5. Sorghum Agronomy and Physiology

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Executive summary

A. Kharif Agronomy

In All India Coordinated Sorghum Improvement Project (AICSIP), Agronomic research was conducted on mandatory and eco-region specific trials in kharif 2008. In mandatory trials, pre-released genotypes that were promoted to the second year of testing in AVHT by the breeding programme have been evaluated for their fertility response and yield potential across different sorghum zones of the country. The eco-region specific research was emphasized on improving productivity and profitability of sorghum, maximization of kharif sorghum yield, integrated nutrient management (INM) in sorghum based cropping systems. The details of AICSIP Agronomy technical programme with summary of promising treatments and entries are listed in Table 1.

Table.1: Summary of results of AICSIP Sorghum Agronomy, kharif - 2008

S. No	Trial	Experiment name	Test entries	Checks	Locations	Promising treatments / entries
A. Mandatory Trials						
1. Grain sorghum	1(K) B	Response of advanced (pre-released) sorghum genotypes to different fertility levels under rainfed condition	SPV 1786	CSV 17, SPV 1616, CSV-15, CSH-16	Dharwad, Parbhani, Akola, Indore, Surat (Zone-II)	Responded up to 120 Kg N+60 P_2O_5 + 60 K_2O / ha and SPV 1786 produced higher yield than checks CSV 15 and CSV 17
2. Grain sorghum	1(K) C	–do-	SPH 1596	CSV 17, SPV 1616, SPV-462	Udaipur, Mauranipur, Deesa and Pantnagar (Zone-III)	Responded up to 80 Kg N + 40 Kg P_2O_5 +40 K_2O and SPH 1596 was at par with other checks in grain yield, but superior to CSV17.
3.Dual-purpose	1(K) E	–do-	SPV1779, SPV 1781, SPV 1782	CSV-15	Coimbatore, Palem, Surat, Udaipur, Indore, Mauranipur	Responded up to 120 Kg N+60 P_2O_5 + 60 K_2O / ha and SPV 1779 and SPV 1782 were at par with CSV 15 for grain yield
4. Sweet sorghum	1.1	-do-	SPSSV-11, SPSSV 6	SSV-84, CSH 22SS & CSV-19SS	Akola, Dharwad, Indore, solapur and Coimbatore	Responded up to 120 kg N + 60 Kg P_2O_5 + 60 K_2O/ ha and SPSSV 11 and SPSSV 6 were at par with check varieties.
B. Location specific trials						
5.Grain sorghum	2.1	Integrated nutrients & moisture conservation in kharif sorghum	CSH-23		Parbhani, Dharwad, Akola, Udaipur	Sowing in rows at 45cm and opening furrows 3 weeks after sowing along with 80 Kg N + 40 Kg P_2O_5 / ha was found optimum
6.Grain sorghum	3.1	Evaluation of public-private sector seeds sold in the market	CSH 23,CSH 16,SPV 1616	MSH 51,Glow ,PJH 65,MRS 4094,GK 4013,GK 4009, Ajeet 997, Bhagyalakshmi & 296,Mahabeej7	Palem, Dharwad, Parbhani, Akola, Indore, Surat, Udaipur, Mauranipur	GK 4009 produced 14.1% and 37.2% more grain yield than CSH 16 and CSH 23, respectively.
7.Grain sorghum	4.1	Maximization of kharif sorghum yield	CSH 23, CSH 16, SPV1616 and local	-	Dharwad, Parbhani, Akola, Indore, Surat, Deesa, Udaipur, and Mauranipur	CSH 16 sown in 45 x 15 cm spacing with 150% RDF + 5t FYM produced maximum yield, but 100% RDF was more economical.
C. Forage sorghum						
8	**6**	Response of single cut forage sorghum genotypes to different nitrogen levels.	SRF 305, UTFS 49, SU 1211, NFS 2, S 541	HC 308	Hisar,Pantnagar, Udaipur,Mauranipur,Dharwad	Application of 80 to 120 kg N/ha increased the green fodder yield from 23.9 to 28.8 t/ha, but the rate of response decreased from 0.30 t to 0.24 t/kg N. UTFS 49 and S 541 were superior
9	7	Effect of integrated nutrient management (INM) on yield and quality of single cut forage sorghum	Local	-	Hisar, Pantnagar and Udaipur	80 Kg N + 40 Kg P_2O_5 +40 Kg K_2O (RDF) + 15 kg Zn SO_4 / ha wasoptimum.
10	8	Inter cropping studies on single cut forage sorghum.	Local	-	Pantnagar	Sorghum+Phillipesara (2:2) intercropping produced higher green and dry fodder yields.
11	9	Response of multi-cut forage sorghum genotypes to different nitrogen levels	UTMC 534, CSH 20MF,UTMC H 1304, GK 909	*SSG 59-3 (Local)*	Pantnagar, Hisar, Dharwad and Udaipur	Forage sorghum cv. GK 909 with 150kg N/ha was superior for fodder yields
12	10.	INM studies in forage sorghm - based cropping systems	Local (Multicut)	-	Hisar, Pantnagar and Udaipur	Combination of 75% RDF and Azospirillum was promising

I. *Kharif* grain sorghum

Trail 1KB: Agronomic investigation of advanced / pre released kharif grain sorghum genotypes for their yield potential under rainfed conditions, Kharif 2008 (Zone II):

Increasing fertility levels upto 150% of RDF significantly increased the grain yield dry fodder and at all the centres, and the magnitude of response was maximum at Surat. In general, the test entry gave 8.3% and 38.3 % higher grain yield over CSV 15 and CSV 17, respectively, but at par with SPV 1616. On an average, the test genotype produced 24.7% and 9.2% higher fodder yield over CSH 16 and SPV 1616 respectively.

Trail 1KC: Agronomic investigation of advanced/ pre released kharif grain sorghum genotypes for their yield potential under rainfed conditions, Kharif 2008 (Zone-III)

Increasing fertility levels from native to 150% RDF has increased the grain yield from 2078 kg to 2924 kg/ha, respectively, which was on par with 100% RDF (2681 kg/ha). There was 13% and 24% increase in grain yield with 100 and 150% RDF as compared to 50% RDF (2369 kg/ha). The test genotype SPH 1596 (2634 kg/ha) was on par with SPV 1616 (2709 kg/ha) and SPV 462 (2633 kg/ha) bur superior to CSV 17 in grain yield.

II. *Kharif* dual-purpose sorghum

Trial 1 KE: Agronomic investigations of advanced/ pre-released sorghum genotypes (dual-purpose) for their yield potential under rainfed conditions.

Increasing levels fertility up to 150% RDF significantly increased the grain yield by 20.0% (3607 kg/ha) and stover yield by 15.8 % (15.38 t/ha) as compared to 100% RDF (2986 kg and 13.28 t/ha, respectively). Among the genotypes, the grain yield produced by SPV 1779 (2751 kg/ha) and SPV 1782 (2854 kg/ha) was at par with check CSV 15 (2776 kg/ha).

III. *Kharif* sweet sorghum

Trial 1.1: Agronomic Investigation of advanced –prerelease sweet sorghum genotypes for their yield potential

Increasing fertility levels from 50% to 150% of recommended dose of fertilizer (RDF) significantly increased the stalk yield (33.1 to 41.4 t/ha), Juice yield (3261 liters to 5605 liters/ha), dry fodder yield (26.6 tones to 36.0 tones/ha) and grain yield (2443 kg to 3080 kg/ha). Stalk yield of the test genotypes SPSSV 11 and SPSSV 6 was at par with SSV84 and CSV 19SS but significantly lower than the hybrid check CSH 22SS. Grain yield of SPSSV 11 (3336 kg/ha) was significantly higher than SPSSV 6(2576kg/ha), SSV 84 (2252 kg/ha) and CSV 19SS (1999 Kg) but was at par with CSH22SS (3567 kg).

The test entries responded more to high fertility (150 %RDF) than checks as compared to 100 % RDF. At Akola, response of fertility was significant up to 150% RDF over 50 %RDF in SSV 84 (27.8 t/ha) and CSH 22SS (29.7 t/ha) as compared to CSV 19SS (28.4 t/ha) in dry fodder yield.

Trial 2.1: Integrated nutrient and moisture conservation in *kharif* sorghum

Sowing sorghum at 45 cm rows and opening furrows 3 weeks after sowing (WAS) produced the highest grain yield (3597 kg/ha) and was at par with paired row planting at 30:60 cm and opening furrows at 3 WAS (3491 Kg/ha) (Table 2.1-1). However, the mean stover yield did not vary significantly due to moisture conservation practices. The grain yield (3626 Kg/ha) with recommended dose of fertilizer (80:40:40 kg NPK/ha) was on par with that of 50% RDF + 2.5t FYM + Azotobacter (3607 Kg/ha), but significantly superior to FYM@5t/ha + Azotobacter + PSB (2927 Kg/ha)(Table 2.1-1). Similar trend was observed with stover yield.

Trail 3.1: Evaluation of public and private sector *kharif* grain sorghum cultivars sold in the market for yield potential.

Private sector entry GK 4009 produced 14.1% and 37.2% more grain yield than CSH 16 and CSH 23, respectively. While it produced 24.2% more grain yield than variety SPV 1616. Grain yield across the locations ranged from 3297 (Palem) to 6998 kg/ha (Indore). GK 4009 produced 16.6% and 8.3% more stover yield than CSH 16 and SPV 1616, respectively.

Trial 4.1: Maximization of *kharif* sorghum yield

Different planting geometries did not effect the grain yield except at Udaipur, where 45 x 15 cm spacing produced (10.3%) higher yield (4620 Kg/ha) than that of 45 x 10 cm (4188 Kg/ha). CSH 16 being at par with SPV 1616 produced the maximum grain yield (3851 kg/ha) as compared to local checks (3166 Kg/ha). Increasing levels of fertility from 100% RDF to 150% RDF + 5t FYM/ha significantly increased the grain yield at Coimbatore, Parbhani, Akola and Dharwad. There was no response of adding 5t FYM/ha at Indore and Udaipur centres. Application of 150% RDF and 150% RDF + 5t FYM/ ha increased the grain yield of sorghum by 12.6% and 19.8% respectively as compared to 100% RDF alone. Among different genotypes, SPV 1616 produced the maximum dry fodder yield (13.22 t/ha), which was 31% and 17% higher than CSH 23 and CSH 16, respectively. Maximum B:C ratio (2.31) was obtained from 100% RDF followed by 150%RDF (2.24) and least with addition of 5t FYM + 150% RDF (1.9).

IV. Forage sorghum

Trial 6: Response of single cut forage sorghum genotypes to different nitrogen levels.

Increase in nitrogen levels from 80 to 120 kg/ha increased the green and dry fodder yields from 23.9 to 28.8 t/ha, 9.0 to 11.8 t/ha, respectively. On the other hand, the rate of response decreased from 0.30 t to 0.24 t/kg N in green fodder yields and from 0.11 to 0.09 t/Kg N in dry fodder yields. Forage sorghum cultivars UTFS 49 and S 541 were superior for green fodder (31.9 and 32.2 t/ha) and dry fodder (13.4 and 13.0 t/ha) yields.

Trial 7: Effect of integrated nutrient management (INM) on yield and quality of single cut forage sorghum

Maximum green fodder yield (52.9 t/ha) was obtained from 100% RDF+25kg Zn SO_4 /ha which was at par with 100% RDF+15kg Zn SO_4/ha, but significantly superior to 100 RDF alone, indicating the positive response of Zn in forage sorghum. Dry fodder yield also showed the similar response to fertility levels.

Trial 8: Inter cropping studies on single cut forage sorghum

Sorghum+Phillipesara intercropping was slightly better than sorghum + Cowpea intercropping in terms of total green fodder productivity. Sorghum + Phillipesara (2:1) produced equal amount of dry fodder of sorghum as sorghum alone in addition to 5.4 t/ha fodder yield of Phillipesara.

