2. Forage sorghum trials

Contents

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Forage sorghum summary

Introduction: During 2008-09, two experiments under single-cut forage, two experiments on multi-cut forages and one seed trial were carried out across 17 locations, comprising of two zones (zone I- 10 locations in North India and zone II- 7 locations in rest of India).The most important findings of breeding trials and trials on animal nutrition for the year are mentioned below.

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A. Breeding and quality

Single-cut

Trial 1: Advanced varietal trial (Single-cut)

1. Eleven genotypes along with 2 checks (HC 308 and CSV 21F) were evaluated at 16 locations during kharif 2008.
2. The genotype, SPV 1846 ranked first for both green (386 q/ha) and dry (152 q/ha) fodder yields with 4% and 5% improvement for green and dry fodder yields over CSV 21F at national level. It is followed by SPV 1852 with 3% improvement for green and dry fodder yields over CSV 21F.
3. For quality, SPV 1845 was found to be the best for protein content (7.8%) and protein yield (9.1 q/ha), and SPV 1846 for IVDMD (52.5%) and DDM (59 q/ha).

4. SP 1852 recorded less shoot fly deadhearts (28%) compared to CSV 21F (43%).

Trial 2: Initial varietal trial (Single-cut)

1. Nine genotypes along with two checks (HC 308 and CSV 21F) were evaluated.
2. The genotype SPV 1860 ranked first for green (374 q/ha) and second for dry (111 q/ha) fodder yields with 4% improvement over CSV 21F.
3. For dry fodder yield SPV 1855 was in first place with 6% improvement over CSV 21F.
4. Highest protein percentage was noticed in SPV 1854 (8.43%) followed by SPV 1855 (8.37%). SPV 1857 had high IVDMD (48.6 q/ha) value, and high DDM was observed in SPV 1860 (59 q/ha) among the test entries.

Multi-cut

Trial 3: Advanced varietal and hybrid trial (Multi-cut)

1. Nine entries including 4 hybrids, 3 varieties and 2 checks (SSG 59-3 and CSH 20MF) were evaluated over 15 locations.
2. SPH 1626 was the best genotype for green (789 q/ha) and dry (197 q/ha) with 10% and 8% improvement for green and dry fodder yields over CSH 20MF. Its per day productivity of green (5.6 q/ha) fodder was also higher.
3. Per day dry fodder productivity was high in SPH 1625 and SPH 1627 (1.6 q/ha).
4. SPH 1626 also reported to have high protein percent (8.1%), protein yield (11.9 q/ha), IVDMD (54.9%) and DDM (80.6 q/ha).
5. None of the multi-cut varieties could over come SSG 59-3 for fodder yield. But the variety, SPV 1843 had high protein (8%) and IVDMD (54.7%) values.

Trial 4: Initial varietal and hybrid trial (Multi-cut)

1. Six entries involving 2 hybrids and 2 varieties and 2 checks (SSG 59-3 and CSH 20MF) were evaluated in this trial
2. The hybrid SPH 1623 (717 q/ha) recorded 4% improvement in green fodder yield over CSH 20MF. SPH 1623 ranked first for green fodder yield per day also.
3. None of the varieties could out yield the check, SSG 59-3, but SPV 1840 and SPV 1841 had high protein and IVDMD values.
4. SPH 1623 had high protein yield (12.9 q/ha), IVDMD (56%) and DDM (94.2 q/ha).
5. The variety SPV 1840 with 37% shoot fly deadhearts (SFDH) was the best line with better level of tolerance to shoot fly where SSG 59-3 recorded 58% SFDH.

Trial 5: Seed trial

1. 14 entries involving 9 single-cut, 3 multi-cut varieties and two checks, HC 308 and CSV 21F
2. The single-cut varieties SPV 1845 and SPV 1847 had given grain yield of 17.2 q/ha which is 38% over HC 308 and 25% improvement over CSV 21F.
3. The multi-cut variety SPV 1844 had given 15.3 q/ha of grain which is 24% increase over HC 308.

B. Animal nutrition experiments

Trial 6: Nutritional evaluation of single cut forage sorghum genotype SRF-305 against check variety HC-308 in growing calves

Sorghum fodder from SRF-305 was nutritionally better than variety HC-308 in terms of nutrient intake, nutrient utilization, nutritive value and total digestible nutrients.

Trial 7: Chemical composition studies of forage sorghum strains of Pantnagar center

13 germplasm lines out of 155 evaluated were identified to have more protein percent, low lignin and cellulose content.

Trial 8: Effect of feeding reconstituted sorghum grain on nutrient utilization and growth performance of calves

Maize grain can be replaced with sorghum grain in the diet of growing calves. 2. Reconstitution of sorghum grain significantly ($P<0.05$) improves the growth rate of calves, nutrient utilization and feed conversion efficiency as compared to maize or sorghum grain based concentrate mixture.

Trial 9: In-vitro nutrient disappearance in new germplasm of forage sorghum

Out of 50 genotypes tested, IS651, IS1032-2, IS3225, IS4718, S534, S534-1, S536, G46, G73, G104, G119, G165, G171, EJ167 and WT51 are of better nutritional composition and they also have higher value of IVDMD and IVNDFD.

Looking ahead

- Promising genotypes from initial trials of both single-cut and multi-cut types will be evaluated in the advanced trials during kharif 2009.
- The F_1s made for trait specific breeding program are being advanced and the F_2 seed will be distributed to different centers for making selections at their end.
- The promising germplasm and breeding lines identified with good quality attributes will be utilized in the breeding program to enhance fodder quality

Forage sorghum Kharif 2008 - Detailed report

During 2008-09 emphasis continued to be given on identification of genotypes with improved fodder yield and quality involving different disciplines like breeding, agronomy, entomology, plant pathology, quality and animal nutrition. A new program on trait based improvement of forage genotypes has been initiated during 2008 involving different centers working on forage sorghum. The improved genotypes for the all India evaluation were contributed by various SAUs, ICAR institutes and private organizations for their evaluation at all India level under different eco-geographical regions of the country. Separate trials for screening of the genotypes for important pests and diseases were also taken up during this year by the scientists involved in crop health management. The performance of test genotypes was evaluated at all India level as well as in two zones.

Zone I: UP, Uttaranchal, Delhi, Gujarat, Rajasthan, Haryana, Punjab and Bihar
Zone II: Maharashtra, Madhya Pradesh, Andhra Pradesh and Tamil Nadu

Zone I is characterized by the areas where sorghum is utilized as fodder whereas Zone II involves the states where grain and dual purpose sorghums are mainly grown. During kharif 2008, following co-ordinated trials were conducted over 17 locations. The trials conducted as per technical programme of kharif 2008 are listed below:

A. Breeding and Quality

Trial 1: Advanced Varietal Trial on Forage Sorghum (single cut)
Trial 2: Initial Varietal Trial on Forage Sorghum (single cut)
Trial 3: Advanced Hybrid/Varietal Trial on Multicut Forage Sorghum
Trial 4: Initial Hybrid/Varietal Trial on Multicut Forage Sorghum
Trial 5: Advanced Seed Yield Trial

B. Agronomy and Quality

Trial 6: Response of Single cut forage sorghum genotypes to different nitrogen levels
Trial 7: Effect of INM on yield and quality of single cut forage sorghum
Trial 8: Intercropping studies on single cut forage sorghum
Trial 9: Response of multicut forage sorghum hybrids/varieties under different nitrogen levels
Trial 10: Integrated nutrient management studies in forage sorghum based cropping system

C. Animal nutrition

Trial 13: Nutritional evaluation of single cut forage sorghum genotype, SRF 305 against check variety HC 308 in cross bred calves.

Trial 14: Chemical composition studies of multicut forage sorghum strains at different cuts

Trial 15: Effect of feeding reconstituted sorghum grain on nutrient utilization and growth performance of calves

Trial 16: In vitro nutrient disappearance in new germplasm of multi-cut forage sorghum

The results of the agronomy trials are reported in the agronomy report along with the grain sorghum and sweet sorghum agronomy trials. The results of the breeding and animal nutrition experiments are discussed below.

1. Single-cut forage sorghum

Two trials were conducted under single-cut forage sorghum experiments (11 entries in advanced trial and 9 entries in initial trial). These trials were sent to 17 locations out of which 16 locations conducted these trials. Trials were not conducted at Warangal. Parbhani carried out single-cut advanced trial only. At Hisar, IVT-SC was viciated due to water logging conditions. The genotypes were tested for their green fodder yield, dry fodder yield, per day productivity, quality and resistance to important pests and diseases. The summary of performance of checks and test entries is given in the table below (Table 1).

Table 1: Summary results of single-cut trials

No	Trial no	1						2					
	Name	AVT-SC						IVT-SC					
	Traits	GFY (q/ha)	DFY (q/ha)	GF/day (q/ha)	DF/day (q/ha)	PY	DDM	GFY (q/ha)	DFY (q/ha)	GF/day (q/ha)	DF/day (q/ha)	PY	DDM
Performance of checks													
1	HC 308	331	137	3.88	1.66	8.8	57.0	342	108	4.17	1.38	8.1	57.8
2	CSV 21F	370	145	4.31	1.80	7.7	53.5	360	107	4.55	1.41	10.5	64.8
3	Mean	346	139	4.12	1.67	7.8	53.3	343	106	4.32	1.39	7.9	55.9
4	Min.	306	129	3.73	1.55	6.4	46.0	319	94.8	3.93	1.23	6.7	50.8
5	Max.	386	152	4.78	1.81	9.1	58.5	374	113	4.59	1.52	10.5	64.8
6	CD (0.05)	54	30	0.68	0.36	2.7	15.8	34.6	17.2	0.41	0.23	3.3	23.0
7	CV (%)	16.8	21.7	17.6	23	26	23	12	18	11	18	27	20.7
8	Lines signi. > check	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
9	Lines > best check	SPV 1846, SPV 1852	SPV 1846, SPV 1852	SPV 1846, SPV 1852, SPV 1847	SPV 1852	SPV 1845	SPV 1846	SPV 1860	SPV 1855, SPV 1860, SPV 1859, SPV 1854	SPV 1860	SPV 1855, SPV 1856, SPV 1859	Nil	Nil
10	Data from locations (no)	12	13	12	13	6	6	13	13	13	13	5	4
11	Loc. for national average (no)	9	8	9	9	5	6	11	10	11	10	4	4

1.1 Advanced Varietal Trial for single-cut forage sorghum (AVT-SC)

Breeding: The advanced varietal trial for single cut forages was carried out with 11 genotypes including two checks, HC 308 and CSV 21F. The results of the trial are presented below (Tables 1.1 to 1.16)

Zone-I:

Yield parameters

Green fodder yield SPV 1852 ranked first both for total green fodder (355 q/ha) with significant improvement over HC 308 (293 q/ha). It is on par with CSV 21F (350 q/ha) which is in second rank in Zone I. SPV 1852 and CSV 21F were followed by SPV 1849 (326 q/ha) and SPV 1846 (323 q/ha).

Dry fodder yield SPV 1852 ranked first for dry fodder yield (152 q/ha) also in zone I with 11% improvement over HC 308 (137 q/ha) and was on par with CSV 21F (150 q/ha). These two were followed by SPV 1846 (146 q/ha) and SPV 1848 (144 q/ha) in this zone.

Green fodder yield per day was reported to be more in SPV 1852 (4.33 q/ha) followed by CSV 21F (4.25 q/ha) and SPV 1846 (4.17 q/ha).

