467*	0.10	-	ICSB 467	05.0	10.0

*Name of no organization for lifting the breeder seed was mentioned in the allocation for 2011-12. Moreover, breeder seed of parental lines 2219A/B and ICSA/ICSB 467 produced during 2009-2010 was not lifted therefore the breeder seed of parental lines was not produced. However, sufficient quantity of nucleus seed of these parental has been produced during Kharif 2011 which may also be given to the interested agencies.

Germplasm evaluation: 334 germplasm lines of single cut/multicut forage sorghum, Sudan types, dual purpose types/sweet sorghum types and brown midrib type were planted and evaluated; 42 A/B pairs of CMS lines (A1 and A2 cytoplasm based) were planted and evaluated for gca

Objectives of breeding programme:

- Development of high yielding single cut/dual purpose and multi cut forage sorghum varieties and cytoplasmic male sterility based single cross multicut forage sorghum hybrids between sorghum (CMS lines) and sudan grass pollinators, with high level of resistance to foliar diseases, improved nutritional quality, high energy value, palatability and voluntary intake.
- Basic genetic studies on inheritance of anti-nutritional factors viz. HCN, tannin and fiber (components of NDF and ADF like celluloses, hemicelluloses, lignin etc.) and foliar disease resistance, using conventional and molecular techniques.
- Development of three way cross multi cut forage sorghum hybrids using Milo as well as alternate (A2, A3 and A4) cytoplasm.
- Development of new fodder/tillering type CMS lines with coloured grains, for their use in multi cut hybrid development programme.
- Development of stable forage types having brown mid rib (BMR) with high level of digestibility, protein, sweetness and foliar disease resistance and their use in nutritional quality improvement breeding programme.
- Genetic improvement of parental lines/stock for value addition in terms of increased digestibility, protein content, total soluble solids (TSS), resistance to foliar diseases and shoot pests, reduced HCN content and other anti-nutritional factors

Number of crosses trait based successfully made (with pedigree): Following crosses were successfully made with objective of improvement in forage yield (multicut as well as single cut), forage quality, foliar disease resistance (particularly anthracnose and zonate leaf spot), seed yielding ability and grain quality.

S. No.	Pedigree	Objectives of cross (Trait based)
1.	IS 21461 x SSG 223	Tillering and regeneration
2.	IS 22996 x IS 21602	Foliar disease resistance, multicut
3.	IS 21602 x IS 25419	Foliar disease resistance and forage yield
4.	IS 21461 x IS 21021	Foliar disease resistance, single cut, high forage yield
5.	IS 22996 x IS 20740	Foliar disease resistance, multicut type

S. No.	Pedigree	Objectives of cross (Trait based)
6.	IS 21602 x IS 21461	Multicut trait and foliar disease resistance
7.	IS 30209 x IS 25419	Foliar disease resistance, height, multi cut type
8.	PM 98019-1 x IS 3555	Foliar disease resistance, dual purpose type
9.	PM 98019-1 x GMS 1378-1	Foliar disease resistance, multicut type
10.	IS 30209 x IS 22996	Foliar disease resistance, dual purpose type
11.	CSV 15 x Co(FS) 29	Foliar disease resistance with high tillering
12.	IS 30209 x IS 21602	Tall, multicut
13.	Pant Chari 8 x Pant Chari 7	Foliar disease resistance, multi cut and improved seed yield
14.	Pant Chari 8 x Pant Chari 6	To improve tillering capacity with improved seed yield
15.	Pant Chari 8 x Pant Chari 5	Multicut, foliar disease resistance, improved seed yield
16.	Pant Chari 8 x CSV 15	Multicut, foliar disease resistance, improved seed yield
17.	Pant Chari 8 x CSV 21F	Multicut, foliar disease resistance, improved seed yield
18.	Pant Chari 8 x UTMCH 543	Multi cut with improved tillering
19.	Pant Chari 6 x Pant Chari 7	Foliar disease resistance and less leaf senescence
20.	Pant Chari 6 x Pant Chari 5	Multicut, foliar disease resistance, improved seed yield
21.	Pant Chari 6 x CSV 15	Multicut, foliar disease resistance, improved seed yield
22.	Pant Chari 6 x CSV 21F	Multicut, foliar disease resistance, improved seed yield, with high fodder yield
23.	Pant Chari 6 x UTMCH 543	Improved tillering and seed yield
24.	Pant Chari 5 x Pant Chari 7	Foliar disease resistance and improved grain quality
25.	Pant Chari 5 x CSV 15	Improvement in fodder yield with high seed yield
26.	Pant Chari 5 x CSV 21F	Improvement in fodder yield with high seed yield
27.	Pant Chari 5 x UTMCH 543	Improvement in fodder yield with high seed yield
28.	Pant Chari 7 x CSV 21F	Improvement in fodder yield and nutritional quality
29.	CSV 21F x CSV 15	Improvement in fodder yield with high seed yield
30.	CSV 21F x UTMCH 543	Improvement in fodder yield (multi cut) with high seed yield
31.	CSV 15 x Pant Chari 7	Improvement in fodder yield with high seed yield
32.	CSV 15 x UTMCH 543	Improvement in fodder yield (multi cut) with high seed yield
33.	Pant Chari 7 x UTMCH 543	Improvement in fodder yield (multi cut) with high seed yield