Trial 9: Response of multi-cut forage sorghum genotypes to different nitrogen levels

Increasing levels of N from 0 to 150 kg/ha significantly increased the green and dry fodder yields, but response of N declined. Maximum green fodder (100.8 t/ha) and dry fodder yield (45.4 t/ha) was obtained with 150kg N/ha. Among different genotypes, GK 909 (89.3t/ha) being at par with Local (87.5t) highest green fodder yield than others. Similar trend was observed with dry fodder yield too. At Hisar, the green fodder yields obtained from CSH 20MF (82.9), GK 909 (82.9) and Local (81.9) at 100 kg N/ha was as high as that of UTMC 534 (82.3t/ha) at 150kg/ha.

Trial 10: INM studies in forage sorghm -based cropping systems

Application of 75% RDF+ 25%N through FYM produced maximum green fodder yield (60.3 t/ha) at Hisar, while that of 75% RDF+Azospirillum at Pantnagar (93t/ha) and 100% RDF through inorganic fertilizer (49.2t/ha) at Udaipur. Overall, 75% RDF+Azospirillum produced the highest green fodder yield (64.8t/ha) but was at par with rest of the combinations and 100% RDF through inorganic fertilizer (63.8t/ha).

B. Kharif Physiology

Table 2K: Evaluation of sweet sorghum germplasm for high sugar content, stalk yields and biomass

Fifty six sweet sorghum promising germplasm along with 2 checks (CSV 19SS and SSV 84) were evaluated in augmented design at Parbhani, Rahuri and Hyderabad. 13 lines i.e., IS 5352, IS 5353, IS 5356, IS 5360, IS 5362, IS 7541, IS 7543, IS 11152, ICSV 25274, SPV 422, IS 5357, IS 7555 and IS 9609 produced higher stalk yield and biomass than check SSV 84 (534 g). In stalk sugar content (brix %) content, none were superior to check SSV 84 (19.7%), however, SPV 422 (20.8%) showed marginal superiority in stalk sugar content than checks. The detailed centre wise data are presented in tables 2k-1 to 2 K-5.

Table 2: Promising sweet sorghum germplasm for stalk yield, brix content and biomass, Kharif 2008

(Mean of 3 locations)

S. No.	Trait	Mean	Min	Max.	Range	SSV 84 (Check)	CD(0.05)	Promising entries superior to check
2	Fresh stalk yield (g/plant)	479	125	897	772	534	39.7	IS-5352, IS-5353, IS-5356, IS-5360, IS-5362, IS-7541, IS-7543 ,IS-11152, ICSV -25274, SPV-422 etc
3	Total fresh biomass (g/plant)	670	186	1260	1074	781	54.8	IS-5352, IS-5353, IS-5356, IS-5360, IS-5362, IS-7541, IS-7543 ,IS-11152, ICSV -25274, SPV-422 etc
4	Juice brix at mat. (%)	18	14.0	22.0	8.0	19.7	0.4	IS-5352, IS-5353, IS-5356, IS-5360, IS-5362, IS-7541, IS-7543 ,IS-11152, ICSV -25274, SPV-422 etc

Trial 4K: Influence of stage of harvesting of sweet sorghum on changes in juice quality, stalk yield and biomass in sweet sorghum, Kharif 2008.

Fresh stalk yield varied from 34.0 to 47.6 t/ha across cultivars and harvesting treatments with a mean of 41.0 t/ha. Stalk yield increased from 15 days after flowering (DAF) to 45 DAF and declined subsequently. Brix value increased significantly from 15 DAF to 60 DAF. Maximum brix value recorded at physiological maturity (45 DAF) was 17 % higher by than at 15 DAF. Sugar yields ranged from 1.44 to 2.80 t/ha across cultivars and treatments. It increased from 15 DAF to 30 DAF, while both 45 DAF and 60DAF treatments were at par. Sugar yields declined by 22 % when sweet sorghum crop harvested at 45 DAF (phy mat) than at 30 DAF (hard dough stage). Mean computed bioethanol yields varied from 725 to 1906 L/ha across cultivars and treatments. Bioethanol yields increased from 15 DAF to 30 DAF, while, it declined at subsequent stages (45 DAF & 60 DAF). Harvesting at 45 DAF decresed the bioethanol yield by 20% as compared to that of 30 DAF.

Trial 5K: Assessment of sweet sorghum for post-harvest deterioration of stalks and juice quality.

As the days from storage increases, there was an increase in brix content from 18 to 24 % mainly because of concentration of sugars. Stalk yield declined by 15.0% after two days of storage. The total sugars marginally increased from 15 to 17% after four days of storage, while reducing sugars (RS) had markedly increased from 1.27 to 5.97% up to 4 days after storage (DAS) due to inversion. The results suggest that the sugar content in the stalks can be retained up to 3 days after harvest in the ambient field storage conditions under the mild winter conditions of November

Sorghum Agronomy and Physiology - Detailed Report

Agro-climatic situation at different kharif sorghum centers

The sowing details, physico-chemical properties of soil and weekly meteorological data on rainfall, temperature and relative humidity are given in for kharif cropping season are presented in Annexure I and II.

Zone- I

Coimbatore: The total rainfall received during kharif crop period (st. week 24 - 43) was just 139 mm. The quantity and distribution of rainfall were not adequate to grow good kharif crop without irrigations. Mean maximum and minimum temperatures ranged from 29 – 33^{0}C and 20 – 24^{0}C, respectively.

Palem: The soils are alfisols with sandy loamy texture having low available N and K. the rainfall received was 498mm just adequate to raise good kharif crop. The distribution was more or less uniform throughput the crop growth period.

Zone- II

Dharwad: Total rainfall received during crop period was 613mm with almost uniform distribution. Very high relative humidity (75 – 96%) was recorded through out the crop growth period.

Hyderabad (NRCS): Total rainfall received during crop growth period was 785mm which is above normal. The distribution of rainfall was highly erratic with very late onset of monsoon by 2nd week of July. The crops sown in June suffered from seedling drought. This followed by torrential rains during August resulted in crop lodging due to water logging. Maximum and minimum temperatures ranged from 29 – 34^{0}C and 14 – 25^{0}C respectively.

Phaltan: Total rainfall received during cropping season was 365mm which was 19.4% below normal for the corresponding period. Early season and terminal droughts were prevailing. Soils are characterized as medium black clay (100cm deep) in texture and possessing high available K (564 Kg/ha) content and low N (182 Kg).

Akola: Actual total rainfall received was 565mm which was 27% less than normal 717mm for this location. The crop experienced midseason drought of two weeks followed by terminal drought in mid-September to late October. Soil has clay texture with low availability N (174Kg/ha) and moderate K (372Kg/ha).

Parbhani: The rainfall received was adequate (562mm) to grow successful kharif crop and the distribution was also uniform in GS1, GS2 and GS3stages of crop.

Zone-III

Gujarat: A total of 1254mm of rainfall was received in kharif season which was about 40% more than normal. Heavy downpour occurred in June and July months.

Udaipur: Kharif crop received a total of 616mm rainfall which was near normal with uniform distribution throughout the season.

Pantnagar: This location received unusually a very high rainfall of 1654mm which was 70% more than normal. Continuous torrential rains disrupted sowings and other crop management operations. The RH recorded at 8.00hr was 80 – 95% with temperature of 29 – 32^{0}C and 15 – 26^{0}C for maximum and minimum, respectively.

A. Kharif Agronomy

I. Kharif grain sorghum

Trail 1KB: Agronomic investigation of advanced / pre releasedkharif grain sorghum genotypes for their yield potential under rainfed conditions, Kharif 2008 (Zone II).

The experiment was conducted at 5 locations (Parbhani, Akola, Dharwad Indore and Surat). Results revealed that increasing fertility levels upto 150% of RDF significantly increased the grain yield at all the centres, and the magnitude of response was maximum at Surat. The test genotype SPV 1786 produced maximum grain yield (6329 kg/ha) at Indore which was at par with SPV 1616 (6072 kg/ha) but significantly superior to hybrid CSH 16' (5729 kg/ha). The test variety also performed better as compared to other check varieties at Akola (Table 1KB-1). Over all, the highest grain yield (5288 kg/ha) was recorded at Indore and the lowest (1977kg/ha) at Parbhani. The interaction between fertility levels and genotypes was found significant at Parbhani centre. (Table 1KB-2). Among different genotypes, cultivar CSV 15 showed higher response at 150% RDF compared to 100% RDF.

Table 1KB-1: Grain yield (kg/ha) of promising grain sorghum genotypes as influenced by different fertility levels, Kharif 2008

Treatment	Parbhani	Akola	Dharwad	Indore	Surat	Mean
Fertility levels						
Native fertility	1185	2548	2272	4471	1325	2360
50% RDF	1926	3134	3126	5192	1959	3067
100% RDF (80:40:40)	2218	3894	3493	5539	2446	3518
150% RDF	2579	4247	3667	5950	3349	3958
CD (p= 0.05)	117	232	188	338	181	229
Genotype						
SPV1786	1719	3725	3152	6329	2177	3420
CSV 17	1458	2912	3292	2399	2304	2473(38.3%)
SPV 1616	2465	3338	2910	6072	2223	3402
CSV 15	1395	3276	2998	5912	2213	3159(8.3%)
CSH 16	2847	4028	3343	5729	2432	3676
CD (P= 0.05)	94	204	156	329	151	483
Location mean	1977	3456	3139	5288	2270	

Table 1KB-2: Grain yield of grain sorghum genotype as influenced by fertility levels at Parbhani, Kharif 2008

Genotype	Native fertility	50% RDF	100%RDF	150% RDF	Mean
SPV1786	1065	1782	1852	2176	1719
CSV 17	880	1343	1667	1944	1458
SPV 1616	1551	2454	2824	3032	2465
CSV 15	694	1319	1435	2130	1395
CSH 16	1736	2731	3310	3611	2847
Mean	1185	1926	2218	2579	
CD (p= 0.05)					
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Similarly, increasing levels of fertility up to 150% RDF had significantly increased the dry fodder at all the centres. However, the difference in yield between 100% RDF (18.82 t) and 150% RDF (17.36 t) at Indore centre was not significant. Test entry SPV 1786 produced higher fodder yield compared to other cultivars at all the centres except at Parbhani (Table 1KB-3). On an average, this genotype produced 24.7% and 9.2% higher yield over CSH 16 and SPV 1616 respectively. Over all, the highest dry fodder yield (16.19 t/ha) was recorded at Indore followed by Akola (11.42 t) and Dharwad (10.88t).

Table 1KB-3: Dry fodder yield (t/ha) of grain sorghum as influenced by fertility levels and genotype, Kharif 2008

Treatment	Parbhani	Akola	Dharwad	Indore	Surat	Mean
Fertility level s						
Native fertility	7.37	9.96	10.19	12.82	3.81	8.83
50% RDF	8.57	10.67	11.13	15.76	5.59	10.35
100% RDF (80:40:40)	9.13	11.93	10.52	17.36	7.02	11.19
150% RDF	9.66	13.11	11.66	18.82	9.57	12.57
CD (p= 0.05)	0.31	0.71	0.89	1.77	0.34	1.31
Genotype						
SPV1786	8.51	13.98	13.38	20.28	6.13	12.46
CSV 17	8.28	11.67	7.61	6.97	6.63	8.23
SPV 1616	8.96	8.89	13.01	19.88	6.34	11.47
CSV 15	8.36	12.87	12.36	18	6.27	11.57
CSH 16	9.29	9.68	8.02	15.83	7.11	9.99
CD (p= 0.05)	0.25	1.05	0.62	1.36	0.3	1.74
Location mean	8.68	11.42	10.88	16.19	6.5	10.73

Plant stand did not vary significantly due to fertility levels and genotypes (**Table** 1KB-4). Increasing fertility levels from native to 150% of RDF reduced the number of days for 50% flowering from 70 to 68. Increasing levels of fertility significantly increased the plant height and 100 seed weight; however, the difference between 100% RDF and 150% RDF was not significant. Test entry SPV 1786 grew tall (247 cm) but, at par with SPV 1616 (245 cm) and CSV15 (237cm). 100-seed weight of SPV 1786 (2.82%) was at par with other check varieties but significantly lower than CSH 16 (3.40g) **(Table** 1KB-4).