Dry fodder yield per day For dry fodder yield per day, CSV 21F (1.79 q/ha) ranked first followed by SPV 1852 (1.78 q/ha) and SPV 1848 (1.71 q/ha).

Phenology and morphological parameters

Days to 50% flowering ranged from 78 to 85 days. SPV 1845 was the earliest genotype in this zone.

Early vigour varied from 2.75 to 3.58. SPV 1849 had more vigour (3.58 score) compared to both the checks, HC 308 (3.04) and CSV 21F (3.5).

Leaf parameters did not vary much among the genotypes under study. Comparatively SPV 1853 had more number of leaves and SPV 1851 had longer and broader leaves.

Stem girth ranged from 2.4 cm to 2.83 cm. Thin stems were observed in CSV 21F (2.4 cm) followed by SPV 1848 (2.45 cm).

High **leaf-stem ratio** was observed in SPV 1848 (0.36) followed by SPV 1851 (0.35). HC 308 had leaf-stem ratio of 0.33.

Zone-II:

Yield parameters

Green fodder yield In Zone II, SPV 1846 ranked first for green fodder yield (607 q/ha) followed by SPV 1847 (528 q/ha) and SPV 1851 (507 q/ha). All the three showed significant improvement for green fodder yield over the checks HC 308 (464 q/ ha) and CSV 21F (439 q/ha).

For **Dry fodder yield** also SPV 1846 (170 q/ha) leads with significant improvement over HC 308 (136 q/ha) and CSV 21F (133 q/ha), and was followed by SPV 1852 (141 q/ha) and SPV 1847 (139 q/ha).

Green fodder yield per day ranged from 3.71 to 6.0 q/ha. For this trait, SPV 1846 (6 q/ha) was in the first rank followed by SPV 1847 (5.16 q/ha) and SPV 1851 (4.99 q/ha).

For **Dry fodder yield per day** also SPV 1846 (2.31 q/ha) was leading, followed by SPV 1852 (1.88 q/ha) and SPV 1847 (1.88 q/ha).

Phenology and morphological parameters

Days to 50% flowering All the genotypes flowered earlier compared to zone I. It ranged from 65 to 74 days, the earliest genotype in this zone being SPV 1847. The checks HC 308 and CSV 21F flowered in 74 and 68 days respectively.

Early vigour was observed to be more in SPV 1849 in this zone. All others are on par with each other.

Leaf parameters were observed to be good in SPV 1852 which had more number of leaves. For leaf length SPV 1852 (81.4 cm) was the best genotype.

Stem girth ranged from 2.04 to 2.66 cm with thinner stems in SPV 1848 followed by CSV 21F (2.13 cm).

Leaf-stem ratio ranged from 0.27 to 0.32, and was higher in the varieties SPV 1848 and SPV 1851.

National level:

Yield parameters

For **Green fodder yield** SPV 1846 ranked at the top (386 q/ha) at all India level which is a significant improvement over the check HC 308 (331 q/ha). It recorded 4% improvement over the check, CSV 21F (370 q/ha). SPV 1846 was followed by SPV 1852 (382 q/ha) and CSV 21F (370 q/ha).

For **Dry fodder yield** also, SPV 1846 ranked at the top (152 q/ha) which is 11% improvement over HC 308 and 5% improvement over CSV 21F. SPV 1852 (149 q/ha) and CSV 21F (145 q/ha) were in the second and third ranks respectively.

Green fodder yield per day For per day green fodder productivity, SPV 1846 (4.78 q/ha) was the best followed by SPV 1852 (4.5 q/ha) and SPV 1847 (4.35 q/ha).

Dry fodder yield per day was high in SPV 1852 (1.84 q/ha), followed by CSV 21F (1.8 q/ha) and SPV 1846 (1.78 q/ha).

Phenology and morphological parameters

Days to 50% flowering ranged from 74 - 80 days, with the earliest being SPV 1847 and SPV 1845.

Early vigor was high in SPV 1849 (3.58) followed by CSV 21F (3.5) and SPV 1852 (3.42).

Leaf parameters Not much variation was observed for number of leaves, leaf length and leaf width. However, the genotype SPV 1853 had relatively more number of leaves (12.3) and SPV 1851 had long long and broad leaves.

Stem girth ranged from 2.40 to 2.83 cm. CSV 21F was found to have thin stem (2.4 cm) followed by SPV 1848 (2.45cm).

For **leaf-stem ratio** also there was vey little variation ranging from 0.30 to 0.35. SPV 1848 was the best genotype (ratio of 0.35) followed by SPV 1851 (0.34) among the genotypes studied.

Reaction to major pest and diseases

For **Shoot fly** resistance, SPV 1852 was found to be the best with deadheart percentage (DH%) of 27.9, followed by SPV 1853 (29.4% DH) and SPV 1849 (35.4% DH). All these were better than the checks, HC 308 (38.2% DH) and CSV 21F (43.1% DH) for their reaction to shoot fly.

For **Stem borer** reaction, SPV 1845 (12.8% DH) recorded less percent of deadhearts followed by SPV 1847 (12.9% DH) and SPV 1848 (13% DH). The checks HC 308 and CSV 21F recorded 13.4% and 13.5% stem borer deadhearts respectively.

For **leaf diseases** SPV 1846, SPV 1852 and SPV 1853 showed multiple resistance, and were on par with the checks. .

Quality paramers: Nine genotypes along with two single-cut forage checks, HC 308 and CSV 21F were analyzed for quality for the samples of 6 locations (Tables 1.15 to 1.17).

Total soluble sugars ranged from 7.87% (SPV 1846) to11.9% (SPV 1847).

Brix varied from 6.7% (SPV 1851) to SPV 1853 (12.3%). SPV 1853 was followed by SPV 1845 (12.2%) and HC 308 (11.3%).

HCN content ranged from 40.1 to 153.9 ppm which is within the safe limit of <200ppm.

Protein percent varied from 6.53 to 7.8 percent, the highest being in SPV 1845 (7.8%) closely followed by SPV 1851 (7.38%) and HC 308 (7.27%).

Average **protein yield** protein yield (q/ha) varied from 6.36 q/ha (SPV 1850) to 9.07 q/ha (SPV 1845).

IVDMD values ranged from 47.8 (SPV 1853) to 52.5% (SPV 1846).

Digestible dry matter (DDM) DDM yield ranged from 46 q/ha (SPV 1850) to 58.5 q/ha (SPV 1846).

The promising single-cut genotypes in the advanced trial are given in the table 2.

Table 2: Performance of promising single-cut sorghum genotypes in advanced trial during 2008-09

(Entries - 11; Checks - 2; Locations: 13)

	GFY (q/ha)				DFY (q/ha)				GFY/day (q/ha)		DFY/day (q/ha)		PY (q/ha)		DDM (q/ha)		SF	SB	ZLS	ALS	GLS	SS
Entry		*R*	*% +/- over HC 308*	*% +/- over CSV 21F*		*R*	*% +/- over HC 308*	*% +/- over CSV 21F*		*R*		*R*		*R*		*R*						
SPV 1846	386	1	16.6	4.3	152	1	11	4.8	4.8	1	1.8	3	7.4	8	59	1	55	14	24	6.6	1.3	2.7
SPV 1852	382	2	15.4	3.2	149	2	8.8	2.8	4.5	2	1.8	1	7.8	5	54	6	28	16	26	6.6	1.3	2.7
SPV 1847	361	4	9.1	-2.4	135	8	-1.5	-6.9	4.4	3	1.7	8	7.3	9	52	8	45	13	28	5.4	1.7	3
Checks																						
HC 308	331	7			137	6			3.9	8	1.7	7	8.8	2	57	2	38	13	28	6.6	2.7	1.7
CSV 21F	370	3			145	3			4.3	4	1.8	2	7.7	7	54	7	43	14	26	7.2	1.7	2.3
CD (5%)	54				30				0.7		0.4		2.7		16		18	7.5	0.4	1.3	1.9	1.5
CD (1%)	72				40				0.9		0.5		3.6		21		25	9.9	0.6	1.8	2.6	2.1
C.V. (%)	17				22				18		23		26		23		21	44	11	12	55	41

GFY- Green fodder yield, DFY- Dry fodder yield, PY- Protein yield; DDM- Digesible dry matter, SF - Shoot fly (% deadhearts), SB - Stem borer (% deadhearts), ZLS- Zonate leaf spot, ALS- Anthracnose leaf spot, GLS- Grey leaf spot, SS- Sooty stripe (1-9 scale)

The performance of promising genotypes tested in All India Co-ordinated trials during last 2-3 years is presented in the following table:

Table 3: Performance of promising single cut sorghum genotypes tested in AICSIP over last 3 years

		Yield								Quality				Insect pests DH (%)		Diseases (score)			
		GFY (q/ha)		DFY (q/ha)		GFY/day (q/ha)		DFY/day (q/ha)		PY (q/ha)		DDM (q/ha)		SF	SB	ZLS	ALS	GLS	SS
Entry	**Year**		**R**		**R**		**R**		**R**		**R**		**R**						
SPV1846	2007*	416	3	161	4	5.38	3	2.02	3	7.5	5	50.4	4	22	26	2.7	2.0	1.0	3.0
	2008	386	1	152	1	4.78	1	1.78	3	7.4	8	59	1	55	14	2.4	6.6	1.3	2.7
	Av	**401**		**157**		**5.08**		**1.9**		**7.5**		**54.7**		**37**	**20**	**2.6**	**4.3**	**1.2**	**2.9**
SPV1848	2006*	355	5	103	4	4.61	5	1.47	5	8.97	6	45.6	2	18	15	2.4	2.1	1.0	3.0
	2007	381	4	151	2	4.86	5	1.89	3	8.6	2	56.6	1	15	19	2.1	2.5	1.0	2.0

		Yield								Quality				Insect pests DH (%)		Diseases (score)			
		GFY (q/ha)		DFY (q/ha)		GFY/day (q/ha)		DFY/day (q/ha)		PY (q/ha)		DDM (q/ha)		SF	SB	ZLS	ALS	GLS	SS
Entry	Year		R		R		R		R		R		R						
	2008	327	8	135	3	3.87	4	1.66	2	7.8	6	54	5	37	13	2.7	5.4	2.3	2.3
	Av.	**354**		**130**		**4.45**		**1.67**		**8.5**		**52.1**		**23**	**16**	**2.4**	**3.3**	**2.4**	**2.4**
SPV 1853	2006*	366	3	111	2	4.62	4	1.49	4	10.3	3	46.3	1	16	15	2.8	2.6	2.5	1.0
	2007	409	1	157	1	5.04	2	1.91	2	8.6	1	53.4	2	17	18	2.4	3.4	3.0	1.0
	2008	324	9	133	6	3.81	8	1.59	7	6.9	10	49	10	29	14	2.7	7.2	3.3	1.3
	Av	**366**		**133**		**4.49**		**1.66**		**8.6**		**49.6**		**21**	**15**	**2.6**	**4.4**	**2.9**	**1.1**
SPV 1852	2006	359	2	105	3	4.73	4	1.32	5	5.67	4	46.5	5	11	17	2.5	-	1.0	2.0
	2007	288	10	114	9	3.60	10	1.41	9	8.1	4	40.9	7	18	21	1.7	2.3	1.0	2.0
	2008	382	2	149	2	4.5	2	1.94	1	7.8	5	54	6	28	16	2.6	6.6	1.3	2.7
	Av	**343**		**122**		**4.28**		**1.56**		**7.2**		**47.1**		**19**	**18**	**2.3**	**4.5**	**1.1**	**2.2**
Checks																			
HC 308	2006	349	4	102	4	4.78	2	1.37	3	10.1	3	47.6	3	13	16	1.0	2.1	2.3	2.0
	2007	387	3	139	6	4.99	3	1.77	7	8.2	3	46.7	5	14	15	2.1	2.6	1.0	2.0
	2008	331	7	137	6	3.88	8	1.66	7	8.8	2	57	2	38	13	2.8	6.6	2.7	1.7
	Av	**356**		**126**		**4.55**		**1.60**		**9.0**		**50.4**		**22**	**15**	**1.9**	**3.7**	**2.0**	**1.9**
CSV 21F	2008	370	3	145	3	4.31	4	1.8	2	7.7	7	54	7	43	14	2.6	7.2	1.7	2.3
	Av	**370**	**3**	**145**	**3**	**4.31**	**4**	**1.8**	**2**	**7.7**	**7**	**54**	**7**	**43**	**14**	**2.6**	**7.2**	**1.7**	**2.3**

GFY- Green fodder yield, DFY- Dry fodder yield, PY- Protein yield; DDM - Digesible dry matter, SF - Shoot fly (% deadhearts), SB- Stem *borer (% deadhearts), ZLS- Zonate leaf spot, ALS - Anthracnose leaf spot, GLS- Grey leaf spot, SS- Sooty stripe (1-9 scale)*

Conclusions: The genotypes, SPV 1846 and SPV 1852 performed well for green and dry fodder yields. Regarding quality parameters, SPV 1845 was found to be the best for protein, and SPV 1846 for IVDMD and DDM values.