Advanced generations maintained and lines selected

Generation	Crosses/ progenies planted	Crosses/ progenies/ progeny plots selected
F ₁	27 crosses	22 crosses
F ₂	16 crosses	140 single plant progenies of 13 crosses
F ₃	174 progenies of 22 crosses	55 progenies of 15 crosses
F ₄	174 progenies of 46 crosses	82 progenies/progeny plot of 27 crosses
F ₅	121 progeny plots of 11 crosses	45 progeny plots of 9 crosses
F ₆	98 progeny plots of 21 crosses	44 progeny plots of 15 crosses
F ₇	17 progeny plots of 9 crosses	7 progeny plots of 5 crosses
Screening plots (F ₈ onwards)	37 progeny plots of 25 crosses	13 progeny plots of 10 crosses

Number of MS, R and Varieties/ hybrids in pipe line: *National level:* One (SPH 1697 –UTMCH 1310); *State level:* Three (UTMCH 539, UTMCH 1308 & UTMCH 1309)

Any new experiment conceptualized: Assessment of single crosses between different cytoplasm and different maintainers for sterility, heterosis for panicle size and combining ability with potential pollinators for their use in development of three way cross hybrids.

Professional achievements (2011-12): Pantnagar was awarded the Best Performing Kharif Centre 2010 in 41st Annual Sorghum Group Meeting at University of Agriculture Sciences, Dharwad from 15-17 April, 2011.

No. of entries contributed to AICSIP and State trials: AICSIP Trials: Two multicut hybrids of forage sorghum viz. UTMCH 1309 and UTMCH 1310 and two checks hybrids CSH 20 MF and CSH 24 MF

State Trials: i. Multicut forage sorghum: Eight test entries (Two hybrid and six varieties of multicut forage sorghum) and three checks (one varietal and two hybrids). ii. Single cut forage sorghum: Six test entries of single cut forage sorghum with two checks.

No. of entries promoted to next level in AICSIP and State trials

AICSIP Trials: One [SPH 1697 (UTMCH 1310)] promoted from IHT to AHT I

State Trials: i. Multicut forage sorghum: Two (UTMCH 1308 and UTMCH 1309) promoted to SVT II

Workshops / conference / meetings attended: 41st Annual Sorghum Group Meeting at University of Agriculture Sciences, Dharwad from 15-17 April, 2011; Annual Day Celebration and DUS Project Review Meeting held at NASC Complex, New Delhi, November 11-12, 2011

Awards / rewards: Pantnagar was awarded the Best Performing Kharif Centre 2010 in 41st Annual Sorghum Group Meeting at University of Agriculture Sciences, Dharwad from 15-17 April, 2011.

13. Hisar

Research Highlights: During kharif 2011, total rainfall and number of rainy days were more than the average rainfall. Forage sorghum genotype S 541, was identified by University varietal identification committee for its release at state level. The proposed variety has given 12.8 and 5.2% increase over the check HC 308 in green and dry fodder yield, respectively. It has also given 10.5% increase in seed yield over the check. The variety has been tested at farmers' fields in 8 districts of Haryana and exhibited 12% increase over the check. It has also been found to be resistant to three important foliar diseases viz. zonate leaf spot, gray leaf spot and sooty stripe. It has also shown 15% shoot fly dead hearts as against 22% dead hearts shown by the check, HC 308. It was also found better in nutritional quality due to low NDF (61.47%), ADF (45.35%) and more digestible crude protein (3.38%) and total digestible nutrients (59.17%) than the check. In total, nine experiments of Breeding were conducted during kharif, 2011 at CCS HAU, Hisar. Quality analyses were carried out in most of the breeding experiments.