Table 1KB-4. Plant stand, phenology and yield components of grain sorghum as influenced by fertility levels and genotype, Kharif 2008

Treatment	Plant stand after thinning (1000/ha)	Days to 50% flow	Days to maturity	Plant height (cm)	100 seed wt (g)	Harvest index (%)	B:C ratio
Fertility levels							
Native fertility	143	70	111	194	2.77	23.54	2.14
50% RDF	147	69	111	206	2.93	24.92	2.39
100% RDF (80:40:40)	146	69	111	220	3.08	26.09	2.55
150% RDF	149	68	111	222	3.22	25.78	2.71
CD (p= 0.05)	NS	1	NS	13	0.15	NS	NS

Treatment	Plant stand after thinning (1000/ha)	Days to 50% flow	Days to maturity	Plant height (cm)	100 seed wt (g)	Harvest index (%)	B:C ratio
Genotype							
SPV1786	149	71	113	247	2.82	23.57	2.72
CSV 17	144	61	104	132	2.85	22.79	2.04
SPV 1616	149	72	114	245	2.99	28.49	2.43
CSV 15	143	71	113	237	2.94	23.13	2.49
CSH 16	147	69	111	191	3.4	27.43	2.57
CD (p= 0.05)	NS	1	2	17	0.14	4.31	0.36

Trail 1KC: Agronomic investigation of advanced/ pre released kharif grain sorghum genotypes for their yield potential under rainfed conditions, Kharif 2008 (Zone-III)

This trial was conducted at Udaipur, Mauranipur and Deesa in zone III. Increasing fertility levels from native to 150% RDF has increased the grain yield from 2078 kg to 2924 kg/ha, respectively, which was on par with 100% RDF (2681 kg/ha). There was 13% and 24% increase in grain yield with 100 and 150% RDF as compared to 50% RDF (2369 kg/ha). The test genotype SPH 1596 (2634 kg/ha) was on par with SPV 1616 (2709 kg/ha) and SPV 462 (2633 kg/ha). Dry fodder yield (9.43 t/ha) produced at 100% RDF was at par with 150% RDF (10.31 t/ha). The test genotype SPH 1596 was late in 50% flowering (68 days) as compared to CSV 17 (51 days), but was on par with SPV 1616 (69 days) and SPV 462 (71 days) (Table1KC-2).

Table .1KC-1. Effect of fertility levels on grain and fodder yield of kharif sorghum genotypes, Kharif 2008

Treatment	Grain yield (kg/ha)				Dry fodder yield (t/ha)			
Fertility levels	*Udaipur*	*Mauranipur*	*Deesa*	*Mean*	*Udaipur*	*Maurinipur*	*Deesa*	*Mean*
Native fertility	3160	2292	783	2078	11.04	6.98	4.47	4.5
50% RDF	3421	2704	982	2369	12.8	7.76	5.23	8.59
100% RDF	3926	2979	1133	2681	14.12	8.2	5.98	9.43
150% RDF	4211	3176	1385	2924	14.38	8.5	8.07	10.31
CD (p= 0.05)	364	457	66	250	0.83	0.24	0.32	1.29
Genotype								
SPV1596	4287	2336	1281	2634	14.44	7.28	6.51	9.41
CSV 17	2959	2407	865	2075	8.03	6.37	3.58	6
SPV 1616	4012	3074	1041	2709	15.79	9.29	7.68	10.92
CSV 462	3465	3333	1101	2633	14.07	8.5	5.98	9.52
CD (p= 0.05)	401	442	66	371	1.2	0.45	0.33	1.14
Loc.mean	3679	2788	1072	2513	13.08	7.86	5.93	8.96

Table1KC-2. Effect of fertility levels on phenology and yield components of kharif sorghum genotypes and net returns, Kharif 2008

Treatment	Plant stand after thinning	Days to 50% flowering	100 seed weight (g)	Net return (Rs./ha)
Fertility levels				
Native fertility	86.25	65	2.8	22428
50% RDF	85.79	65	2.85	25239
100% RDF	85.56	65	2.87	28892
150% RDF	85.19	65	2.9	29733
CD (p= 0.05)	1.0	NS	0.18	2153
Genotype				
SPV1596	93.43	68	3.03	32127
CSV 17	60.83	51	2.6	15137
SPV 1616	98.75	69	2.95	32354
CSV 462	89.77	71	2.83	26674
CD (p= 0.05)	1.33	5	0.15	3060

II. Kharif dual-purpose sorghum

Trial 1 KE: Agronomic investigations of advanced/ pre-released sorghum genotypes (dual-purpose) for their yield potential under rainfed conditions.

Increasing levels fertility up to 150% RDF significantly increased the grain yield (3607 kg/ha) and stover yield (15.38 t/ha) as compared to 100% RDF (2986 kg and 13.28 t/ha, respectively). The crop grew taller at 150% RDF (295 cm), but it was on par with 50% RDF (283 cm). Increase in fertility levels up to 100% RDF reduced the number of days required for 50% flowering (67) as compared to that of native fertility level (69) (Table1KE-1). The grain yield produced by SPV 1779 (2751 kg/ha) was on par with SPV 1782 (1854 kg/ha) and CSV 15 (2776 kg/ha) but was significantly superior to SPV 1781 (2567 kg/ha). Similar trend was observed with stover yield. All test genotypes being at par with each other grew taller (280-287 cm) than check CSV 15 (259 cm). SPV 1779 was late in 50% flowering (68 days) as compared to SPV 1781 (65 days) but was earlier to SPV 1782 (69 days) and CSV 15 (70 days) (Table 1KE-1).

Table 1 KE-1. Plant stand, phenology, grain and stover yield of dual purpose sorghum genotypes at different fertility levels (mean of Palem, Udaipur, Indore and Surat)

Treatment	Grain yield (kg/ha)	Stover yield (t/ha)	Plant stand after thinning	Plant height (cm)	100 seed weight (g)	Days to 50% flowering (days)	Net return (Rs./ha)
Fertility levels							
Native fertility	1828	7.79	123	238	2.64	69	10570
50% RDF	2528	10.95	123	283	2.76	68	18342
100% RDF	2986	13.28	121	288	2.89	67	23559
150% RDF	3607	15.38	122	295	2.95	67	29418
CD (p= 0.05)	516	1.48	NS	39	0.14	1	9245
Genotype							
SPV 1779	2751	12.22	122	278	2.84	68	20836
SPV 1781	2567	11.57	122	280	2.80	65	17407
SPV 1782	2854	12.58	124	287	2.76	69	22177
CSV 15	2776	11.03	120	259	2.84	70	21469
CD (p= 0.05)	180	1.3	NS	17	NS	1	3388

III. Kharif sweet sorghum

Trial 1.1. Agronomic Investigation of advanced –prerelease sweet sorghum genotypes for their yield potential

Two test genotypes SPSSV11 and SPSSV6 along with checks SSV84, CSH22SS, and CSV19SS were evaluated at three fertility levels (F1-50% RDF; F2-100% RDF and F3-150% RDF= 80:40: 40 Kg NPK/ha). Mean data of various centre's (Table1.1-1) revealed that increasing fertility levels from 50% to 150% of recommended dose of fertilizer (RDF) significantly increased the stalk yield (33.1 to 41.4 t/ha) , Juice yield (3261 liters to 5605 liters/ha), dry fodder yield (26.6 tones to 36.0 tones/ha) and grain yield (2443 kg to 3080 kg/ha). Stalk yield of both the test genotypes was at par with SSV84 and CSV 19SS but significantly lower than the hybrid check CSH 22 SS. Grain yield of SPSSV 11 (3336 kg/ha) was significantly higher than SPSSV 6 (2576kg/ha), SSV 84 (2252 kg/ha) and CSV 19SS (1999 Kg) but was at par with CSH22SS (3567 kg) (Table1.1-1).

Table 1.1-1. Plant stand, phenology, stalk yield , quality traits of sweet sorghum grown under different fertility levels (mean of Akola, Dharwad, Indore, Solapur and Coimbatore)

Treatment	Plant stand at harvest (000/ha)	Plant height (cm)	Days to 50% flowering	Days to maturity	100-seed weight (g)	Dry fodder yield(t/ha)	Grain yield (kg/ha)	Juice yield (lit/ha)	Brix (%)	Stalk yield (t/ha)
Fertility level										
50% RDF	117	294	80	120	2.8	26.6	2443	3261	15.3	33.1
100% RDF	117	306	80	120	2.99	31.6	2714	4689	15.2	37.4
150% RDF	118	307	79	119	3.16	36.0	3081	5605	15.6	41.4
CD (P=0.05)	NS	NS	NS	NS	0.19	5.0	249		NS	8.3
Genotype										
SPSSV 11	118	291	74	117	2.89	29.2	3336	4688	16.2	34.9
SPSSV 6	117	300	83	119	2.88	31.7	2576	4115	15.7	35.5
SSV 84 (C)	114	287	84	121	3.1	31.6	2252	4130	16.7	37.3
CSH 22SS (C)	121	329	80	119	3.07	33.7	3567	4950	11.8	40.2
CSV 19SS (C)	117	305	76	120	2.98	30.7	1999	4709	16.5	38.6
CD (P=0.05)	NS	14	3	2	NS	3.9	589	NS	3.7	2.6

Irrespective of the treatments, the lowest grain yield of sweet sorghum was recorded at Akola and the highest at Dharwad (Table 1.1-2). None of the test varieties proved their superiority over CSH 22SS at Akola and Indore. However, SPSSV 11 produced significantly higher grain yield (4574kg/ha) as compared to SPSSV 6 and checks at Dharwad. At Indore, SPSSV 11was significantly superior over rest of the varieties except CSH 22 SS.

Table 1.1-2. Grain yield (kg/ha) of sweet sorghum as influenced by fertility levels and genotype interaction

	Akola				Dharwad				Indore			
Fertility	*50% RDF*	*100% RDF*	*150% RDF*	*Mean*	*50% RDF*	*100% RDF*	*150% RDF*	*Mean*	*50% RDF*	*100% RDF*	*150% RDF*	*Mean*
Variety												
SPSSV 11	1654	1631	1765	1683	4054	4504	5163	4574	3449	3773	4028	3750
SPSSV 6	1465	1726	1943	1711	2975	3242	3721	3313	2454	2708	2951	2704
SSV 84	1609	1770	2109	1830	2883	3074	3527	3161	1488	1817	1986	1764
CSH 22SS	2298	2493	2604	2465	3626	3970	4402	3999	3757	4225	4731	4238
CSV 19SS	1509	1676	2048	1744	1712	2074	2356	2048	1708	2021	2882	2204
Mean	1707	1859	2094		3050	3373	3834		2571	2909	3316	
CD (P=0.05)												
AiBi-AiBj					412				716			
AiBi-AjBi					423				715			

Interaction of fertility levels and genotypes for dry fodder and stalk yields was found significant at Akola centre (Table1.1-3). For the dry fodder yield response of increase in fertility up to 150% RDF over 50% RDF was significant in SSV 84 (124%) and CSH 22SS (92%) as compared to CSV 19SS (73%). At 100% RDF, CSH22SS (61%) and CSV19SS (51%) responded significantly superior as compared to rest of the cultivars. At 150% RDF, SSV 84 followed by SPSSV 11 and SPSSV 6 responded significantly superior over CSH 22SS and CSV 19SS as compared to 100% RDF for the stalk yield, and CSH22SS responded significantly higher (61%) as compared to SPSSV 11 (45%) at 100% RDF over 50% RDF(Table1.1-3).

Similarly, CSV 19SS proved its superiority over SPSSV 6. At 150% RDF, SPSSV 11 (99%) was at par with CSH 22SS (92%) in its response as compared to 50% RDF. However, SPSSV 11, responded better (37%) than CSH 22SS (19%) and SPSSV 6 (31%) than CSV 19SS (15%) when fertility levels were increased from 100% to 150% RDF. At Akola, response of fertility was significant up to 150% RDF over 50 %RDF in SSV 84 (27.8 t/ha) and CSH 22SS (29.7 t/ha) as compared to CSV 19SS (28.4 t/ha). At 100% RDF, CSH 22SS (24.9 t/ha) and CSV19 SS (24.7 t/ha) responded significantly as compared to the rest of the cultivars (Table1.1-3).