1.2: Initial Varietal Trial for single-cut forage sorghum (IVT-SC)

Breeding: The trial was conducted with nine entries including two checks, HC 308 and CSV 21F. The results of this trial are summarized below (Tables 2.1 to 2.15).

Zone-I:

Yield parameters

Green fodder yield None of the entries could out yield the check, CSV 21F (347 q/ha) for green fodder yield. However, the entry SPV 1860 (343 q/ha) showed 6% improvement over the second check, HC 308 (325 q/ha).

For **Dry fodder yield,** SPV 1855 (114 q/ha) was ranking first, followed by SPV 1860 (112 q/ha). The checks, HC 308 and CSV 21F recorded dry fodder yields of 109 q/ha and 107 q/ha respectively in this zone.

Green fodder yield per day In zone I per day productivity of green fodder was highest in CSV 21F (4.22 q/ha) followed by SPV 1855 (4.12 q/ha) and SPV 1860 (4.12 q/ha). HC 308 recorded 3.87 q/ha of green fodder yield per day.

Dry fodder yield per day SPV 1855 had given the highest dry fodder yield per day (1.51 q/ha) followed by SPV 1860 (1.43 q/ha) and SPV 1859 (1.39 q/ha).

Phenology and morphological parameters

Days to 50% flowering ranged from 78 to 84 days. SPV 1855 was the earliest genotype in this zone.

Early vigour ranged from 3.13 to 3.53 showing less variation for early vigour, all were on par with each other.
Leaf parameters There was no variation for leaf number. Longer leaves were observed in SPV 1857 (76.1 cm) and SPV 1854 (73.2 cm) which are significantly longer than that of the check, HC 308 (69.1 cm). SPV 1860 was found to have broader leaves.

Leaf-stem ratio ranged from 0.36 to 0.43. Highest ratio was in SPV 1854, followed by SPV 1857 and SPV 1858 (0.39).

Zone-II:

Yield parameters

Green fodder yield In the second zone, five genotypes surpassed the best check, CSV 21F (396 q/ha) for green fodder yield with significant improvement in SPV 1860 (457 q/ha) for this trait. SPV 1860 was followed by SPV 1858 (426 q/ha) and SPV 1854 (423 q/ha) for green fodder yield.

Dry fodder yield For dry fodder yield, SPV 1856 (118 q/ha) was ranking first in this zone, followed by SPV 1859 (115 q/ha) and SPV 1854 (114 q/ha).

Green fodder yield per day For green fodder yield per day, five genotypes showed better performance over the checks, HC 308 (4.98 q/ha) and CSV 21F (5.45 q/ha). Of these, SPV 1860 (5.84 q/ha) and SPV 1858 (5.65 q/ha) recorded significant improvement in per day productivity of green fodder over HC 308.

For **Dry fodder yield per day** SPV 1856 (1.67 q/ha) was in first rank with significant improvement over HC 308 (1.36 q/ha). It is followed by SPV 1855 (1.56 q/ha) and SPV 1859 (1.53 q/ha). CSV 21F yielded 1.49 q/ha of dry fodder per day in this zone.

Phenology and morphological parameters

Days to 50% flowering SPV 1855 flowered early in 65 days among all the genotypes in this zone, where HC 308 had taken 72 days and CSV 21F 67 days to flower.

Early vigour ranged from 3.00 (SPV 1858) to 3.56 (SPV 1856 and SPV 1857).

Leaf parameters There is no variation in leaf number among the genotypes. Leaf length and width were more in SPV 1860 (83.2 cm and 6.9 cm).

Stem girth varied from 2.54 cm (SPV 1855) to 3.1 cm (SPV 1860).

Leaf-stem ratio ranged from 0.26 (SPV 1858) to 0.31 (SPV 1856).

National level:

Yield parameters

Green fodder yield At all India level, SPV 1860 (374 q/ha) ranked first for green fodder yield with 9.5% improvement over HC 308 and 3.8% over CSV 21F. Other entries did not show much improvement over the checks.

For **Dry fodder yield**, SPV 1855 (113 q/ha) was in first rank with 5.5% and 6.4% improvement over HC 308 and CSV 21F respectively. It is followed by SPV 1860 (111 q/ha) and SPV 1859 (110 q/ha) with very marginal improvement over HC 308 (108 q/ha) and CSV 21F (107 q/ha) .

For **Green fodder yield per day**, SPV 1860 (4.59 q/ha) with significant improvement over HC 308 (4.17 q/ha) was ranking first followed by CSV 21F (4.55 q/ha) and SPV 1855 (4.5 q/ha).

Dry fodder yield per day SPV 1855 (1.52 q/ha) was leading in dry fodder yield per day, followed by SPV 1856 (1.45 q/ha) and SPV 1859 (1.43 q/ha). The checks HC 308 and CSV 21F recorded per day dry fodder yields of 1.38 q/ha and 1.41 q/ha respectively.

Phenology and morphological parameters

Days to 50% flowering ranged from 74 - 81 days, with the earliest being SPV 1855.

Early vigor ranged from 3.08 (SPV 1858) to 3.42 (SPV 1857 and SPV 1856).

Leaf parameters Not much variation was observed for number of leaves, leaf length and leaf width. However, the genotype SPV 1857 had relatively longer leaves (76.6 cm) and SPV 1860 had broad leaves (6.92 cm).

Stem girth ranged from 2.54 to 3.10 cm. SPV 1855 had thinner stems, followed by SPV 1857 (2.69 cm).

For **leaf-stem ratio** also there was vey little variation ranging from 0.33 to 0.38.

Reaction to major pest and diseases

For **Shoot fly** resistance, HC 308 was found to be the best with 46% DH (deadhearts), followed by SPV 1853 (29.4% DH) and SPV 1849 (35.4% DH). The test entries showed deadheart percentage of 47.3 to 57.7%. SPV 1858 showed better level of resistance to shoot fly (47.3% DH), followed by CSV 21F (47.9% DH).

Stem borer deadhearts were less in CSV 21F (11.8% DH) followed by SPV 1854 (12.5% DH) and SPV 1855 (13.2% DH).

For **leaf diseases** almost all the entries were on par with the check, HC 308.

Quality parameters: Nine genotypes along with two single-cut forage checks, HC 308 and CSV 21F were analyzed for fodder quality on the samples of 6 locations (Tables 2.15).

For **Total soluble sugars**, SPV 1857 (14.2%) was ranking first, followed by SPV 1860 (13.2%) and SPV 1854 (13.1%).

Brix value was higher for SPV 1856 (11.5) and SPV 1857 (11.4) indicating that they have sweeter stem compared to other entries of the trial.

For **HCN**, all the genotypes were in safer limit with the lowest being in CSV 21F (31.6 ppm) and SPV 1860 (42.8 ppm).

High **Protein percent** was recorded in SPV 1854 (8.43%), followed by SPV 1855 (8.37%) and SPV 1857 (8.17%). The check CSV 21F showed 8.1% protein and HC 308 had 7.8%.

Protein yield CSV 21F was in the first place for protein yield (10.5 q/ha) followed by SPV 1860 (8.8 q/ha) and HC 308 (8.1 q/ha).

IVDMD values ranged from 46.5 to 48.6% with the highest being in SPV 1857 (48.6%) followed by HC 308 (48.2%). CSV 21F recorded 47.3% IVDMD.

For **Digestible dry matter (DDM)**, CSV 21F showed highest values (64.8 q/ha) followed by SPV 1860 (58.7 q/ha) and HC 308 (57.8 q/ha).

The promising single-cut genotypes in the initial trial are given in the table 3.

Table 4: Performance of promising single-cut sorghum genotypes in initial trial during 2008-09

(Entries- 9; Checks - 2; Locations: 13)

	GFY (q/ha)				DFY (q/ha)				GFY/day (q/ha)		DFY/day (q/ha)		PY (q/ha)		DDM (q/ha)		SF	SB	ZLS	ALS	GLS	SS
Entry		*R*	*% +/- over HC 308*	*% +/- over CSV 21F*		*R*	*% +/- over HC 308*	*% +/- over CSV 21F*		*R*		*R*		*R*		*R*						
SPV 1860	374	1	9.5	3.8	111	2	2.8	3.7	4.59	1	1.41	5	8.8	2	59	2	54	16	2.7	3.6	2.5	1.0
SPV 1859	348	3	1.8	-3.5	110	3	2.2	3.1	4.41	5	1.43	3	7.9	4	57	4	51	14	3.2	3.3	1.0	2.0
SPV 1855	346	4	1.3	-3.9	113	1	5.5	6.4	4.50	3	1.52	1	7.7	5	54	6	58	13	2.9	3.1	1.0	2.0
Checks																						
HC 308	342	6			108	5			4.17	6	1.38	7	8.1	3	58	3	46	13	2.6	2.9	1.2	2.7
CSV 21F	360	2			107	7			4.55	2	1.41	4	11	1	65	1	48	12	2.4	3.0	1.0	2.0
CD (5%)	35				17				0.41		0.23		3.3		23		24	6	0.7	1.4	2.1	0.8
CD (1%)	46				23				0.55		0.30		4.6		34		33	8	0.9	2.0	3.1	1.1
C.V. (%)	12				18				11		18		27		21		24	33	17	26	60	25

GFY- Green fodder yield, DFY- Dry fodder yield, PY- Protein yield; DDM - Digesible dry matter, SF - Shoot fly (% deadhearts), SB- Stem *borer (% deadhearts), ZLS- Zonate leaf spot, ALS - Anthracnose leaf spot, GLS- Grey leaf spot, SS- Sooty stripe (1-9 scale)*

Conclusion: SPV 1860 and SPV 1855 were the best genotypes for green and dry fodder yields, and SPV 1860 for fodder quality.

2. Multi-cut forage sorghum

Two trials were conducted under multi-cut forage sorghum experiments (9 entries in advanced trial and 6 entries in initial trial). These trials were sent to 16 locations out of which 14 locations conducted the trials. Trials were not conducted at Warangal and Parbhani. The genotypes were tested for their green fodder yield, dry fodder yield, per day productivity at different cuts, quality and resistance to important pests and diseases.