Summary of results of different experiments

Breeding: In the experiment involving evaluation of germplasm lines, 187 forage sorghum lines available with CCS HAU, Hisar were planted, maintained and some of these lines were utilized in the crossing programme involving high yielding fodder lines. Besides these, 234 lines of mini core collection were also evaluated for earliness and the genotypes IS 26701, IS 28614, IS 21863, IS 30231, IS 29519 and IS 13782 were found very early.

The Advance and Initial Varietal Trial on Forage Sorghum (multicut), was conducted at Hisar and Karnal locations in which eight entries were tested against three checks. At Hisar, the genotype SPH 1698 could outyield the best hybrid check CSH 24 MF for green fodder yield however, for dry fodder yield SPH 1695 and SPH 1698 out yielded the best check. None of the varieties could out yield the best check for green as well as dry fodder yield. At Karnal, none of the varieties as well as hybrids could out yield the best check. Similarly, Advance and Initial Hybrid/Varietal Trial on Forage Sorghum (Single cut), was also conducted at Hisar and Karnal and eleven varieties were tested against three checks. At Hisar, genotype SPV 3132 ranked first for green fodder yield and the genotype SPV 2057 ranked first for dry fodder yield. At Karnal, SPV 2131 ranked first for green fodder yield, and was followed by SPV 2028 and the genotype SPV 2132 ranked first for dry fodder yield.

In AHT (GS & DP) trial, the genotypes 1040 and 1062; in AVT (GS & DP) trial, the genotypes 2030 and 2028; in IHT (GS & DP) trial, the genotypes 3031 and 3044 and in IVT (GS & DP) trial, the genotypes 4048 and 4079 were found promising dual purpose genotypes. In Advance Seed Trial, the genotypes 8006, 8018 and 8002 were found promising for seed yield.

Breeding material in different filial generations were planted and selections were made for fodder related traits and resistance to foliar diseases and insect-pests. Eleven fresh F₁'s were attempted. Twenty seven F₃'s were grown and selection was made in them for further advancement. From the 19 F₃'s and 50 F₄'s planted, 12 F₃'s and 20 F₄'s were selected. Out of 13 F₅'s, and 18 F₆ families, plants were selected in 7 F₅'s and 9 F₆ families. Sixty single plant progenies were grown and 15 were selected from different filial generations.

Fifteen male sterile lines along with their maintainers were planted. Among these ICS 9 A, 467 A, 725 A and AKMS 14 A were found better for fodder related traits and tillering capacity. Eleven pollinators were also grown and evaluated and the pollinators S 541, S 540, IS 3237, G 46, SSG 9, and IS 2389 (Tan) had high tillering capacity. Sixty two hybrids were evaluated for fodder yield, its component traits and resistance to stem borer and foliar diseases in State Hybrid Trial. Among these HH 485, HH 454, HH 456, HH 479 and HH 484 were found promising. Sixteen SSG lines improved through mutagenesis were evaluated for DUS traits. Eleven genotypes were evaluated for fodder yield, component traits and quality under different salinity conditions. It was observed that there was significant decrease in the fodder yield and its components with the increased level of salinity. The loss was maximum in terms of percentage in EC 3 (12.0 ds-1) followed by EC 2 (8.0 ds-1) and EC 1 (4.0 ds-1). About 125 kg of nucleus seed of all the released varieties was produced during kharif 2011. Besides this, breeder seed (HC 136 – 1.0 q, HC 171- 1.1 q, HC 308- 1.0 q and HJ 513- 1.0 q) was also produced and about 5.0 q TFL seed of the released varieties was also produced.

V. Publications

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5. C.V.Sameer Kumar, Ch.Sreelakshmi and D.Shivani 2010 Genetic diversity analysis in rabi sorghum (*Sorghum bicolor* L.Moench) local genotypes. Electronic Journal of Plant Breeding, 1(4): 527-529.
6. C.V.Sameer Kumar, Ch.Sreelakshmi and D.Shivani 2011. Assessment of variability and cause and effect relationship in interspecific crosses of sorghum (*Sorghum bicolor* L. Moench). Journal of Research, ANGRAU, 39 (1&2): 48-52.
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15. Effect of safflower petal extracts on spore germination of sorghum grain mold fungi. Published in Journal of Oilseeds Research Volume 29 Page No.329-332 (2012)
16. Genetic analysis for qualitative traits in sweet sorghum. C.V.Sameer Kumar, Ch.Sreelakshmi and D.Shivani. 2010. Forage Research, 36 (1): 1-3.
17. Genetic analysis for qualitative traits in sweet sorghum. C.V.Sameer Kumar, Ch.Sreelakshmi and D.Shivani. 2010. Forage Research, 36 (1): 1-3.
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