Table1.1-3. Dry fodder and stalk yields (t/ha) of sweet sorghum as influenced by interaction of fertility and genotypes at Akola

	Dry fodder yield (t/ha)				Stalk yield (t/ha)			
Genotypes	*50% RDF*	*100% RDF*	*150% RDF*	*Mean*	*50% RDF*	*100% RDF*	*150% RDF*	*Mean*
SPSSV 11	13.6	19.9	27.3	20.3	21.4	31.1	42.6	31.7
SPSSV 6	16.1	22	28.8	22.3	25.1	34.3	45.0	34.8
SSV 84 (C)	12.4	18.7	27.8	19.6	19.3	29.2	43.5	30.7
CSH 22SS(C)	15.5	24.9	29.7	23.4	24.2	39	46.4	36.5
CSV19SS (C)	16.4	24.7	28.4	23.2	25.6	38.5	44.3	36.2
Mean	14.8	22	28.4		23.1	34.4	44.4	
CD (P=0.05)								
AiBi-AiBj	2.1				3.2			
AiBi-AjBi	2.2				3.1			

Trial 2.1. Integrated nutrients & moisture conservation in kharif sorghum

Field experiment was conducted at Pharbhani, Akola, Dharwad, and Udaipur to find out the effect of moisture conservation technique and nutrient management on productivity of sorghum. Maximum grain yield (4365 Kg/ha) was recorded at Akola and minimum at Pharbhani (1723 Kg/ha). Sowing sorghum at 45 cm rows and opening furrows 3 weeks after sowing (WAS) produced the highest grain yield (3597 kg/ha) and was at par with paired row planting at 30:60 cm and opening furrows at 3 WAS (3491 Kg/ha) (Table 2.1-1). Application of recommended dose of fertilizer (80:40:40 & NPK/ha) (3626 Kg/ha) was on par with 50% RDF + 2.5t FYM + Azotobacter (3607 Kg/ha), but significantly superior to FYM@5t/ha + Azotobacter + PSB (2927 Kg/ha)(Table 2.1-1). Mean stover yield did not vary significantly due to moisture conservation practices. Application of 100% RDF (11.28 t/ha) was on par with 50% RDF + 2.5t FYM + Azotobacter (11.04 t/ha) in producing stover yields.

Table 2.1-1: Grain and stover yields of kharif grain sorghum as influenced by moisture conservation and nutrient management, Kharif 2008 (Mean of 4 locations)

Treatment	Grain yield (t/ha)					Stover yield(t/ha)				
	Parbhani	Akola	Dharward	Udaipur	Mean	Parbhani	Akola	Dharward	Udaipur	Mean
Moisture conservation technique										
Flat-bed sowing (45cm)	1620	4377	3463	3489	3237	8.47	10.54	11.25	11.45	10.43
sowing at 45cm and opening furrows 3 weeks after sowing (WAS)	1898	4704	3701	4048	3597	8.5	1081	11.88	12.86	11.01
Paired planting at 30:60cm and opening furrows at 3WAS	1798	4236	3871	4059	3491	8.49	10.03	12.84	13.08	11.11
Paired planting at 30:60cm and with one row of green gram/cowpea	1574	4142	3502	3669	3222	8.3	10.19	11.46	11.62	10.39
CD (p= 0.05)	174	443	163	283	238	0.48	1.01	0.88	0.8	NS
Nutrient management										
RDF (80:40:40 & NPK/ha)	2176	4632	3800	3896	3626	9.14	10.9	12.48	12.61	11.28
FYM @5t/ha + Azotobacter + PSB	1100	3706	3325	3578	2927	7.61	8.99	11.2	11.74	9.89
50% RDF + 2.5t FYM + Azotobacter	1892	4756	3778	4002	3607	8.58	11.28	11.9	12.41	11.04
CD (p= 0.05)	98	222	204	221	168	0.18	0.62	0.99	0.75	0.37
Location mean	1723	4365	3634	3825	3387	8.41	10.39	11.86	12.25	10.74

The interaction effect of moisture conservation practices and fertility levels on grain yield was found significant at Parbhani (Table 2.1-2). Sowing at 45 cm and opening furrows 3 WAS with 100% RDF produced the maximum grain yield (2361 Kg/ha). None of the moisture conservation techniques significantly affected the plant stand, growth and yield parameters and B: C ratio (Table 2.1-3). However, 100% RDF application resulted in early flowering (58 days) as compared to FYM 5t/ha + Azotobacter + PSB (61days) and also the taller plants (193cm) with higher B : C ratio (3.76).

Table 2.1-2: Grain yield (t/ha) of kharif grain sorghum as influenced by interaction between moisture conservation practices and fertility levels at Parbhani, Kharif 2008

Treatment	Fertility levels			
	RDF	FYM 5t + Azotobacter + PSB	50% RDF + 2.5t FYM + Azotobac ter	Mean
Moisture conservation technique				
Flat-bed sowing (45cm)	2083	1111	1667	1620
sowing at 45cm and opening furrows 3 weeks after sowing (WAS)	2361	1319	2014	1898
Paired planting at 30:60cm and opening furrows at 3WAS	2222	995	2176	1798
Paired planting at 30:60cm and with one row of green gram/cowpea	2037	972	1713	1574
Mean	2176	1100	1892	
CD (p= 0.05)				
Aibi-Aibj	196			
Aibi-Ajbi	235			

Table 2.1-3: Effect of moisture conservation technique and fertility on growth, yield attributes and economics

Treatment	Plant stand after thinning (1000/ha)	Days to 50% flow	Plant height (cm)	Days to maturity	100 seed wt (g)	B:C ratio
Moisture conservation technique						
Flat-bed sowing (45cm)	154	59	184	99	3.03	3.13
sowing at 45cm and opening furrows 3 weeks after sowing (WAS)	153	59	191	99	3.15	3.31
Paired planting at 30:60cm and opening furrows at 3WAS	152	59	192	99	2.89	3.16
Paired planting at 30:60cm and with one row of green gram/cowpea	153	59	186	99	2.87	3.33
CD (p= 0.05)	NS	NS	NS	NS	NS	NS
Nutrient management						
RDF (80:40:40 & NPK/ha)	153	58	193	98	3.02	3.76
FYM @5t/ha + Azotobacter + PSB	153	61	179	101	2.93	2.5
50% RDF + 2.5t FYM + Azotobacter	153	59	192	98	3	3.43
CD (p= 0.05)	NS	1	5	3	NS	0.058

Trail 3.1.Evaluation of public and private sector kharif grain sorghum cultivars sold in the market for yield potential

Nine kharif grain sorghum hybrids along with three public sector bred cultivars (CSH 16, CSH 23 and SPV 1616) have been evaluated at six locations in dry land conditions. Significant genotypic differences were observed for grain, stover yields and plant height (Table 3.1-1). Grain yield ranged from 3713 kg /ha (CSH 23) to 5095 Kg/ha (GK 4009) with a mean of 4404 kg/ha. Cv. GK 4009 produced significantly 14.1% more grain yield than CSH 16 and 37.2% higher than CSH 23. While it produced 24.2% more grain yield than variety SPV 1616. Grain yield across the locations ranged from 3297 (Palem) to 6998 kg/ha (Indore). CSH 23 produced 10.5% less grain yield than CSV1616 (Table 3.1-1). Dry fodder yield differed significantly at all locations and ranged from 6.2 t/ha (Surat) to 13.6 t/ha (Udaipur) with a mean of 10.8 t/ha. Private sector hybrid GK 4009 produced 16.6% and 8.3% more stover yield than CSH 16 and SPV 1616, respectively. Plant height and 100 seed weight varied from 183-251 cm and 2.97-3.19 g (Table 3.1-3). Mean days to 50% flowering and harvest Index did not varied significantly across the locations (Table 3.1-4). Significant genotypic differences were

observed for gross returns, net returning, B: C ration at Akola, Surat and Udaipur. The net returns and B: C ranged from Rs 30497-40141 and 2.72-3.44, respectively. Bhagyalakshmi 296, GK 4009 and MSH 51 showed higher B: C ratio than others (Table 3.1-5).

Table 3.1.1 Evaluation of public and private sector kharif grain sorghum cultivars sold in the market for yield potentials, Kharif, 2008, (Mean of 6 Loc- Palem, Parbh, Akola, Indore, Surat, & Udaipur)

S. No	Name	Grain yield (kg/ha)	Stover yield (kg/ha)	Plant height (cm)	100-seed wt(g)	Days to flowering (days)	Harvest Index (%)	Net return (Rs/ha)	B:C ratio
1	MSH 51	4315	10152	183	3.15	64	30.7	37015	3.09
2	Glow	4355	11266	193	3.05	64	29.5	36366	2.96
3	PJH 65	4602	11395	214	3.17	64	29.8	39525	3.04
4	MRS 4094	4582	11115	197	2.98	66	29.7	34191	2.74
5	GK 4013	4273	9929	185	3.11	64	30.7	32018	2.72
6	GK 4009	5095	12157	200	3.19	66	30.7	40141	3.21
7	Ajeet 997	4633	11254	201	3.03	63	30.3	36127	2.99
8	Bhagyalakshmi 296	4439	11070	195	3.02	62	28.1	38891	3.44
9	Mahabeej 7	4275	10612	206	2.97	65	30.0	32844	2.92
10	CSH 23	3713	9602	195	3.06	62	29.2	30497	2.73
11	CSH 16	4464	10427	200	3.05	62	32.0	35381	2.84
12	SPV 1616	4104	11221	251	2.98	67	26.9	31949	2.89
	LOC. MEAN	**4404**	**10850**	**202**	**3.06**	**64**	**29.8**	**35412**	**2.96**
	CD (0.05)	628	1501	14	0.27	5	3.6	7503	0.67
	CV (%)	12.3	12.0	5.88	6.82	5.3	6.1	9.4	9.35

Trial 4.1. Maximization of kharif sorghum yield

Field experiments was conducted at 8 centers to find out the effect of increasing fertility levels on yields of different sorghum genotypes as influenced by various planting geometries (Table 4.1-1). Different planting geometries did not effect the grain yield except at Udaipur, where 45 x 15 cm spacing produced (10.3%) higher yield (4620 Kg/ha) than that of 45 x 10 cm (4188 Kg/ha). The performance of different genotypes varied across the centres indicated that SPV 1616 produced maximum grain yield at Coimbatore (4358 kg/ha) and Indore (7064 Kg/ha), where as CSH 16 yielded higher at parbhani (3226 kg/ha), Akola (4628 Kg/ha), dharwad (3435 Kg/ha) and Udaipur (4689 Kg/ha). Overall, CSH 16 being at par with SPV 1616 produced the maximum grain yield (3851 kg/ha) as compared to local checks (3166 Kg/ha). Increasing levels of fertility from 100% RDF to 150% RDF + 5t FYM/ ha significantly increased the grain yield at coimbatore, parbhani, akola and Dharwad. There was no response of adding 5t FYM/ha at Indore and Udaipur centres. Application of 150% RDF and 150% RDF + 5t FYM/ ha increased the grain yield of sorghum by 12.6% and 19.8% respectively as compared to 100% RDF alone (Table 4.1-1).

Table: effect of planting geometry, genotype and fertility levels on grain yield of kharif sorghum

Treatment	Coimbatore	Parbhani	Akola	Dharwad	Indore	Udaipur	Maurinipur	Deesa	Mean
Planting geometry									
45 x 15 cm	4154	3251	3747	2929	5555	4620	1909	1903	3509
45 x 10 cm	4204	2241	3789	3151	5682	4188	2070	1977	3412
CD (p= 0.05)	NS	149	NS	NS	NS	410	NS	NS	NS
Genotype									
CSH 23	4029	2417	4308	2993	3863	4464	2004	2390	3309
CSH16	4244	3226	4628	3435	6373	4689	2011	2199	3851
SPV 1616	4358	2916	3034	2969	7064	4117	1948	1721	3516
Local check	4086	2424	3103	2764	5176	4344	1995	1438	3166
CD (p= 0.05)	242	83	41	104	258	225	NS	106	437
Local check	Co(s)28	PVK 801	SPV 669	DSV 6	JJ1022	CSV 23	N	GJ39	N
Fertility levels									
100% RDF	3653	2364	3414	2847	4924	4213	1928	1645	3123
150% RDF	4167	2708	3826	3066	5988	4413	1977	1973	3517
150% RDF + 5t FYM	4717	3166	4065	3207	5944	4567	2064	2194	3740
CD (p= 0.05)	126	53	44	86	243	203	NS	106	96
Local mean	4179	2746	3768	3040	5619	4404	1990	1937	3460

The overall effect of planting geometry on grain yield was not significant. However , CSH 16 responded more (10% higher) to the addition of 5t FYM with 150% RDF at 45 x 15 cm spacing as compared to 2% only at 45 x 10 cm spacing (Table 4.1-2.).