Table 5: Summary results of multi-cut trials

No	Trial no	1						2					
	Name	AVT-MC						IVT-MC					
	Traits	GFY (q/ha)	DFY (q/ha)	GF/day (q/ha)	DF/day (q/ha)	PY (q/ha)	DDM (q/ha)	GFY (q/ha)	DFY (q/ha)	GF/day (q/ha)	DF/day (q/ha)	PY	DDM
Performance of checks													
1	SSG 59-3	680	176	5.04	1.47	9.98	67	662	183	4.89	1.45	11.9	83.2
2	CSH 20MF	718	183	5.18	1.52	10.5	72	691	185	4.96	1.43	11.6	89.7
3	Mean	696	178	4.98	1.46	10.1	67	652	171	4.70	1.32	11.2	83.5
4	Min.	638	159	4.46	1.30	7.72	54	535	135	3.83	1.03	9.53	66.1
5	Max.	789	197	5.63	1.6	11.9	81	717	185	5.16	1.45	12.9	94.2
6	CD (0.05)	50.8	17.9	0.42	0.17	2.92	21	72	22	0.55	0.19	3.43	29.7
7	CV (%)	9	11.9	10.9	13.6	21.4	18	15	16	15.4	18	20	19
8	Lines signi. > check	SPH 1626	Nil	SPH 1626	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
9	Lines > check	SPH 1627	SPH 1626, SPH 1627, SPH 1625	SPH 1627, SPH 1625	SPH 1625, SPH 1627, SPH 1626,	SPH 1626, SPV 1844, SPH 1625	SPH 1626 SPH 1625	SPH 1623	Nil	SPH 1623	Nil	SPH 1623	SPH 1623, SPH 1622
10	Data from locations (no)	14	14	14	14	6	5	14	14	14	14	6	4
11	Loc. for national average (no)	12	11	13	11	6	5	14	13	14	12	6	4

2.1 Advanced Varietal and Hybrid Trial for multi-cut forage sorghum (AVHT-MC)

Breeding: The advanced varietal and hybrid trial for multi cut forages was carried out with 9 genotypes including 4 hybrids and 3 varieties. One multi-cut variety SSG 59-3 and hybrid, CSH 20MF were included as checks for these experiments. The results of the trial are presented below (Tables 3.1 to 3.36).

Zone-I:

Yield parameters

Green fodder yield SPH 1626 ranked first for total green fodder yield from different cuts (749 q/ha) which is a significant improvement over the check, CSH 20MF (676 q/ha). Eventhough the variety, SPV 1844 had given high green fodder yield over SSG 59-3 in the I cut, none of the varieties could out yield the check, SSG 59-3 (646 q/ha) in zone I for total green fodder yield.

Dry fodder yield SPH 1626 ranked first for dry fodder yield from three cuts (217 q/ha), where the CSH 20MF recorded 202 q/ha of dry fodder over 3 cuts. SPH 1626 was followed by SPH 1625 (209 q/ha). Among the varieties, none were found to be better than SSG 59-3 (192 q/ha).

Green fodder yield per day was reported to be more in SPH 1626 (5.37 q/ha) over all the cuttings, followed by SPH 1627 (4.94 q/ha) where CSH 20 MF recorded 4.92 q/ha of green fodder yield per day. None of the varieties could perform better than SSG 59-3 (4.85 q/ha) in this zone.

Dry fodder yield per day SPH 1626 produced the highest dry fodder yield per day (1.61 q/ha) on average, followed by SPH 1625 (1.58 q/ha). CSH 20MF recorded 1.55 q/ha of dry fodder yield per day.

Phenology and morphological parameters
Days to 50% flowering ranged from 71 to 77 days, CSH 20MF being the earliest of all in this zone.

Early vigour was found to be high in SSG 59-3 (4.0), all the rest being on par with each other.

Leaf parameters were found to be good in SPH 1626 which had long (82.5 cm) and wide (6.23 cm) leaves.

Stem girth varied from 2.33 cm to 3.14 cm. SSG 59-3 had thin stems (2.33 cms) followed by SPV 1844 (2.61 cm).

Number of tillers was high in SSG 59-3 (3.3) followed by SPV 1844 (2.97).

High **leaf-stem ratio** was observed in SPV 1842 (0.75) followed by SPV 1844 (0.68).

Zone-II:
Yield parameters
Green fodder yield SPH 1626 ranked first for green fodder yield across all the cuts (846 q/ha) in zone II also, where CSH 20MF had given 777 q/ha of green fodder yield. Among the varieties, SPV 1842 (764 q/ha) yielded highest green fodder, where SSG 59-3 recorded 727 q/ha of green fodder yield.

Dry fodder yield in zone II was found to be highest in SPH 1627 (181 q/ha) followed by SPH 1626 (173 q/ha) and SPH 1625 (172 q/ha). CSH 20MF recorded 162 q/ha of dry fodder in this zone. None of the varieties yielded more than SSG 59-3 (157 q/ha).

Green fodder yield per day ranged from 4.84 to 6.05 q/ha, the highest being in SPH 1626. It is followed by SPH 1627 (5.97 q/ha) in zone II. Among the varieties, SPV 1842 (5.4 q/ha) recorded highest green fodder yield per day.

Dry fodder yield per day was high in SPH 1627 (1.68 q/ha), followed by SPH 1625 (1.63 q/ha). None of the varieties were better than SSG 59-3 (1.49 q/ha) for dry fodder yield per day in this zone.

Phenology and morphological parameters
Days to 50% flowering All the genotypes flowered earlier compared to zone I. It ranged from 57 to 63 days. Both the checks were the earliest to flower (57 days), followed by SPH 1625 and SPH 1627 which flowered in 58 days.

Early vigour was observed to be more in SSG 59-3 in this zone also. All others are on par with each other.

Leaf parameters were observed to be good in SPH 1625, SPH 1626 and SPV 1843 which had long broad leaves.

Number of tillers was found to be more in SPV 1844 (5.2) among the varieties and in SPH 1627 (4.4) among the hybrids, compared to their respective checks in this zone.

Leaf-stem ratio was higher in the varieties SPV 1843 (0.37) and SPV 1844 (0.36).

National level:
Yield parameters
Green fodder yield The hybrid SPH 1626 (789 q/ha) recorded significant improvement in green fodder yield over the check, CSH 20MF (718 q/ha) at all India level. It is followed by SPH 1627 (734 q/ha). None of the varieties could out yield SSG 59-3 for green fodder yield at all India level.

Dry fodder yield ranged from 159 to 197 q/ha at all India level. SPH 1626 ranked first for dry fodder yield (197 q/ha) with 7% improvement over CSH 20MF (183 q/ha). SPH 1627 was in second rank (193 q/ha). None of the varieties were better than SSG 59-3 (176 q/ha).

Green fodder yield per day On average SPH 1626 (5.6 q/ha) was the best genotype for per day productivity of green fodder across different cuts with significant improvement over CSH 20MF (5.2 q/ha). SPH 1627 (5.3 q/ha) occupied second place.

Dry fodder yield per day was high in SPH 1625 and SPH 1627 (1.6 q/ha) which is 5% more than the check, CSH 20 MF (1.5 q/ha). Again among varieties, none were better than SSG 59-3.

Phenology and morphological parameters
Days to 50% flowering ranged from 64 - 70 days and all the genotypes were at par with each other.

Early vigour was high in SSG 59-3. There is no variation in early vigour.

For **number of leaves** SPH 1627 was the best genotype. SPH 1626 had long leaves (6.23 cm).

Stem girth ranged from 2.78 to 3.63 cm. SSG 59-3 (2.8 cm) was found to have thin stems followed by SPV 1844 (3.1 cm).

Number of tillers was found to be high in SPV 1844 (3.5) where SSG 59-3 had 3.3 tillers. Among the hybrids SPH 1627 had more tillers (3.1) compared to CSH 20 MF (2.9).

For **leaf-stem ratio,** SPV 1842 was the best genotype (ratio of 0.54) followed by SPV 1843 (0.48) and SPH 1626 (0.42).

Reaction to major pests and diseases
Shoot fly reaction of multi-cut genotypes showed that the hybrid, SPH 1624 recorded lowest deadhearts (47% DH) where as CSH 20MF recorded 57.8 % DH. Among varieties, SPV 1843 was having better shoot fly tolerance (47% DH).

Stem borer deadheart percentage was found to be less in SPH 1626 (13.2% DH) where CSH 20MF recorded 15.7% DH. None of the varieties were better than SSG 59-3 for their reaction of stem borer.

For **leaf diseases** all the genotypes were observed to be on par with the checks. SPV 1844 was good with better level of resistance to zonate leaf spot, anthracnose and grey leaf spot. For sooty stripe SSG 59-3 was the best.

Quality paramers
Total soluble sugars were high in SPH 1625 (5.5%) and SPH 1627 (5.2%). The hybrid check, CSH 20MF recorded 4.8% TSS. Among the varieties, SPV 1844 and SPV 1843 had high TSS values compared to the check, SSG 59-3 (4.2 %).

HCN of all the entries is with in the safe limit with the lowest value being in SSG 59-3 (51 ppm).

Protein percent ranged from 7.6 to 8.1%, the highest being in SPH 1626, followed by SPH 1624 (8%). The checks SSG 59-3 and CSH 20MF recorded 7.9% of protein. Among the varieties, SPV 1843 had high protein of 8%.

Average **protein yield** over two cuts was also highest in SPH 1626 (11.9 q/ha), followed by SPH 1625 (10.9 q/ha). The hybrid check, CSH 20MF had 10.6 q/ha of protein. Among the varieties SPV 1844 had high protein yield (11.0 q/ha). SSG 59-3 had 9.98 q/ha of protein yield.

IVDMD values ranged from 53.5 to 56.6%. The variety SPV 1842 had the highest IVDMD value (56.6%), followed by SPH 1626 (54.9%). The variety SPV 1843 (54.7%) and the hybrid SPH 1626 (54.9%) also recorded more IVDMD compared to the checks, SSG 59-3 (54.4%) and CSH 20MF (54.5%).

Total digestible dry matter (DDM) over two cuts was highest in SPH 1626 (80.6 q/ha) followed by SPH 1625 (73.4 q/ha), where CSH 20MF recorded 71.5 q/ha of DDM. Among the varieties, only SPV 1844 had given 67.5 q/ha of DDM, against 67 q/ha by SSG 59-3.

The promising multi-cut genotypes tested during kharif 2008 are given in table 6 and the genotypes which performed well during the last 2-3 years are given in table 7.