Table 4.1-2.: interaction effect of planting geometry, genotypes and fertility levels on grain yield of sorghum

Treatment	45 x 15 cm				45 x 10 cm			
Fertility levels	*CSH 23*	*CSH 16*	*SPV 1616*	*Local*	*CSH 23*	*CSH 16*	*SPV1616*	*Local*
100% RDF	3024	3501	3252	2859	3079	3425	3038	2800
150% RDF	3251	3954	3704	3283	3437	3893	3415	3200
150% RDF + 5t FYM	3485	4349	3971	3461	3576	3982	3705	3394
Mean	3253	3935	3642	3201	3364	3767	3386	3131

Dry fodder yield did not vary significantly due to change in planting geometry. However significantly higher plant stand (174 thousands/ha) was recorded with 45 x 10 cm as compared to that of 45 x 15 cm (127 thousands/ha) (Table 4.1-3). Among different genotypes, SPV 1616 produced the maximum dry fodder yield (13.22 t/ha), which was 31% and 17% higher than CSH 23 and CSH 16, respectively. Increasing fertility levels from 100% RDF to 150% RDF and addition of 5t FYM / ha did not respond significantly for increase in fodder yields. Maximum B: C ratio (2.31) was obtained from 100% RDF followed by 150%RDF (2.24) and least with addition of 5t FYM + 150% RDF (1.9).

Table 4.1-3: effect of planting geometry, genotypes and fertility levels on dry fodder yield of sorghum

Treatment	Dry fodder (t/ha)	Plant stand after thinning (1000/ha)	Plant height (cm)	Days to 50% flow	100 seed wt (g)	B:C ratio
Planting geometry						
45 x 15 cm	11.5	127	215	111	3.13	2.13
45 x 10 cm	11.9	174	216	112	3.03	2.17
CD (p= 0.05)	NS	45	NS	NS	NS	NS
Genotype						
CSH 23	10.07	149	190	107	3.11	2.14
CSH 16	11.34	150	200	111	3.29	2.28
SPV 1616	13.22	151	243	113	3	2.03
Local check	12.28	150	228	116	2.91	2.14
CD (p= 0.05)	1.4	NS	16	5	0.19	0.07
Fertility levels						
100% RDF	11.01	148	207	112	3	2.31
150% RDF	11.88	149	216	112	3.11	2.24
150% RDF + 5t FYM	12.28	154	223	111	3.13	1.9
CD (p= 0.05)	NS	2	4	NS	0.05	0.05

IV. Forage sorghum

Trial 6. Response of single cut forage sorghum genotypes to different nitrogen levels.

At all centers, the increase in nitrogen levels from 80 to 120 kg/ha had increased the green fodder yield. The response was maximum at Hisar (35%) followed by Pantnagar (23%). Among different genotypes UTFS 49 produced the highest yield (48.9 t/ha) at Hisar and S 541at Pantnagar (38.4t/ha) and were superior to check HC 308 **(Table 6.1).** Cv S541 produced higher fodder yield at Udaipur too (48.>t/ha), where as at Dharwad, SV 1211 (28.4t/ha) and SRF 305 (27.6t/ha) were better than other genotypes. By and large, S 541 and UTFS 49 proved better than rest of the genotypes.

Table 6.1. Green fodder yield of single cut forage sorghum as influenced by different nitrogen levels, Kharif 2008

N levels (kg/ha)	Green fodder yield (t/ha)					
	Hisar	*Pantnagar*	*Udaipur*	*Mauranipur*	*Dharwad*	*Mean*
80	30.2	30.3	32.1	6.9	20.3	23.9
100	34.0	34.5	36.0	6.9	21.6	26.8
120	40.7	37.4	36.7	7.0	22.1	28.8
CD (P=0.05)	1.9	2.3	-	-	-	-

N levels (kg/ha)	Green fodder yield (t/ha)					
	Hisar	*Pantnagar*	*Udaipur*	*Mauranipur*	*Dharwad*	*Mean*
Genotypes						
SRF 305	28.3	30.4	45.0	7.8	27.6	27.8
UTFS 49	48.9	36.1	41.9	7.8	24.8	31.9
SU 1211	23.3	36.1	38.3	8.9	28.4	27.0
NFS 2	23.1	31.0	35.7	8.4	25.5	24.7
S 541	43.8	38.4	48.7	8.7	21.7	32.2
HC 308	44.0	32.5	-	-	-	38.3*
CD (P=0.05)	8.0	4.4	-	-	-	

*mean of 2 centres

Dry fodder yield increased with increasing levels of N from 80 to 120 kg/ha. The response was higher (75%) at Pantnagar followed by Hisar (45%) and Udaipur (18%). Cv UTFS 49 produced the highest dry fodder yields at Hisar (15.1 t/ha) and Pantnagar (12.4 t/ha) which was 15% and 32% higher, respectively over check HC 308 (Table 6.2).

Table 6.2. Dry fodder yield as influenced by nitrogen levels and genotypes, Kharif 2008

Treatment	Dry fodder yield (t/ha)			
N levels (kg/ha)	*Hisar*	*Pantnagar*	*Udaipur*	*Mean*
80	8.6	6.7	9.6	9
100	10.5	10.4	11.2	10.7
120	12.5	11.7	11.3	11.8
CD (P=0.05)	0.57	0.67	-	-
Genotypes				
SRF 305	8.4	8.1	13.9	10.1
UTFS 49	15.1	12.4	12.8	13.4
SU 1211	7.1	10.6	11.5	9.7
NFS 2	6.9	10	10.8	9.2
S 541	12.7	11.1	15.2	13
HC 308	13.1	9.4	-	11.3
CD (P=0.05)	2.3	1.3	-	-

Trial 7. Effect of integrated nutrient management (INM) on yield and quality of single cut forage sorghum (mean of Hisar, Pantnagar and Udaipur)

Application of recommended dose of fertilizer (RDF) significantly increased the green and dry fodder yields and plant height over control (Table 7.1). Maximum green fodder yield (52.9 t/ha) was obtained from 100% RDF+25kg Zn/ha which was 15.5% higher as compared to 100% only closely followed by 100% RDF+20kg Zn/ha at all the centres, indicating the positive response of Zn in forage sorghum. Dry fodder yield also showed the similar response to fertility levels. Further, there was no response of fertility levels on days to 50% flowering and leaf; stem ratio. (Table 7.1)

Table 7.1. Effect of INM practices on green and dry fodder yields and phenology of f forage sorghum

S. No	Treatments	Green fodder yield (t/ha)	Dry fodder yield (t/ha)	Plant height (cm)	Days to 50% flowering (days)	Leaf: stem ratio
1	Control	32.9	8.99	206	82	0.24
2	100% RDF	45.8	13.97	272	79	0.24
3	100% RDF + 15 kg Zn SO_4/ha	49.1	15.19	274	79	0.24
4	100% RDF + 20kg Zn SO_4/ha	51.2	16.06	276	79	0.24
5	100% RDF + 25 kg Zn SO4/ha	52.9	16.43	271	79	0.24
6	75%RDF+10t FYM	45.8	13.34	253	79	0.29
7	75%RDF+1.5t Vermicompost	44.4	12.96	262	80	0.3
8	50%RDF+20t FYM	45.1	13.33	234	80	2.7
9	50%RDF+3.0t Vermicompost	45.4	13.21	245	79	0.33
10	CD (P=0.05)	6.1	1.8	23	NS	NS

Trial 8. Inter cropping studies on single cut forage sorghum (Pantnagar)

The experiment was conducted at Pantnagar to study the effect legume intercrops on forage Yield of sorghum. Two legumes viz., Phillipesara and Cowpea were intercropped with forage sorghum in different proportions as 1:1, 2:1 and 2:2 (Table 8.1). Results revealed that intercropping of both legumes increased the total green fodder yields as compared to sorghum alone. None of the intercrops had direct increase on sorghum green fodder yield. Sorghum + Phillipesara (2:1) and sorghum + Cowpea (2:2) produced higher sorghum green fodder as compared to other row ratios. Overall, Sorghum+Phillipesara intercropping was slightly better than sorghum + Cowpea intercropping in terms of total green fodder productivity. Sorghum + Phillipesara (2:1) produced equal amount of dry fodder of sorghum as sorghum alone in addition to 5.4 t/ha fodder yield of Phillipesara.

Table: 8.1 Effect of intercropping on fodder yield of sorghum, Kharif 2008

Treatments	Green fodder yield (t/ha)				Dry fodder yield (t/ha)			
	Sorghum	*Phillipesara*	*Cowpea*	*Total*	*Sorghum*	*Phillipesara*	*Cowpea*	*Total*
Sole sorghum	38.7	-	-	38.7	10.5	-	-	10.5
Sole Phillipesara (Wild moong)	-	44.2	-	44.2	-	10.5	-	10.5
Sole Cowpea	-	-	53.8	53.8	-	-	9.9	9.9
Sorghum+Philipesara (1:1)	29.2	28.8	-	58.0	5.8	5.6	-	11.4
(2:1)	34.2	25.8	-	60.0	10.5	5.4	-	15.9
(2:2)	30.8	32.1	-	62.9	6.7	5.9	-	12.6
Sorghum+Cowpea (1:1)	27.9	-	31.3	59.2	5.7	-	4.8	10.5
(2:1)	25.8	-	33.8	59.6	5.5	-	4.7	10.2
(2:2)	32.1	-	24.2	56.3	7.2	-	4.3	11.5
CD (P=0.05)	2.5	9.2	15.3	-	0.58	1.8	2.5	-

Trial 9. Response of multi cut forage sorghum genotypes to different nitrogen levels

Increasing levels of N from 0 to 150 kg/ha significantly increased the green and dry fodder yields as well as plant height and leaf to stem ratio. Maximum green fodder (100.8 t/ha) and dry fodder yield (45.4 t/ha) was obtained with 150kg N/ha (Table 9.1). Among different genotypes, GK 909 (89.3t/ha) being at par with Local (87.5t) followed by CSH 20MF (85.3t/ha) produced the highest green fodder yield than others. Similar trend was observed with dry fodder yield too. Different genotypes did not vary significantly with respect to plant height and days to 50% flowering, however, significantly higher leaf to stem ratio (0.87 and 0.86) was obtained with GK 909 and UTMC 534 (Table 9.1).

Table 9.1. Effect of nitrogen levels and genotypes on dry and green fodder yields, phenology in multi-cut forage sorghum, Kharif 2008

Treatment	Green fodder yield (t/ha)	Dry fodder yield (t/ha)	Plant height (cm)	Leaf: stem ratio	Days to 50% flowering
N levels (kg/ha)					
0	60.1	28.4	186	0.69	56
50	80.7	37.1	209	0.77	55
100	92.2	41.7	224	0.81	54
150	100.8	45.4	235	0.84	54
CD (p=0.05)	4.8	3.3	4	0.02	NS
Genotypes					
UTMC 534	75.4	34.1	209	0.86	55
CSH 20MF	85.3	39.1	212	0.87	55
UTMCH 1304	79.7	35.5	207	0.65	54
GK 909	89.3	40.8	220	0.87	55
SSG 59-3 (Local)	87.5	41.3	218	0.74	55
CD (p=0.05)	8.9	6.3	NS	0.02	NS

Interaction effect of nitrogen and genotypes for fodder yield was significant at different centres. At Hisar, the yields obtained from CSH 20MF (82.9), GK 909 (82.9) and Local (81.9) at 100 kg N/ha was as high as produced by UTMC 534 (82.3t/ha) at 150kg/ha (Table 9.2.a and b). At Udaipur the fodder yield obtained with Local (58.1t/ha) was as good as that obtained with UTMC 534, CSH 20MF and UTMCH 1304 at 150kg/ha. At

Hisar, GK 909 & Local showed significantly higher response of increasing levels of N from 0 to 150kg/ha. At pantnagar UTMCH 1304 showed significantly higher response of increasing levels of N from 50 to 150kg/ha, where as, at Udaipur, GK 909 & Local showed higher response. At Dharwad, GK 909 and Local gave higher yield at 50kg/ha than produced by UTMC 534 and UTMCH 1304 at 100kgN /ha (Table 9.2.a and b).

Table 9.2. a. Nitrogen by genotype interaction for green fodder yield at different centers (contd.).

	Hisar					Pantnagar				
	N levels kg/ha									
Genotype	0	50	100	150	M	0	50	100	150	M
UTMC 534	50.4	66.7	74.1	82.3	68.4	37.2	67.8	82.9	95.2	70.8
CSH 20MF	54.7	74.9	82.9	96.1	77.2	43.7	75.2	91.1	103	78.3
UTMCH 1304	44.2	66.5	78.0	87.9	69.1	47.4	72.3	93.5	121	83.6
GK 909	47.3	74.9	82.9	92	74.3	53.1	83.3	105	117	89.8
SSG 59 -3 (Local)	45.9	71.8	81.9	89.7	72.3	49	73.1	86.6	97.6	76.6
Mean	48.5	70.9	80.0	89.6		46.1	74.3	91.9	107	
CD (p=0.05)(N levels)	1.9					4.3				
Genotypes	6.5					12.2				
Aibi -Aibj Aibi -Ajbi	4.3 7.5					9.7 14.8				

Table 9.2.b. Nitrogen by genotype interaction for green fodder yield at different centres

N levels kg/ha	Udaipur					Dharwad				
	N levels kg/ha									
Genotype	0	50	100	150	M	0	50	100	150	M
UTMC 534	31.3	41.1	48.1	52.1	43.1	97.5	119	125	136	119
CSH 20MF	38.3	48.2	55.9	58.1	50.1	108	135	146	154	136
UTMCH 1304	40.1	48.0	54.4	54.4	49.2	99	112	127	130	117
GK 909	40.3	50.2	61.9	64.9	54.3	113	139	148	155	139
SSG 59-3 (Local)	43.4	58.1	68.5	69.2	59.8	118	138	151	159	141
Mean	38.7	49.1	57.8	59.7		107	128	139	147	
CD (p=0.05)(N levels)	2.1					2.4				
Genotypes	2.8					2.2				
Aibi-Aibj Aibi-Ajbi	4.6 4.9					5.3 5.1				

Trial: 10. INM studies in forage sorghm -based cropping systems

The experiment was conducted to find out the optimum combination of organic and inorganic fertilizers and biofertilizer in forage sorghum at three locations (Hisar, Pantnagar and Udaipur). It was observed that the effect of INM treatments varied with locations. While 75% RDF+ 25%N through FYM produced maximum yield 60.3 t/ha at Hisar, 75% RDF+Azospirillum was the best at Pantnagar (93t/ha) and 100% RDF through inorganic fertilizer (49.2t/ha) at Udaipur. Overall, 75% RDF+Azospirillum produced the highest green fodder yield (64.8t/ha) but was at par with rest of the combinations and 100% RDF through inorganic fertilizer (63.8t/ha) (Table 10.1). Similarly dry fodder yield also did not vary significantly due to different INM combinations, expert 50% RDF + Azospirillum, which produced the lower fodder yield (13.8t/ha) as compared to 75% RDF+Azospirillum (16.8t/ha and 100% RDF through inorganic fertilizer (16.8t/ha) (Table 10.1).

Table: 10.1: Effect of integrated nutrient management on fodder yield of forage sorghum

Treatments	Green fodder yield (t/ha)				Dry fodder yield (t/ha)			Pl. ht. (cm)	Days to flow (days)	
	Hisar	*Pant*	*Udaipur*	*Mean*	*Hisar*	*Pant*	*Udaipur*	*Mean*	*Udaipur*	*Udaipur*
Control	36.0	37.2	26.6	33.3	9.3	7.8	8.8	8.6	171	71
100% 'N'through FYM	52.1	66.0	35.1	51.1	13.5	13.6	12.3	13.1	95	70
100% RDF through inorganic fertilizer	55.4	86.8	49.2	63.8	14.9	17.7	17.8	16.8	218	67
75%RDF+75%'N' through FYM	60.3	86.6	39.9	62.3	16.9	16.7	14.5	16.1	212	67

Treatments	Green fodder yield (t/ha)				Dry fodder yield (t/ha)			Pl. ht. (cm)	Days to flow (days)	
	Hisar	*Pant*	*Udaipur*	*Mean*	*Hisar*	*Pant*	*Udaipur*	*Mean*	*Udaipur*	*Udaipur*
50%RDF+50%'N' throughFYM	58.1	82.9	37.7	59.6	16.2	16.3	13.6	15.4	208	68
50%RDF+Azospirillum	50.2	79.8	35.6	55.2	13.1	15.5	12.8	13.8	199	69
50%RDf+25%'N'Through Fym+Azospirillum	53.9	82.7	47.2	61.3	14.6	16.2	17.1	16.0	210	67
75% RDF+ Azospirillum	52.7	93.0	48.6	64.8	13.4	19.3	17.6	16.8	214	69
CD(P=05)	4.3	12.7	5.6	12.9	1.6	3.2	1.9	2.7	1.4	NS

B. Kharif Physiology

Table 2K: Evaluation of sweet sorghum germplasm for high sugar content, stalk yields and biomass

Fifty six sweet sorghum promising germplasm along with 2 checks (CSV 19SS and SSV 84) were evaluated in augmented design at Parbhani, Rahuri and Hyderabad during kharif 2008. Data on crop phenology, biomass, stalk yield, sugar content (brix) were recorded. Checks were planted in every eight row interval to identify promising lines. In stalk yield at physiological maturity, 13 lines i.e., IS 5352, IS 5353, IS 5356, IS 5360, IS 5362, IS 7541, IS 7543, IS 11152, ICSV 25274, SPV 422, IS 5357, IS 7555 and IS 9609 produced higher stalk yield than check SSV 84 (534 g) (Table 2K-1). The same entries too produced very high biomass than check SSV 84(781g/pl). Interestingly, IS 5352 (897 g/pl) IS 5362 (838 g/pl) and IS 5357 (885 g/pl) produced very high stalk yield than check indicating the scope for selection these lines as restorers for high biomass production along with high sugar content. In stalk sugar content (brix %) content, none were superior to check SSV 84 (19.7%), however, SPV 422 (20.8%) showed marginal superiority in stalk sugar content than checks. The detailed centre wise data are presented in tables 2k-1 to 2K-5.

Table 2K-1. Promising sweet sorghum germplasm for stalk yield, sugar content (juice brix) and biomass among the fifty six lines grown in Kharif 2008

Entry	Plant height at phy.maturity (cm)	Fresh biomass at physiological maturity (g/pl)	Fresh stalk yield at Phy. Maturity (g/pl)	Juicy brix at phy. Maturity (%)	Juice extrction at phy. Maturity (%)
IS-5352	427	1183	897	17.3	26.4
IS-5353	391	1019	775	16.2	25.6
IS-5356	478	795	709	18.1	25.4
IS-5360	406	881	735	17.5	21.6
IS-5362	375	1145	838	17.2	20.3
IS-7541	366	754	623	15.3	29.0
IS-7543	381	793	536	16.2	25.0
IS-11152	350	822	562	16.8	21.0
ICSV-25274	308	810	572	19.0	29.1
SPV-422	266	808	635	20.8	29.0
IS-5357	337	1094	885	18.1	21.8
IS-7555	359	907	659	15.6	31.0
IS-9609	390	1008	702	17.7	34.0
SSV-84 (C)	305	781	534	**19.7**	24.2
CSV-19SS (C)	310	670	485	18.7	19.5
Grand Mean	**308**	**670**	**479**	**18.0**	**24.0**
Minimum	138	186	125	14.0	4.0
Maximum	478	1260	897	22.0	37.0
Range	341	1074	772	8.0	33
SD	59.6	229.8	166.4	1.8	5.5
CD (0.05)	14.2	54.8	39.7	0.4	1.3

Trial 4K. Influence of stage of harvesting of sweet sorghum on changes in juice quality, stalk yield and biomass in sweet sorghum, Kharif 2008

This trail was organized at Rahuri, Phaltan, coimbator, and Almel with an objective of quantifying the effect of stage of harvesting (from post flowering to post phy.maturity stages) on changes in stalk yield, sugar content, biomass and bioethanol in sweet sorghum. Four cultivars along with four stages of harvesting treatments were

tried in FRBD. Factor-A, comprising four cultivars include SSV84 (V1), CSH22SS (V2) CSV19SS (V3) and SPSSV 6 (V4), while, stages of harvesting (Factor B) include ;T1- harvesting at 15 days after flowering (DAF)-soft-dough stage; T2-harvesting at 30 DAF-hard-dough stage; T3-harvesting at 45 DAF- phy. maturity; and T4-harvesting at 60 DAF-post phy. maturity.

Stalk Yields: Fresh stalk yield varied from 34.0 to 47.6 t/ha across cultivars and harvesting treatments with a mean of 41.0 t/ha. There were significant differences among cultivars for stalk yield but not among treatments. Similarly, the interaction effects were not significant. Stalk yield increased from 15 DAF to 45 DAF followed by a decline at 60 DAF. Harvesting at phy. maturity gave higher stalk yields than earlier stages.

Juice brix: Brix values varied from 11 to 18% across cultivars and treatments. The differences in brix were significant among treatments but not the cultivars. Brix value increased significantly from 15 DAF to 60 DAF. Among the stages of harvest, brix value recorded was significantly higher by 17 % at physiological maturity than preceding stages, but on par with 60DAF (Table 4K.1).

Juice extraction and yields: In general juice extraction declined from 15 DAF (43.6%) to 6 DAF (36.4%) across stages of harvest. Differences were significant among the treatments but not the cultivars. The extraction percent ranged between 36.0 and 45 % across the cultivars and treatments. Similarly, juice yields declined from 15 DAF to 60 DAF.

Sugar Yields: Sugar yields ranged from 1.44 to 2.80 t/ha across cultivars and treatments. Sugar yields did not differed significantly among cultivars and treatments. It increased from 15 DAF to 30 DAF, while both 45 DAF and 60DAF treatments are at par to each other. Sugar yields declined by 22 % when sweet sorghum crop harvested at 45 DAF (phy mat) than at 30 DAF–hard dough stage.

Bioethanol yields: Mean computed bioethanol yields varied from 725 to 1906 L/ha across cultivars and treatments (Table 4K.1). Differences in bioethanol yields were significant among cultivars and stages of harvest at Rahuri and Phaltan. Bioethanol yields increased from 15 DAF to 30 DAF, while, it declined at subsequent stages (45 DAF & 60 DAF). Harvesting at 45 DAF decreased the bioethanol yield by 20% as compared to that of 30 DAF.