Table 6: Performance of promising multi-cut sorghum genotypes in advanced trial during 2008-09

(Entries- 9; Checks - 2; Locations: 14)

	GFY (q/ha)				DFY (q/ha)				GFY/day (q/ha)		DFY/day (q/ha)		PY (q/ha)		DDM (q/ha)		SF	SB	ZLS	ALS	GLS	SS
Entry		*R*	*% +/- over SSG 59-3*	*% +/- over CSH 20MF*		*R*	*% +/- over SSG 59-3*	*% +/- over CSH 20MF*		*R*		*R*		*R*		*R*						
SPH 1626	789	1	16	9.9	197	1	11.8	7.4	5.63	1	1.58	3	11.9	1	80.6	1	51	13	2.1	2.3	1.0	2.0
SPH 1627	734	2	8.0	2.2	193	2	9.5	5.1	5.33	2	1.60	2	10.5	5	70.0	4	57	14	2.3	3.2	2.3	2.0
SPH 1625	717	4	5.5	-0.2	192	3	9.0	4.6	5.20	3	1.60	1	10.9	3	73.4	2	51	14	2.3	3.2	2.3	1.7
Checks																						
CSH 20MF	718	3			183	4			5.18	4	1.52	4	10.6	4	71.5	3	58	16	2.1	1.9	1.3	2.7
SSG 59-3	680	5			176	5			5.04	5	1.47	5	10.0	6	67.0	6	48	13	2.1	2.9	4.0	1.3
CD (5%)	50.8				17.9				0.42		0.17		2.92		21.3		23	6.6	0.7	1.1	1.2	1.3
CD (1%)	67.3				23.7				0.56		0.22		3.96		29.4		32	8.8	1.0	1.6	1.6	1.8
C.V. (%)	9.0				11.9				10.9		13.6		21.4		17.6		24	23	20	26	38	34

GFY- Green fodder yield, DFY- Dry fodder yield, PY- Protein yield; DDM- Digesible dry matter, DH- deadhearts, SF - Shoot fly, SB- Stem *borer, ZLS - Zonate leaf spot, ALS- Anthracnose leaf spot, GLS - Grey leaf spot, SS- Sooty stripe*

Table 7. Performance of promising multi cut sorghum genotypes tested in AICSIP over last 3 years

		Yield								Quality				Insect pests DH (%)		Diseases (score)			
		GFY (q/ha)		DFY (q/ha)		GFY/day (q/ha)		DFY/day (q/ha)		PY (q/ha)		DDM (q/ha)		SF	SB	ZLS	ALS	GLS	SS
Entry	**Year**		**R**		**R**		**R**		**R**		**R**		**R**						
SPH 1626	2007*	711	1	183	1	6.61	1	1.67	1	17.9	1	127	1	16	22	2.1	1.8	-	2.0
	2008	789	1	197	1	5.63	1	1.58	3	11.9	1	80.6	1	51	13	2.1	2.3	1.0	2.0
	Av	**750**		**190**		**6.12**		**1.63**		**14.9**		**103.8**		**34**	**18**	**2.1**	**2.1**	**1.0**	**2.0**
SPH 1624	2006*	692	6	184	3	6.38	3	1.45	3	19.9	3	102.4	3	23	14	2.0	1.7	1.0	3.0
	2007	764	4	212	3	6.13	3	1.35	5	14.4	2	93.5	2	15	18	2.6	1.9	1.0	3.0
	2008	657	7	161	8	4.53	8	1.30	9	9.4	7	63.9	7	47	15	2.1	1.9	1.0	2.7
	Av.	**704**		**186**		**5.68**		**1.37**		**14.6**		**86.6**		**28**	**16**	**2.2**	**1.8**	**1**	**2.9**
SPH 1625	2006*	878	1	208	1	6.84	1	1.62	1	22.7	1	109.4	1	25	33.9	2.8	1.8	2.5	1.0
	2007	772	3	209	4	6.11	4	1.37	4	12.8	6	82.1	5	12	15.2	2.8	2.0	4.0	1.0
	2008	717	4	192	3	5.20	3	1.60	1	10.9	3	73.4	2	51	14	2.3	3.2	2.3	1.7
	Av	**789**		**203**		**6.05**		**1.53**		**15.5**		**88.3**		**29**	**21**	**2.6**	**2.3**	**2.9**	**1.2**
SPV 1842	2006*	649	8	145	8	5.06	8	1.14	8	14.5	7	76.8	7	22	36.4	2.2	1.8	1.0	3.0
	2007	666	7	179	8	4.93	8	1.07	8	11.9	8	90.6	4	11	12.8	2.1	1.9	1.0	3.0
	2008	654	8	166	7	4.73	6	1.37	7	7.72	9	53.5	9	47	15	2.1	2.1	1.0	3.3
	Av	**656**		**163**		**4.91**		**1.19**		**11.4**		**73.6**		**27**	**21**	**2.1**	**1.9**	**1.0**	**3.1**
Checks																			
CSH 20MF	2006	721	4	169	4	5.91	3	1.33	3	16.6	2	93.5	3	25	16	2.1	1.7	1.0	3.0
	2007	793	2	219	1	6.31	1	1.46	1	14.1	3	93.1	3	13	19.4	2.08	2.00	1.00	3.00
	2008	718	3	183	4	5.18	4	1.52	4	10.6	4	71.5	3	58	16	2.1	1.9	1.3	2.7
	Av	744		190		5.8		1.44		13.8		86.0		32	17	2.09	1.8	1.1	2.9
SSG 59-3	2006	679	7	153	8	5.49	7	1.18	8	14.2	7	75.5	8	19	10	3.0	2.3	2.5	1.0
	2007	685	6	191	6	5.36	6	1.18	6	12.5	7	72.7	7	12	13.9	2.5	2.1	4.0	1.0
	2008	680	5	176	5	5.04	5	1.47	5	10.0	6	67.0	6	48	13	2.1	2.9	4.0	1.3
	Av	681		173		5.30		1.28		12.2		71.7		26	12	2.5	2.4	3.5	1.1

Conclusions: SPH 1626 was the best genotype both for fodder yield and quality, followed by SPH 1625 and SPH 1627. None of the varieties could out yield SSG 59-3.

2.2 Initial Varietal and Hybrid Trial for multi-cut forage sorghum (IVHT-MC)

Breeding: The initial varietal and hybrid trial for multi cut forage genotypes was carried out with 6 genotypes including 2 hybrids, 2 varieties and two checks consisting of one multi-cut variety SSG 59-3 and one hybrid, CSH 20MF. The results of the trial are presented below (Tables 4.1 to 4.36).

Zone-I:

Yield parameters

Green fodder yield SPH 1623 ranked first for total green fodder yield from different cuts (675 q/ha) which is 7% improvement over the check, CSH 20MF (629 q/ha). Eventhough the variety, SPV 1841 had given high green fodder yield over SSG 59-3 in the I cut, none of the varieties could out yield the check, SSG 59-3 (627 q/ha) in zone I for total green fodder yield.

Dry fodder yield Both the hybrids SPH 1622 and SPH 1623 ranked first for dry fodder yield from three cuts (190 q/ha), where CSH 20MF recorded 184 q/ha of dry fodder over 3 cuts. Among the varieties, none were found to be better than SSG 59-3 (186 q/ha).

Green fodder yield per day was reported to be more in SPH 1623 (5.05 q/ha) over all the cuttings, followed by SPH 1622 (4.89 q/ha) where CSH 20 MF recorded 4.66 q/ha of green fodder yield per day. Among the varieties, eventhough SPV 1841 yielded on par with SSG 59-3 in the first cut, none of the varieties could perform better than SSG 59-3 (4.75 q/ha) over all the cuts in this zone.

Dry fodder yield per day also SPH 1623 ranked first for dry fodder yield per day (1.40 q/ha) on average, followed by SPH 1622 (1.36 q/ha). CSH 20MF recorded 1.34 q/ha of dry fodder yield per day. SPV 1841 yielded onpar with SSG 59-3 in the first cut, but could not out yield SSG 59-3 (1.39 q/ha) over three cuttings.

Phenology and morphological parameters

Days to 50% flowering ranged from 73 to 78 days, CSH 20MF being the earliest of all in this zone.

Early vigour was found to be high in SPH 1622 (3.31), followed by SSG 59-3 (3.19) and CSH 20MF.

Leaf parameters were found to be good in SPH 1623, which had long (81.6 cm) and wide (7.18 cm) leaves. Number of leaves was more in SPH 1622 (12) compared to CSH 20MF (10).

Number of tillers were high in SSG 59-3 (3.8) followed by SPH 1622 (2.89)

High **leaf-stem ratio** was observed in CSH 20MF (0.67) followed by SPH 1623 (0.62).

Zone-II:

Yield parameters

Green fodder yield CSH 20MF ranked first for green fodder yield across all the cuts (802 q/ha) in zone II, followed by SPH 1623 (794 q/ha). None of the varieties could out yield SSG 59-3 (725 q/ha).

For **Dry fodder yield** also none of the genotypes could out yield the checks, CSH 20MF (186 q/ha) and SSG 59-3 (177 q/ha) in zone II.

Green fodder yield per day ranged from 4.41 to 5.51 q/ha, the highest being in CSH 20MF. It is followed by SPH 1623 (5.36 q/ha) in zone II.

Dry fodder yield per day was high in CSH 20MF (1.59 q/ha), followed by SSG 59-3 (1.57 q/ha). None of the genotypes were better than the checks in this zone.

Phenology and morphological parameters

Days to 50% flowering All the genotypes flowered earlier compared to zone I. It ranged from 61 to 66 days. Both the checks were the earliest to flower, followed by SPH 1622 which flowered in 63 days.

Early vigour was observed to be more in SPH 1622, followed by CSH 20MF.

Leaf parameters More number of leaves were observed in SPV 1840, good leaf parameters like long, broad leaves were observed in SPH 1623.

Number of tillers ranged from 3.1 to 6.43. Tillers were found to be more in SSG 59-3 (6.43), followed by SPV 1841 (5.65) and SPH 1622 (4.25).

Leaf-stem ratio was higher in SPH 1622 (0.37) and SPH 1623 (0.34).

National level:

Yield parameters

Green fodder yield The hybrid SPH 1623 (717 q/ha) recorded 4% improvement in green fodder yield over the check, CSH 20MF (691 q/ha) at all India level. None of the varieties could out yield SSG 59-3 for green fodder yield at all India level.

Dry fodder yield ranged from 135 to 185 q/ha at all India level. CSH 20MF ranked first for dry fodder yield (185 q/ha), followed by SPH 1622 (184 q/ha). None of the varieties were better than SSG 59-3 (183 q/ha).

Green fodder yield per day For per day green fodder yield also SPH 1623 ranked first (5.16 q/ha) across different cuts. CSH 20MF (4.96 q/ha) occupied second place.

Dry fodder yield per day was high in the checks, SSG 59-3 (1.45 q/ha) and CSH 20MF (1.43 q/ha).

Phenology and morphological parameters

Days to 50% flowering ranged from 68-73 days and CSH 20MF was the earliest of all.

Early vigour ranged from 2.5 score to 3.32 score. It was high in SPH 1622 followed by CSH 20MF and SSG 59-3.

For **number of leaves** SPH 1623 among hybrids and SPV 1840 among varieties were found to have more leaves which are long and broad.

Stem girth ranged from 2.8 to 3.88 cm. SSG 59-3 (2.8 cm) was found to have thin stems followed by SPV 1841 (3.3 cm).

Number of tillers were found to be high in SSG 59-3 (4.45), followed by SPV 1841 (3.56). Among the hybrids, SPH 1622 (3.23) had more tillers.

For **leaf-stem ratio,** CSH 20MF was the best genotype (ratio of 0.51) followed by SPH 1623 (0.49). There is no much variation among the entries.

Reaction to major pest and diseases

Shoot fly incidence was found to be least in SPV 1840 (37% DH) compared to 58% deadhearts (DH) of SSG 59-3. None of the hybrids were found to be better than the check, CSH 20MF (55% DH).

Stem borer deadheart percentage was found to be less in SPH 1622 (11.5% DH), followed by SPH 1623 (14.2% DH) where CSH 20MF recorded 15.2% DH. None of the varieties were better than SSG 59-3 for their reaction of stem borer.

For **leaf diseases** CSH 20MF was observed to be the best genotype with good level of resistance to all leaf diseases, followed by SPH 1623 and SPH 1622.