Table 4K.-1 Effect of stage of crop harvesting and genotypes on bioethanol yield in kharif sweet sorghum, Kharif 2008

Treatment	Stalk yield (t/ha)				Bioethanol yield(L/ha)		
Cultivars	*Rahuri*	*Phaltan*	*Coimbatore*	*Mean*	*Rahuri*	*Phaltan*	*Mean*
SSV84	43.9	25.7	36.1	35.2	789	815	802
CSH22SS	55.5	38.8	40.4	44.9	939	1401	1170
CSV19SS	53.3	45.8	38.9	46.0	940	1566	1253
SPSSV 6	52.4	27.7	33.5	37.8	853	854	854
CD (P=0.05)	1.7	10.1	2.6	9.1	18	314	-
Stage of harvesting							
15 DAF	49.1	34.9	32.9	39.0	785	1339	1062
30DAF	51.0	38.0	35.2	41.4	936	1367	1151
45DAF	52.1	34.7	40.3	42.4	885	1004	945
60DAF	53.1	30.2	40.6	41.3	916	926	921
CD (P=0.05)	7.2	3.7	4.4	3.0	13	138	-
Location Mean	51.3	34.5	37.2	41.0	880	1159	1020

Trial 5K. Assessment of sweet sorghum for post-harvest deterioration of stalks and juice quality

Sweet sorghum cultivar SSV 84 has been evaluated with an objective of assessing post-harvest deterioration of stalks and juice quality under ambient filed storage conditions. The stalks have been harvested immediately after physiological maturity and were stored in the ambient field conditions for five days. The juice was extracted at one day interval up to five days. Date on juice brix, components of sugar was analyzed every day up to five days after harvest along with a control (0 hour after harvest).

Significant differences were observed for biomass, brix, TSS, RS and sucrose content at Rahuri and NRCS (Table 5k-1). As the days from storage increases, there was an increase in brix content (20.3 – 24% at Rahuri and 18.8 -22.8 % at NRCS) mainly because of concentration of sugars. Mean juice yield declined by 33% at the end of 4 days of storage. On the other hand, stalk yield declined by 15.0% after two days of storage. Similar trend was observed for juice extraction too. The total sugars marginally increased from 15 to 17% after four days of storage, while reducing sugars (RS) had markedly increased from 1.27 to 5.97% up to 4 days after storage (DAS) due to inversion. In case of sucrose content, there was a decrease from control (13.51%) to up to the end of 4 days of storage (11.33%). The results suggest that the sugar content in the stalks can be retained up to 3-days after harvest in the ambient field storage conditions under the mild winter conditions of November.

Trial 5K. Assessment of sweet sorghum (cv SS 84) for post-harvest deterioration of stalks and juice quality, Kharif 2008

	Stalk yields (kg/ha)				Total sugars (%)				Reducing sugars (%)			
Treatment	*RAHURI*	*NRCS*	*MEAN*	*R*	*RAHURI*	*NRCS*	*MEAN*	*R*	*RAHURI*	*NRCS*	*MEAN*	*R*
T1 - 0 hrs	51604	40119	45861	1	14.26	15.31	14.78	6	1.21	1.34	1.27	6
T2 - 24 hrs	51231	35411	43321	2	14.30	17.83	16.07	3	1.30	7.60	4.45	5
T3 - 48 hrs	50669	28736	39703	6	13.14	16.62	14.88	5	1.16	8.63	4.89	4
T4 - 72 hrs	50903	29806	40354	4	15.42	15.78	15.60	4	1.26	8.67	4.97	3
T5 - 96 hrs	49558	31131	40344	5	15.60	19.00	17.30	1	1.36	10.58	5.97	1
T6 - 120 hrs	49451	34681	42066	3	15.89	17.21	16.55	2	1.20	9.44	5.32	2
Loc. Mean	50569	33314	41942		14.77	16.96	15.86		1.25	7.71	4.48	
MIN	49451	28736	39703		13.14	15.31	14.78		1.16	1.34	1.27	
MAX	51604	40119	45861		15.89	19.00	17.30		1.36	10.58	5.97	
C.D. (0.05)	1601	8329	7251		0.06	2.65	2.62		0.04	0.78	5.91	
CV (%)	1.74	13.74	6.73		0.24	8.58	6.43		1.56	5.53	51.30	
F (Prob.)	0.00	0.00	0.37		0.00	0.00	0.26		0.00	0.00	0.49	

T1: Juice & stalk quality at 0 hrs; T2: Juice & stalk quality at 24 hrs; T3: Juice & stalk quality at 48 hrs;
T4: Juice & stalk quality at 72 hrs; T5: Juice & stalk quality at 96 hrs; T6: Juice & stalk quality at 120 hrs

Annexure 1: Particulars of sowing and crop management followed at different centers - Agronomy and Physiology Trials, Kharif 2008

S.No	Particulars	Palem	Coim-batore	Hydera-bad	Dhar-wad	Par-bhani	Akola	Phaltan	Indore	Udaipur	Pant-nagar
1	Soil texture	Sandy loam	Clay loam	Clay loam	Medium	Medium black soil	Clay	Medium black clayey	Medium black soil	Clay loam	Silty clay loam
2	Soil depth (cm):			100	Deep		75	100		100	
3	Soil pH value (1:2.5 soils: water):	6.47		7.5	7.3		7.82	8.4		8.1	6.7
4	Field capacity (%):				32					18.1	
5	Wilting point (%):				16					6.8	
6	Bulk density(g/cc):				1.3		1.37			1.46	1.106
7	EC (1:2.5 soils: water) (d/Sm):	0.27		0.18			0.36			0.89	
8	Soil organic matter (%)	0.72		0.88	0.54		0.741			0.49	
9	Total soil nitrogen (%)										
10	Available Nitrogen (kg/ha):	200		172.45	220		174	182		289.75	
11	Available P2O5 (kg/ha):	28		15.8	21.2		15.4	23		20.35	44.1
12	Available K2O (kg/ha):	298		509.6	305		372	564		395.25	276
13	Date of sowing	27-Jun-08	18-Jun-08	19-Jun-08	15-Jun-08	26-Jun-08	2-Jul-08	25-Jun-08	22-Jun-08	3-Jul-08	30-Jun-08
14	Rainfall received during crop period (mm)	497.9	139	785	613	562	717	365		166.7	1654.4

Annexure II: Weekly weather data at different centres, Kharif 2008

Location :**Coimbatore**; State :Tamil Nadu								Location :Dharwad							Loc: NRCS, Rajendranagar; AP					
Lati: 11^0,0 N; Lon:77^O,0 E;								State :Karnataka							Lati:17^0,27'N; Longi:78^0,28' E				Alt:524 MSL	
St.wk.	Dates	Rainfall	RH(%)		Temp.(^{O}C)			St.wk.	Rainfall	RH(%)		Temp.(^{O}C)			St.wk.	Rainfall	RH(%)		Temperature(^{O}C)	
		(mm)	8.00 h	14.30 h	Max.	Min.			(mm)	8.00 h	14.30 h	Max.	Min.			(mm)	AM	PM	Max.	Min.
24	Jun 11-17	1.8	70.1	49.4	31.4	24.5		24	25.0	92.0	85.7	26.6	20.7		24	14.8	73	49	33.2	24.3
25	18-24	7.0	84.3	48.6	32.1	22.9		25	10.4	90.9	69.6	28.5	21.2		25	0.2	70	40	35.0	25.3
26	25-01	10.8	75.9	61.1	31.0	23.3		26	20.4	91.0	76.1	28.5	21.1		26	39.6	83	59	31.6	23.5
27	Jul 02-08	0.0	80.7	48.4	31.9	22.8		27	7.6	89.4	69.0	37.3	21.2		27	0.0	73	52	33.6	25.0
28	09-15	0.0	81.0	47.9	32.3	23.4		28	11.0	91.3	71.7	28.4	20.5		28	4.1	74	43	33.9	31.9
29	16-22	7.2	89.7	56.4	32.3	22.9		29	1.4	87.6	66.6	30.2	20.5		29	12.8	75	57	33.6	25.3
30	23-29	19.2	81.7	62.3	29.3	23.1		30	78.2	94.4	79.0	27.6	20.3		30	65.2	92	79	28.6	22.5
31	30-05	1.4	80.1	57.5	29.4	24.1		31	37.0	96.0	83.1	26.0	20.8		31	120.2	88	68	29.7	23.0
32	Aug 06-12	3.0	80.4	55.0	30.9	23.5		32	96.0	94.4	88.0	84.8	20.2		32	188.8	90	79	26.6	22.8
33	13-19	18.4	92.1	47.9	30.4	22.4		33	95.6	80.4	85.6	24.9	20.3		33	105.7	89	70	29.6	23.1
34	20-26	1.4	91.0	43.8	31.9	22.1		34	1.8	85.4	59.7	28.9	19.2		34	74.8	89	64	30.2	23.1
35	27-02	50.3	92.3	53.7	32.1	22.5		35	18.6	92.0	65.7	29.8	20.4		35	25.9	88	63	31.6	24.0
36	Sep 03-09	12.9	87.6	60.0	31.6	22.7		36	28.2	93.4	68.9	29.7	20.7		36	47.4	91	63	31.5	22.9
37	10-16	5.6	75.9	55.4	29.9	22.8		37	24.0	91.3	81.1	25.7	19.8		37	25.2	89	78	28.1	22.7
38	Sep17-23	0.0	86.9	46.9	32.0	20.9		38	8.4	92.3	73.6	26.7	20.0		38	6.5	95	89	29.5	22.7
39	24-30	0.0	83.1	42.7	33.0	20.0		39	88.8	89.1	57.1	28.4	18.7		39	0.0	91	59	30.9	21.0
40	Oct 01-07							40	6.6	91.0	59.1	30.1	19.9		40	49.4	88	68	32.6	22.1
41	08-14							41	44.2	88.0	54.6	30.7	19.5		41	3.0	92	57	31.5	21.5
42	15-21							42	0.4	82.9	49.0	31.7	19.2		42	1.2	85	52	31.3	21.1
43	22-28							43	9.2	75.1	50.0	28.9	17.9		43	0.0	75	41	30.3	17.6
44	29-04							44		70.0	27.7	30.9	13.9		44	0.0	69	31	31.8	13.9
Total rainfall (mm)		**139.0**							**613**							**785**				

Annexure II (Contd.)

Location :RARs, Palem (AP)

St.wk.	Dates	Rainfall	RH(%)		Temp.(^{O}C)	
		(mm)	8.00 h	14.30 h	Max.	Min.
24	Jun 11-17	10.0	81.0	45.7	31.9	23.8
25	18-24	2.2	72.5	38.5	33.6	24.9
26	25-01	31.0	83.5	51.2	31.0	19.9
27	Jul 02-08	1.4	74.4	44.8	32.3	24.3
28	09-15	10.8	77.5	42.5	32.8	24.0
29	16-22	27.6	75.8	45.8	32.7	24.4
30	23-29	35.2	91.7	70.2	27.4	22.4
31	30-05	21.8	93.7	63.5	28.6	22.5

Phaltan ;State:MS; Lati:19$^{0.}$47'N; Longi:74^0,32' E

St.wk.	Dates	Rainfall				RH(%)		Temperature(^{O}C)			
		(mm)		Max		Min		Max.			Min.
		N	A	N	A	N	A	N	A	N	A
24	Jun 11-17	29.8	3.6	92.4	95.4	48.6	64.3	33.0	31.8	23.2	24.4
25	18-24	30.8	0.5	91.2	93.7	51.4	53.9	32.3	32.3	23.1	22.9
26	25-01	25.8	7.4	93.3	98.1	56.4	60.7	30.9	31.5	22.8	19.8
27	Jul 02-08	10.1	1.4	92.2	93.9	53.7	57.4	31.0	31.6	22.8	22.9
28	09-15	10.7	0.0	91.9	91.1	54.4	51.3	30.5	32.4	22.7	22.3
29	16-22	23.5	5.7	93.6	100.0	54.3	53.0	30.8	32.6	22.6	22.0
30	23-29	19.5	7.1	95.1	98.6	57.7	63.6	29.9	29.8	22.0	22.5

Location :RARs, Palem (AP)

St.wk.	Dates	Rainfall	RH(%)		Temp.(°C)	
		(mm)	8.00 h	14.30 h	Max.	Min.
32	Aug 06-12	95.0	99.7	78.4	26.1	21.6
33	13-19	66.4	98.4	67.4	27.9	22.4
34	20-26	13.2	85.5	59.8	29.6	22.4
35	27-02	0.0	82.7	47.4	32.3	23.9
36	Sep 03-09	34.0	103.5	69.8	33.8	25.5
37	10-16	32.6	105.2	77.8	31.8	28.3
38	Sep17-23	34.6	100.7	71.1	32.9	25.3
39	24-30	11.0	98.7	63.0	34.4	23.7
40	Oct 01-07	68.1	103.8	52.4	36.6	24.7
41	08-14	0.0	88.7	54.5	35.4	21.5
42	15-21	3.0	73.3	66.1	30.2	21.2
43	22-28	0.0	78.7	37.1	35.8	18.0
44	29-04	0.0	69.2	22.5	37.3	15.1
	Total :	**498**				