Quality parameters

Total soluble sugars were high in SPH 1622 (4.8%). The hybrid check, CSH 20MF recorded 4.4% TSS. Among the varieties, SPV 1840 had high TSS values (4.2%) compar ed to the check, SSG 59-3 (3.7 %).

HCN ranged from 51 to 137 ppm. HCN of all the entries was with in the safe limit with the lowest value being in SSG 59-3 (51 ppm).

Protein percent ranged from 7.5 to 8.6%, the highest being in SPV 1840, followed by SPV 1841 and SSG 59-3. None of the hybrids were found to be better than the check.

Average **protein yield** over two cuts was also highest in SPH 1623 (12.9 q/ha), followed by SSG 59-3 (11.9 q/ha).

IVDMD values ranged from 52.9 to 56.0%. Highest IVDMD value w as recorded in SPH 1623 (56%) followed by SPH 1622 (55.7%). Among the varieties, SPV 1841 (55.3%) was the best for IVDMD.

Total digestible dry matter (DDM) over two cuts was also highest in SPH 1623 (94.2 q/ha) followed by SPH 1622 (91.6 q/ha) and CSH 20 MF (89.7 q/ha). The multi-cut genotypes tested during kharif 2008 are given in table 8.

Table 8: Performance of multi-cut sorghum genotypes in initial trial during 2008-09

(Entries- 6; Checks- 2; Locations: 13)

	GFY (q/ha)				DFY (q/ha)				GFY/day (q/ha)		DFY/day (q/ha)		PY (q/ha)		DDM (q/ha)		SF	SB	ZLS	ALS	GLS	SS
Entry		*R*	*% +/- over SSG 59-3*	*% +/- over CSH 20MF*		*R*	*% +/- over SSG 59-3*	*% +/- over CSH 20MF*		*R*		*R*		*R*		*R*						
SPH 1623	717	1	8.4	3.9	178	4	-2.8	-3.8	5.16	1	1.38	4	12.9	1	94.2	1	60	14	2.1	2.7	1.8	3.5
SPH 1622	684	3	3.4	-0.9	184	2	0.9	-0.1	4.94	3	1.40	3	10.9	4	91.6	2	58	12	2.1	2.3	1.3	2.5
SPV 1840	535	6	-19	-23	135	6	-26	-27	3.83	6	1.03	6	9.5	6	66.1	6	37	16	2.2	3.1	2.3	2.5
SPV 1841	622	5	-6	-9.9	164	5	-10	-11	4.41	5	1.22	5	10.4	5	76.4	5	61	17	2.7	3.5	1.0	2.0
Checks																						
CSH 20MF	691	2			185	1			4.96	2	1.43	2	11.6	3	89.7	3	55	15	1.8	2.2	1.0	2.3
SSG 59-3	662	4			183	3			4.89	4	1.45	1	11.9	2	83.2	4	58	15	2.1	4.5	3.5	1.0
CD (5%)	72.1				21.9				0.55		0.19		3.43		29.7		18	6	1.0	2.1	1.1	0.9
CD (1%)	95.8				29.2				0.73		0.25		4.75		42.3		26	8	1.4	3.0	1.5	1.3
C.V. (%)	15				16				15		18		20		19		17	37	32	38	40	28

GFY- Green fodder yield, DFY- Dry fodder yield, PY- Protein yield; DDM- Digesible dry matter, DH- deadhearts, SF- Shoot fly, SB-Stem borer, ZLS- Zonate leaf spot, ALS- Anthracnose leaf spot, GLS- Grey leaf spot, SS - Sooty stripe

Conclusions: The hybrid SPH 1623 was found to be the best hybrid for both yield and fodder quality. None of the varieties could out yield the check, SSG 59-3, but SPV 1840 and SPV 1841 had high protein and IVDMD values.

3. Advanced seed yield trial

The seed yield trial was taken up at 7 locations to know the seed production ability of the varieties in advanced trials of both single-cut and multi-cut sorghum. There were 14 entries including the checks, CSV 21F and HC 308. 9 single-cut forage varieties and 3 multi-cut forage varieties were included in the study. Data was recorded on grain yield, dry fodder yield, days to 50% flowering, days to maturity, plant height and early vigour (Tables 5.1 to 5.4). The results are discussed below.

Zone-I:

Grain yield of the entries in this zone ranged from 8.8 q/ha to 11.6 q/ha. Highest grain yield was reported in SPV 1845 (11.6 q/ha) followed by SPV 1847 (11.4 q/ha). CSV 21F and HC 308 yielded 9.9 and 9.3 q/ha of grain respectively. Among the multi-cut genotypes, SPV 1842 and SPV 1844 yielded 10.5 q/ha of grain.

Dry fodder yield ranged from 153 q/ha to 245 q/ha in this zone. Highest dry fodder yield was recorded in SPV 1853 (245 q/ha) followed by SPV 1849 (231 q/ha).

Zone-II:
Grain yield varied from 10.3 to 22.9 q/ha. Highest yield was observed in SPV 1847 (22.9 q/ha) followed by SPV 1845 (22.8 q/ha). Seven genotypes had given grain yield more than the checks, where CSV 21F and HC 308 had given 17.6 and 15.5 q/ha of grain yield respectively. Highest grain yield among multi-cut varieties was recorded in SPV 1844 (20.1 q/ha)

Dry fodder yield in this zone ranged from 166 q/ha (HC 308) to 197 q/ha (SPV 1842). SPV 1844 occupied second rank (187 q/ha) in dry fodder yield. It has good grain yield potential also among the multi-cut varieties.

National:
Grain yield ranged from 10.1 to 17.2 q/ha. Seven varieties were observed to yield more grain than the checks, CSV 21F (138 q/ha) and HC 308 (12.4 q/ha). The improvement ranged from 11-38.7% over HC 308, and 7-25% over CSV 21F. SPV 1845 and SPV 1847 was the highest grain yielding single-cut varieties (17.2 q/ha) followed by SPV 1850 (16.5 q/ha). Among the multi-cut varieties, SPV 1844 (15.3 q/ha) had given good grain yield with 24% increase in grain yield over the check, HC 308 and 11% over CSV 21F.

Dry fodder yield at all India level varied from 158 q/ha to 223 q/ha, the highest being in SPV 1853, followed by SPV 1849 (214 q/ha). CSV 21F and HC 308 yielded 210 q/ha and 174 q/ha of dry fodder in this trial.

Conclusions: The single-cut varieties, SPV 1845 and SPV 1847 and the multi-cut variety, SPV 1844 were found to yield more grain compared to the checks in both the zones and at all India level.

4. Co-ordinated research under forage sorghum breeding

Breeding program for trait based improvement of forage sorghum genotypes for quality and resistances has been initiated during kharif 2008. The following crosses were made under this program by different AICSIP centers.

a) Crosses made for improvement of forage quality
   1. EC 582506 x UP chari 2
   2. EC 582506 x Pant Chari 3
   3. Pant Chari 4 x EC 582510
   4. Pant Chari 4 x EC 582508

b) Crosses made for improvement of shoot fly resistance
   1. UPMC 512 x ICSV 705
   2. ICSV 705 x UPMC 503
   3. ICSV 705 x HC 308
   4. IS 2122 x UPMC 503

c) Crosses made for improvement of stem borer resistance
   1. ICSV 93046 x HC 136
   2. ICSV 93046 x HC 308
   3. ICSV 93046 x HJ 513
   4. ICSV 700 x HC 136
   5. ICSV 700 x HC 308
   6. ICSV 700 x HJ 513
   7. HC 136 x ICSV 93046
   8. HC 308 x ICSV 93046
   9. HJ 513 x ICSV 93046
   10. SSG 59-3 x ICSV 93046
   11. SGL 87 x ICSV 93046
   12. ICSV 93046 x HC 171
   13. ICSV 93046 x SSG 59-3
   14. ICSV 93046 x S 541
   15. ICSV 700 x HC 171
   16. ICSV 700 x SSG 59-3
   17. ICSV 700 x S 541
   18. HC 171 x ICSV 93046
   19. HJ 513 x ICSV 93046
   20. S 541 x ICSV 93046
   21. SSG 9 x ICSV 93046

d) Crosses made for improvement of foliar diseases
   1. IS 21461 x IS 2508
   2. IS 21622 x IS 12467
   3. IS 21622 x IS 2508
   4. IS 22996 x IS 12467
   5. IS 29794 x IS 12467
   6. IS 29691 x IS 2508
   7. SDSL 92112 x IS 2508
   8. ICSV 95119-1-2 x IS 2508
   9. IS 6953 x IS 12467
   10. 9533-4 x IS 12467
   11. IS 3359 x IS 12467

These F_1s are advanced during rabi 08 and F_2s will be shared among the centers.

5. Animal nutrition experiments

Trial 6. Nutritional evaluation of single cut forage sorghum genotype SRF-305 against check variety HC-308 in growing calves

The sorghum fodder of two varieties HC-308 and SRF- 305 were grown at Farm under Forage Section, CCSHAU, Hisar. The fodder from both varieties was taken for feeding trial after 72 days of sowing. Ten crossbred female calves of average body weight 111±5.46 kg and of average age of 7±0.2months were allotted randomly to two groups. The animals were kept in well ventilated disinfected stalls provided with individual feeder. The calves of G-I and G-II were fed solely on chafed sorghum fodder from the varieties HC-308 and SRF-305, respectively. The animals were supplemented with 25g mineral mixture per day per animal and drinking water was made available all the time. A feeding trial comprising of 30 days as preliminary period and 7 days digestion trial was conducted. Feed and faecal samples were analyzed for proximate principles and cell wall fractions.

Highlights of results

- The chemical constituents of two varieties of sorghum showed that crude protein was higher in variety SRF -305 compared to HC-308 and crude fibre, NDF, ADF, Cellulose and lignin contents were higher in HC-308 (Table 9).

Table 9: Proximate principles and fibre fraction of different sorghum variety.

Parameters	Variety	
	HC-308	SRF-305
Dry matter	27.06	24.53
Organic matter	91.83	92.64
Crude protein	6.81	7.30
Crude fibre	29.23	26.17
Ether extract	2.22	2.19
NFE	53.57	56.98
Ash	8.17	7.36
Neutral Detergent Fire	66.31	63.22
Acid Detergent Fire	46.43	43.38
Hemicellulose	19.88	19.84
Cellulose	36.48	34.14
Lignin	6.21	5.79

Table 10: Nutrients intake, nutrients digestibility and nutritive value of different varieties of sorghum fodder fed to calves.

Attributes	Variety	
	HC-308	SRF-305
Body weight (kg)	123±6.17	120±7.21
Dry matter intake (kg)	2.94±0.27	3.04±0.14
DMI/100kg B.wt.(kg)	2.39^{a}±0.17	2.54^{b}±0.09
CP intake (g)	200.21±14.31	221.92±14.50
DCP intake (g)	110.99^{a}±7.10	130.33^{b}±8.37
TDN intake (kg)	1.66^{a}±0.07	1.80^{b}± 0.07
Digestibilty% (DM basis)		
Dry matter	59.89^{a}±2.83	63.93^{b}±2.41
Crude Protein	55.44^{a}±1.20	58.73^{b}±2.09
Ether Extract	58.23±1.13	57.55±1.02
Crude fibre	57.19^{a}±0.94	61.34^{b}±1.07
Nitrogen Free extract	61.43±2.73	63.57±2.08
Neutral Detergent Fibre	50.57^{a}±1.11	53.21^{b}±1.35
Acid Detergent Fibre	40.43±2.10	41.11±1.24
Hemi cellulose	52.22±1.31	53.31±1.48
Cellulose	49.43^{a}±2.05	52.83^{b}±0.87
Nutritive Value		
DCP%	3.78^{a}±0.02	4.28^{b}±0.08
TDN%	56.30^{a}±0.69	59.38^{b}±0.51

- The mean values of dry matter intake per day did not differ significantly due to feeding of fodder from either of the variety (Table 8). However, DMI per 100 kg body weight of calves in G-II fed with fodder of SRF-305 was higher (P<0.05) as compared to G-I.
- The mean values of crude protein intake per day were higher in calf groups fed with fodder of SRF-305 (221.92g) as compared to group fed HC-308 fodder (200.21g).
- The digestible crude protein and total digestible nutrient intake were significantly (P<0.05) higher by feeding fodder from SRF-305 as compared to HC-308.
- The nutritive value in terms of DCP and TDN percent were also significantly (P<0.05) more in SRF-305 in comparison to HC-308.
- The mean values of dry matter, crude protein, crude fibre, neutral detergent fibre, and cellulose digestibility were significantly (P<0.05) higher in cross bred calves fed on fodder of SRF-305 as compared to HC-308 fodder. This might be due to higher content of CF, NDF, ADF, cellulose and lignin in HC-308 as compared to SRF-305 fodder.

Conclusion: Sorghum fodder from new variety SRF-305 was nutritionally better than variety HC-308 in terms of nutrients intake, nutrients utilization, nutritive value and total digestible nutrients.

Trial 7. Chemical composition studies of forage sorghum strains of Pantnagar center

One hundred fifty five samples of forage sorghum germplasm lines /varieties/ hybrids from PSG-1 to PSG-155 of Pantnagar center were chemically analysed for CP, CF, OM, Ash, NDF, ADF, Hemicellulose, cellulose and lignin content (Table 9).

Table 11: Chemical composition of different forage sorghum genotypes/Germplasm

Genptype	CP (%)	CF (%)	NDF (%)	ADF (%)	Hemi cellulose (%)	Cellulose (%)	Lignin (%)
PSG 1	8.3	26.14	66.22	39.91	26.31	30.47	5.78
PSG 2	8.45	25.58	65.97	37.41	28.56	30.5	5.69
PSG 3	7.9	26.35	68.92	39.84	29.08	31.43	5.99
PSG 5	7.8	26.11	68.84	39.11	29.73	29.11	5.43
PSG 6	7.8	27.43	68.14	38.4	29.74	30.3	4.28
PSG 7	7.65	27	68.88	39.41	29.47	31.42	5.78
PSG 9	7.45	26.12	68.45	38.15	30.3	32.33	6.11
PSG 10	7.4	27.43	68.02	37.53	30.49	31.17	6.37
PSG 11	7.95	28.14	63.68	34.03	29.65	30.37	5.83
PSG 12	7.6	26.43	65.02	35.45	29.57	32.47	6
PSG 13	8.3	25.51	63.33	34.87	28.46	29.87	5.93
PSG 14	8.45	25.18	63.99	35.63	28.36	30.12	6.03
PSG 15	8.5	26.05	63.54	36.18	27.36	31.14	6.73
PSG 16	8.36	26.17	63.82	33.53	30.29	28.57	6.19
PSG 17	7.4	27.05	67.94	36.71	31.23	29.17	6.73
PSG 18	8.73	26.47	62.92	33.43	29.49	29	6.88
PSG 19	7.4	28.27	68.03	37.23	30.8	31.47	7.3
PSG 20	7.6	26.53	63.69	34.73	28.96	30.12	6.17
PSG 21	7.7	27.11	63.52	34.81	28.71	31.54	7.01
PSG 22	7.4	26.88	64.34	35.35	28.99	29.84	6.84
PSG 23	7.2	25.34	67.61	37.3	30.31	32.28	6.94
PSG 24	7.2	27.21	66.36	36.83	29.53	33.14	6.11
PSG 25	7	28.17	68.54	39.23	29.31	31.43	6.83
PSG 27	7.1	26.41	67.8	40.11	27.69	32.12	5.84
PSG 40	6.75	28.17	69.29	38.32	30.97	30.11	7.43
PSG 44	7.15	28.12	68.52	40.57	27.95	28.57	6.14
PSG 46	7.1	28.22	68.18	39.65	28.53	29.43	6.15
PSG 47	7.33	27.85	68.15	39.02	29.13	30.11	6.23
PSG 48	7.55	25.43	65.88	36.54	29.34	29.17	5.87
PSG 49	7.5	27.11	66.54	37.25	29.29	30.23	6.11
PSG 50	7.6	26.45	66.09	40.15	25.94	31.11	7

Genptype	CP (%)	CF (%)	NDF (%)	ADF (%)	Hemi cellulose (%)	Cellulose (%)	Lignin (%)
PSG 52	7.46	25.12	65.6	40.83	24.77	28.27	5.91
PSG 60	7.3	29.88	69.45	40.25	29.2	29.98	5.98
PSG 81	7.45	26.78	69.08	39.71	29.37	29.89	6.11
PSG 114	7.5	28.64	69.43	38.87	30.56	29.41	6.87
PSG 118	8.1	28.14	68.81	38.53	30.28	29.82	6.59
PSG 120	7.8	27.34	69.37	39.9	29.47	30.22	6.81
PSG 124	8.15	27.18	67.84	38.43	29.41	29.29	6.11
PSG 127	8.1	26.23	68	40.11	27.89	29.52	6.51
PSG 129	7.95	27.11	69.37	37.57	31.8	31.41	6.37
PSG 130	7.85	26.23	69.87	40.17	29.7	32.43	6.82
PSG 131	7.8	27.52	68.47	38.43	30.04	29.53	6.74
PSG 134	7.5	26.64	68.93	39.91	29.02	30.47	6.73
PSG 136	8.1	27.43	68.88	40.11	28.77	29.42	6.37
PSG 140	7.25	26.53	68.47	39.95	28.52	29.23	6.73
PSG 141	7.8	27.92	69.18	41.11	28.07	29.81	6.81
PSG 145	8.45	26.93	66.11	37.39	28.72	28.47	5.88
PSG 149	7.9	27.87	69.34	38.93	30.41	32.33	6.11
PSG 153	8.2	27.31	69.43	41.23	28.2	29.58	6.81
PSG 154	8.4	27.45	68.11	39.57	28.54	30.47	6.98
SE	0.04	0.2	0.24	0.28	0.14	0.18	0.06
Mean	7.22	30.2	70.9	41.6	29.4	32.1	6.94
Min	6.19	25.1	62.9	33.4	24	28.3	4.28
Max	8.73	34.5	76.2	51.3	32.9	36.7	8.8

Conclusion: On the basis of nutrient composition it may concluded that the samples PSG 1,2, 3, 5, 6,7,9,10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 27, 40, 44, 46, 47, 48, 49, 50, 52, 60, 81,114,118,120,124,127,129, 131,134,136, 140, 141, 145,149,153, and 154 are of better nutritional quality than other germplasms /breeding lines/varieties.

Trial 8. Effect of feeding reconstituted sorghum grain on nutrient utilization and growth performance of calves

An experiment was conducted to study the effect of replacing maize grain with sorghum grain or with reconstituted sorghum grain in the concentrate mixture of cross bred female crossbred calves, on their growth performance and nutrients utilization. The sorghum grains were reconstituted by adding sufficient water and stored under anaerobic condition for 21 days. Twelve female crossbred cattle calves of average body weight 100.80±0.44 kg were randomly divided into three equal groups. Animals of G_1 were fed concentrate mixture comprising of GNC (30), Maize (50), DORP (17), Mineral mixture (2) and common salt (1 part). Animals of G_2 and G_3 were fed on concentrate mixture replacing maize grain of G_1 with sorghum grain and reconstituted sorghum grain, respectively (Table 13).

Highlights of results

- DMI was higher ($P<0.05$) in G_3 as compared to G_2, but DMI of % body weight and per kg metabolic body weight did not differ significantly between different groups (Tables 14 and 15).
- The digestibility of DM, CF, EE and NFE were significantly ($P<0.05$) higher in G_3 than G_1 and G_2, but G_1 and G_2 did not differ among themselves.
- The CP, and OM digestibility were higher ($P<0.05$) in G_3 as compared to G_2 but was at par with G_1.The differences between the digestibility value of NDF, ADF and Hemi cellulose were non significant among different treatment groups.
- DCPI and TDNI were higher ($P<0.05$) in experimental calves fed reconstituted sorghum grains.
- The nutritive value in terms of DCP and TDN percent were higher ($P<0.05$) in calves fed with reconstituted sorghum grain based concentrate mixture as compared to maize or sorghum grain. But the differences in DCP and TDN % of diets were non-significant by using maize grain or sorghum grain in the concentrate mixture.

- The body weight gain in group G_3 was also higher ($P<0.05$) than G_1 and G_2, which did not differ among themselves.
- FCR was significantly ($P<0.05$) higher in calves fed with reconstituted sorghum grain.

Table 12: Chemical composition of different feed ingredients fed to calves.

Attribute	GNC	Maize grain	Sorghum grain	Reconstituted Sorghum grain	DORP	Wheat straw
DM	91.89	92.10	92.73	90.11	90.18	92.87
OM	93.46	98.07	98.02	98.26	87.66	89.17
CP	41.13	9.87	11.21	11.07	13.01	2.80
EE	7.30	3.32	3.13	3.34	1.01	1.07
CF	8.14	2.64	2.87	2.61	17.13	33.50
NFE	36.89	82.24	80.81	81.24	56.52	51.80
Ash	6.54	1.93	1.98	1.74	12.33	10.83
NDF	18.31	11.70	16.21	14.53	38.41	73.83
ADF	10.21	3.12	8.13	8.01	20.20	50.17
Cellulose	6.13	2.83	5.13	4.59	10.87	35.11
H. cell	8.10	8.58	8.08	9.94	18.21	23.66

Table 13: Ingredients and chemical composition of different dietary concentrate mixtures

Attribute	G_1	G_2	G_3
Ingredient %			
GNC	30	30	30
Maize	50	-----	-----
Sorghum	----	50	----
Reconstituted Sorghum	----	----	50
DORP	17	17	17
MM	2	2	2
CS	1	1	1
Chemical composition (%)			
DM	91.84	92.13	90.56
OM	94.92	94.88	95.01
CP	19.47	20.06	19.98
EE	4.00	3.93	4.00
CF	6.65	6.71	6.60
NFE	64.80	64.18	64.43
Ash	5.08	5.12	4.99
NDF	17.75	20.00	19.15
ADF	8.01	10.31	10.25
Cellulose	5.02	6.15	5.88
H.cellulose	9.74	9.69	8.90

Table 14: Effect of different dietary tre atments on body weight changes and nutrients intake in calves

Attribute	G_1	G_2	G_3	CD
Body weight				
Intial B.wt.,kg	100.75±3.33	104.25±4.05	97.50±1.44	---
Final B.wt., kg	142.50±3.22	142.00±3.94	147.50±1.44	---
B.wt. gain, kg	41.75^{a}±1.62	37.75^{a}±1.03	48.75^{b}±1.25	4.33
Gain/d, g	463.50^{a}±18.33	419.00^{a}±11.56	541.25^{b}±13.75	48.03
Dry matter intake				
TDMI, kg	3.70^{ab}±0.03	3.56^{a}±0.07	3.78^{b}±0.07	0.19
DMI,%B.wt, kg	2.59±0.05	2.51±0.04	2.57±0.03	NS
DMI, g/kg $W^{0.75}$	89.65±1.15	86.36±1.17	89.76±1.10	NS