Phaltan ;State:MS; Lati:19^{0}.47'N; Longi:74^{0},32' E

St.wk.	Dates	Rainfall				RH(%)		Temperature(°C)			
		(mm)		Max		Min		Max.			Min.
31	30-05	18.6	15.8	94.1	98.3	59.7	66.3	29.5	30.1	22.1	22.5
32	Aug 06-12	17.1	23.4	95.3	100.0	62.8	74.9	28.8	27.6	22.3	22.4
33	13-19	6.9	15.0	94.3	100.0	56.3	68.9	29.8	29.0	21.9	22.1
34	20-26	23.8	4.8	95.2	100.0	55.3	55.1	30.2	31.6	21.7	20.0
35	27-02	15.2	67.3	94.4	100.0	54.4	56.3	30.5	33.1	21.4	22.6
36	Sep 03-09	30.2	156.0	95.6	100.0	53.0	69.6	31.0	31.4	21.6	22.4
37	10-16	31.6	18.0	96.1	100.0	52.0	68.8	31.3	28.9	21.2	22.2
38	Sep17-23	29.3	16.2	85.4	99.9	51.4	63.6	31.7	29.6	21.6	21.5
39	24-30	40.4	0.0	95.9	100.0	51.4	43.7	32.5	33.6	22.0	20.4
40	Oct 01-07	30.5	17.9	94.2	100.0	46.6	48.0	33.5	33.7	21.9	20.9
41	08-14	22.0	2.2	94.9	100.0	45.8	48.0	33.7	34.1	21.7	21.3
42	15-21	12.2	3.3	89.6	94.7	38.6	41.7	33.1	34.8	20.2	18.9
43	22-28	1.9	0.0	88.1	90.1	32.5	30.1	33.9	34.7	18.6	16.6
44	29-04	5.9	0.0	89.6	87.1	36.0	32.0	33.5	35.6	18.1	16.0
	Total	435.79	365								

Annexure II (Contd.)

Location :**Akola**; State :Maharashtra

St.wk.	Dates	Rainfall		RH(%)		Temp.(°C)	
		N	A	8.00 h	14.30 h	Max.	Min.
24	Jun 11-17	43.3	5.0	69.3	38.7	35.3	25.2
25	18-24	52.3	0.5	61.1	39.9	35.1	27.4
26	25-01	38.2	48.1	82.4	69.1	30.9	25.6
27	Jul 02-08	34.7	20.8	78.9	53.3	32.7	24.7
28	09-15	52.2	1.6	77.6	52.0	31.7	24.7
29	16-22	58.6	57.2	75.6	43.1	34.6	26.1
30	23-29	44.2	55.2	92.9	67.3	31.7	23.8
31	30-05	49.3	27.6	90.3	74.0	29.7	24.0
32	Aug 06-12	59.9	62.6	90.3	78.7	27.8	23.5
33	13-19	40.6	3.3	85.0	60.1	31.1	23.9
34	20-26	46.7	13.6	81.3	58.0	32.5	24.0
35	27-02	47.1	11.9	91.3	56.3	31.9	23.6
36	Sep 03-09	28.5	61.4	94.3	63.1	31.8	23.2
37	10-16	18.9	87.7	94.3	70.0	30.6	22.7
38	Sep17-23	24.6	25.1	90.9	71.4	29.7	22.6
39	24-30	24.4	0.0	87.7	54.9	31.2	21.7
40	Oct 01-07	21.8	0.0	84.4	48.9	33.8	22.6
41	08-14	16.0	18.0	88.1	39.7	33.4	20.7

Location :Parbhani; State :Maharashtra

St.wk.	Rainfall	RH(%)		Temp.(°C)	
	(mm)	8.00 h	14.30 h	Max.	Min.
24	43.70	80	49	33.2	22.4
25	11.20	77	38	36.0	23.7
26	31.80	83	54	33.2	22.2
27	2.40	77	54	33.9	22.6
28	10.90	75	48	33.3	21.8
29	41.70	78	49	35.4	23.4
30	88.40	92	74	29.6	21.4
31	14.00	86	68	29.9	21.2
32	20.40	94	77	27.6	20.9
33	21.60	85	61	31.2	21.3
34	23.00	80	55	31.9	20.1
35	6.20	83	62	31.1	21.1
36	55.00	92	67	31.5	20.9
37	74.80	97	78	29.2	19.8
38	85.80	86	69	30.6	19.3
39	0.00	79	47	31.7	17.3
40	29.20	79	47	33.5	19.2
41	1.50	78	45	33.2	17.4

Location :Surat; State :Gujarat

St.wk.	Rainfall	RH(%)		Temp.(°C)	
	(mm)	8.00 h	14.30 h	Max.	Min.
24	214.2	81.3	76.6	31.9	25.9
25	0.0	77.0	66.9	32.3	28.2
26	234.4	87.3	76.3	32.0	26.5
27	82.4	82.7	76.9	29.5	26.5
28	148.2	83.7	76.3	31.4	26.1
29	3.2	82.3	68.1	32.1	26.7
30	30.2	86.0	71.4	31.7	26.5
31	89.0	86.9	81.3	30.0	25.8
32	196.4	86.4	84.3	29.4	25.4
33	19.0	86.1	76.9	29.1	25.6
34	15.0	83.1	69.6	31.5	25.6
35	7.2	81.9	61.3	32.4	26.0
36	22.4	85.4	66.0	32.8	26.0
37	101.0	89.0	75.0	32.0	25.7
38	91.0	88.6	76.7	30.1	25.3
39	0.0	83.9	59.6	31.9	24.3
40					
41					

Location :**Akola**; State :Maharashtra

St.wk.	Dates	Rainfall		RH(%)		Temp.(°C)	
		N	A	8.00 h	14.30 h	Max.	Min.
42	15-21	3.1	0.0	75.9	26.9	34.3	18.2
43	22-28	10.0	0.0	70.6	17.6	33.6	14.5
44	29-04	2.3	0.0	67.6	18.9	34.6	15.8
	Total :	**717**					

Location :Parbhani; State :Maharashtra

St.wk.	Rainfall	RH(%)		Temp.(°C)	
	(mm)	8.00 h	14.30 h	Max.	Min.
42					
43					
44					
	562				

Location :Surat; State : Gujarat

St.wk.	Rainfall	RH(%)		Temp.(°C)	
	(mm)	8.00 h	14.30 h	Max.	Min.
42					
43					
44					
	1254				

Annexure II (C ontd.)

Location :Udaipur; State :Rajasthan

St.wk.	Dates	Rainfall (mm)	RH(%)		Temp.(°C)	
			8.00 h	14.30 h	Max.	Min.
24	Jun 11-17	30.2	79.0	61.0	31.8	24.9
25	18-24	0.0	69.4	48.0	32.7	25.6
26	25-01	25.6	74.6	53.6	34.5	25.5
27	Jul 02-08	10.4	76	59	32.0	24.7
28	09-15	61.0	85.1	78.9	28.3	24.0
29	16-22	0.0	79.7	54.4	31.5	24.6
30	23-29	39.5	81.4	65.9	32.1	24.6
31	30-05	50.4	90.0	80.9	29.8	24.1
32	Aug 06-12	58.4	84.4	75.9	30.1	23.7
33	13-19	11.0	85.7	69.1	29.4	22.9
34	20-26	36.6	82.3	65.3	30.4	22.5
35	27-02	8.4	85.7	60.0	30.5	22.5
36	Sep 03-09	5.0	82.0	57.9	33.0	23.0
37	10-16	151.7	89.0	71.6	31.7	22.4
38	Sep17-23	50.9	87.6	67.6	30.2	21.6
39	24-30	15.4	83.3	47.1	31.3	19.8
40	Oct 01-07	29.0	83.4	47.9	34.7	21.8
41	08-14	0.0	73.1	29.1	34.4	19.8
42	15-21	32.0	74.7	33.4	33.8	17.4
43	22-28					
44	29-04					
	Total :	**616**				

Location :**Pantnagar ;** State :Uttarkhand

St.wk.	Dates	Rainfall	RH(%)		Temp.(°C)	
		(mm)	8.00 h	14.30 h	Max.	Min.
24	Jun 11-17	115.6	87.0	68.0	31.5	25.4
25	18-24	19.6	84.0	70.0	31.3	25.3
26	25-01	113.4	87.0	76.0	30.2	25.0
27	Jul 02-08	139.6	88.0	73.0	31.4	25.4
28	09-15	77.2	84.0	70.0	31.5	25.2
29	16-22	264.0	95.0	84.0	28.6	24.3
30	23-29	28.2	92.0	72.0	30.9	25.0
31	30-05	172.0	89.0	76.0	30.3	24.8
32	Aug 06-12	102.2	86.0	72.0	31.3	25.5
33	13-19	24.2	91.0	83.0	28.5	24.5
34	20-26	135.4	90.0	74.0	31.5	24.8
35	27-02	24.2	87.0	65.0	32.3	24.5
36	Sep 03-09	16.4	88.0	61.0	32.4	23.9
37	10-16	50.4	85.0	68.0	31.6	24.0
38	Sep17-23	347.6	89.0	75.0	28.6	22.0
39	24-30	0.0	88.0	60.0	31.3	21.3
40	Oct 01-07	19.6	87.0	65.0	30.9	23.1
41	08-14	4.8	82.0	57.0	31.0	19.8
42	15-21	0.0	80.0	47.0	30.1	15.9
43	22-28	0.0	83.0	40.0	29.3	15.1
44	29-04	0.0	84.0	47.0	29.4	14.7
	Total :	**1654**				

Annexure III: Compliance report on grain, dual-purpose and forage sorghum agronomy

S.No	Location	Net plot size	Date of sowing	Date of harvest	Date of reporting	Remarks
1	Coimbatore	9.1	18th June 08	19th October 08	22nd November 08	
2	Parbhani	14.4	26th June 08	20th October 08	25th November 08	
3	Akola	10.8	2nd July 08	5th November 08	28th November 08	
4	Pantnagar	8.4	30th June 08	10th October 08	2nd December 08	
5	Mauranipur	10.8	21st July 08	26th November 08	1st December 08	
6	Udaipur	22.5	5th July 08	16th October 08	5th December 08	
7	Hisar	16.2	26th June 08	27th October 08	7th December 08	
8	Dharwad	10.8	15th June 08	16th October 08	10th December 08	
9	Indore	14.4	22nd June 08	23rd October 08	29th November 08	
10	Surat	18.0	7th July 08	8th November 08	2nd December 08	
11	Deesa	18.0	26th July 08	27th November 08	7th December 08	
12	Palem	17.3	27th June 08	28th October 08	28th November 08	

Sweet sorghum Agronomy

S.No	Location	Net plot size	Date of sowing	Date of harvest	Date of reporting	
1	Coimbatore	9.1	18th June 08	20th October 08	27th November 08	
2	Akola	18.0	2nd July 08	3rd November 08	28th November 08	
3	Dharwad	10.8	14th June 08	15th October 08	10th December 08	
4	Solapur	18.0	24th June 08	25th October 08	25th November 08	
	Indore	14.4	14th June 08	16th October 08	29th November 08	

Compliance report on kharif sorghum Physiology

S.No	Location	Net plot size	Date of sowing	Date of harvest	Date of reporting	
1	Coimbatore	8.9	25th June 08	26th October 08	27th November 08	
2	Parbhani	3.0	25th June 08	26th October 08	25th November 08	
3	Hyderabad	3.0	19th June 08	20th October 08	20th November 08	
4	Rahuri	10.6	25th June 08	26th October 08	23th November 08	
5	Phaltan	10.6	25th June 08	26th October 08	28th November 08	
6	Almel	10.6	25th June 08	26th October 08	29th November 08	