Attribute	G_1	G_2	G_3	CD
Crude protein intake				
CPI, g/d	539.00^{ab}±8.08	535.50^{a}±10.20	564.75^{b}±7.08	27.76
CPI, % B.wt., g	378.45±3.45	377.53±7.10	386.13±2.92	NS
CPI,g/kg $W^{0.75}$	13.07±0.06	13.02±0.19	13.42±0.11	NS
Digestible crude protein intake				
DCPI, g/d	373.25^{a}±6.80	367.00^{a}±4.10	399.00^{b}±6.57	19.31
DCPI,%B.wt., g	262.03±1.23	258.92±6.28	267.35±3.13	NS
Total digestible nutrients intake				
TDNI, kg/d	2.45^{a}±0.40	2.36^{a}±0.02	2.56^{b}±0.03	0.031
TDNI,%B.wt.kg	1.72±0.04	1.66±0.04	1.74±0.02	NS
TDNIg/kg $W^{0.75}$	59.46±1.20	57.38±0.93	60.87±0.49	NS

Table 15: Digestibility co-efficient and nutritive value of different dietary treatments fed to experimental animals

Attribute	G_1	G_2	G_3	CD
Digestibility %				
DM	66.16^{a}±0.43	65.52^{a}±0.33	67.73^{b}±0.49	1.36
OM	68.80^{ab}±0.34	68.11^{a}±0.19	69.67^{b}±0.46	1.11
CP	69.22^{ab}±0.34	68.55^{a}±0.80	70.63^{b}±0.46	1.84
EE	69.69^{a}±0.48	68.13^{b}±0.51	71.12^{c}±0.12	1.33
CF	51.45^{a}±0.46	52.64^{a}±0.25	53.52^{b}±0.53	1.41
NFE	73.52^{a}±0.35	71.55^{b}±0.68	73.87^{b}±0.71	1.94
NDF	48.94±0.17	49.43±0.37	50.20±0.40	NS
ADF	43.86±0.67	44.07±0.63	43.83±0.52	NS
H.Cell	53.64±1.29	53.19±2.17	54.16±1.47	NS
Nutritive value%				
DCP	10.10^{a}±0.14	10.37^{a}±0.11	10.57^{b}±0.13	0.41
TDN	66.55^{a}±0.78	66.39^{a}±0.69	67.90^{b}±0.67	1.30
Feed conversion efficiency				
DMI/kg gain	7.21^{a}±0.27	7.56^{a}±0.19	6.83^{b}±0.10	0.64

Conclusion: Maize grain can be replaced with sorghum grain in the diet of growing calves. And reconstitution of sorghum grain significantly ($P<0.05$) improves the growth rate of calves, nutrient utilization and feed conversion efficiency as compared to maize or sorghum grain based concentrate mixture.

Trial 9. In-vitro nutrient disappearance in new germplasm of forage sorghum

The samples from fifty new genotypes/germplasm of forage sorghum grown during kharif season 2008 were taken after 70 days of sowing for chemical analysis and *in-vitro* studies. The samples were analyzed for CP, CF, NDF and ADF content and were also used to see the *In-vitro* dry matter digestibility (IVDMD) and *In-vitro* NDF digestibility (IVNDFD).

Table 16: Chemical composition and in-vitro drymatter and NDF disappearance in different genotypes of forage sorghum

Genotype	CP	CF	NDF	ADF	IVDMD	IVNDFD
IS651	7.55	27.14	66.21	43.12	59.12	48.4
IS1032-2	7.6	28.04	66	42.8	58.38	48.07
IS3225	7.45	27.6	66.28	43.14	61.23	49.51
IS3237	7.7	27.45	65.78	41.24	60.41	50.34
IS4718	7.3	27	66.73	42.57	59.79	47.2
S534	7.45	28.51	65.28	41.21	59.23	49.81
S534-1	7.4	27.33	66.14	43.36	58.11	50.23
S536	7.35	26.24	64.83	42.34	60.28	49.11

Genotype	CP	CF	NDF	ADF	IVDMD	IVNDFD
G46	7.3	30.08	69.2	43.58	59.44	45
G73	7.45	26.58	64.3	44.47	61.48	49.91
G104	7.2	37.32	66.88	43.21	62.23	48.76
G110	7.8	26.93	65.43	42.57	63.37	50.3
G165	7.2	26.21	67.58	43.36	60.33	49.52
G171	7.35	27.18	66.55	44.3	61.45	48.33
EJ167	7.35	26.9	65.23	43	62.84	49.34
WT51	7.25	27.32	66.14	43.21	63	48.71
SE	0.04	0.29	0.33	0.32	0.53	0.39
Mean	7.05	29.7	69.2	45.9	56.5	45.8
Min	6.55	26.2	64.3	41.2	49.3	40.1
Max	7.8	37.3	72.8	49.3	63.4	50.3

Conclusion: Among 50 forage sorghum genotypes IS 651, IS 1032-2, IS 3225, IS 4718, S 534, S 534-1, S 536, G 46, G 73, G 104, G 119, G 165, G 171, EJ 167 and WT 51 are of better nutritional composition and they also have higher value of IVDMD and IVNDFD.

Overall conclusions

1. In AVT (SC), the genotypes SPV 1846, SPV 1852 and SPV 1847 showed better performance both for green and dry fodder yields and per day productivity, and SPV 1845 and 1846 were found promising for fodder quality.
2. In IVT (SC), SPV 1860 and SPV 1855 were promising for yield and quality parameters.
3. Based on data from 3 years, the single-cut varieties SPV 1848, SPV 1853 and SPV 1852 were promising for yield and quality.
4. In AVT (MC), SPH 1626 was the best genotype both for fodder yield and quality, followed by SPH 1625 and SPH 1627, and in IVT (MC) SPH 1623 was promising for yield and quality.
5. Seed yield trial shows that the single-cut varieties, SPV 1845 and SPV 1847 and the multi-cut variety, SPV 1844 yielded more grain compared to the checks in both the zones and at all India level.
6. Nutritional evaluation of the single-cut genotype, SRF 305 indicates that the fodder from SRF 305 was nutritionally better than HC 308 in terms of nutrient intake, utilization, nutritive values and total digestible nutrients.
7. Studies on the effect of feeding reconstituted sorghum grain indicated that maize grain can be replaced with sorghum grain in the diet of growing calves, and reconstituted sorghum improves the growth rate of calves, nutrient utilization and feed conversion efficiency as compared to maize or sorghum grain based concentrate mixture.
8. Evaluation of forage sorghum germplasm and breeding lines for quality traits identified 25 lines promising for protein percent and IVDMD values.

Follow-up for Kharif 2009

1. Based on performance the promising lines identified in IVT will be advanced to AVT.
2. The F_1s made for trait specific breeding program are being advanc ed and the F_2 seed will be distributed to different centers for making selections at their end.
3. The promising germplasm identified for different quality parameters will be utilized in the breeding program to enhance fodder quality

Annexure-I: Compliance report

Sl No	Centre	Trials supplied (No)	Trials received (No)	Date sown		Data received (Date)	Dead line of data receipt (Date)	Deviation from dead line (days)	Ranking
				SC trials	MC trials				
1	Hisar	9	6	4-July	26-Apr	11-Dec	30-Nov	11	8
2	Pantnagar	5	5	26-Jun	16- Apr	26-Nov	30-Nov	-4	6
3	Coimbatore	5	5	4-Jun	4-Jun	7-Nov	30-Nov	-23	2
4	Delhi	5	5	10-Jun	10-Jun	23-Dec	30-Nov	23	9
4	Udaipur	4	4	20-Jun	19-Jun	25-Nov	30-Nov	-5	5
5	Akola	4	4	2-Jul		3-Jan	30-Nov	34	10
6	Kanpur	4	4	24-Jun		19-Nov	30-Nov	-11	4
7	Ludhiana	5	5	17-Jul	9-May	9-Dec	30-Nov	9	7
8	Solapur	4	4	26-Jun	16-Apr	15-Nov	30-Nov	-15	3
9	Deesa	4	4	26-Jul	7-Jul	6-Nov	30-Nov	-24	1
10	Surat	4	4	4-Jul	4-Jul	19-Nov	30-Nov	-11	4
11	Jhansi	4	4	29-Jul	21-Apr	14-Jan	30-Nov	45	14
12	Meerut	4	4	11-Jul		6-Jan	30-Nov	38	12
13	Parbhani	1	1	-		5-Jan	30-Nov	36	11
14	Kovilpatti	2	2	15-Oct		9-Jan	30-Nov	40	13
15	Mandya	4	4	25-Jun	13-Jun	3-Feb	30-Nov	65	15
16	Rahuri	4	3	30-Jun	30-Jun	5-Feb	30-Nov	67	16

Dual-purpose sorghum - 2008-09

Dual-purpose sorghum 2008-09 - Summary

Introduction: During the kharif season of 2008, an Advanced Varietal Trial (AVT) and an Initial Varietal Trial (IVT) were organized from NRCS under AICSIP for testing under zones I, II and III.

1.1 Advanced Varietal Trial

Eight entries including 2 checks (CSV 15 and CSV 23) were tested across 14 locations under Zones I, II & III.

Highlights:

- In Zone I, SPV 1782, SPV 1822 and SPV 1823 were promising for grain yield while SPV 1820 showed superiority for stover and biomass yields
- In Zone II, SPV 1782, SPV 1779, SPV 1820 and SPV 1781 were promising for stover and biomass yields
- In Zone III, SPV 1822 followed by SPV 1779, SPV 1781 and SPV 1820 recorded significant superiority (16-37%) for grain yield over CSV 23 while SPV 1782, SPV 1779, SPV 1820 and SPV 1781 were promising for stover and biomass yields
- At national level, SPV 1782, SPV 1779, SPV 1820 and SPV 1781 maintained the consistency and were promising for stover and biomass yields
- With respect to resistance to shoot fly, stem borer and grain mold (field grade), the entries SPV 1779, SPV 1782 and SPV 1822 were promising.
- SPV 1820 was promising for downy mildew resistance

Conclusions: The entries SPV 1779, SPV 1781 and SPV 1782 have completed 3 years of testing (2 years of testing under advanced trials) and may be considered for release if found promising over years compared to the checks. The entries SPV 1820 and SPV 1822 may be retained in advanced trials for testing for one more year.

1.2 Initial Varietal Trial

Fifteen entries including 2 checks (CSV 23 and CSV 15) were tested across 11 locations under Zones I, II & III.

Highlights:

- In Zone I, SPV No`s 1871, 1870 and 1868 were promising for grain, stover and biomass yields
- In Zone II, 1870 and 1871 maintained their superiority for grain, stover and biomass yields over the checks
- In Zone III, SPV 1870, 1865 and 1862 were promising for grain, stover and biomass yields
- At national level, SPV 1870, SPV 1871 and SPV 1862 maintained the consistency and were promising for grain, stover and biomass yields
- SPV 1870, SPV 1864 and SPV 1866 were more tolerant to stem borer than other test varieties including checks.
- SPV 1871 and SPV 1872 were promising for anthracnose, leaf blight and downy mildew resistances.

Conclusions: The entries SPV 1870, SPV 1871 and SPV 1862 may be promoted to advanced trials because of their superiority for grain, stover and biomass yields in different zones.

Dual-purpose sorghum 2008-09: Detailed report

AVT & IVT (one each) were organized from NRCS for testing during the kharif season of 2008.

1.1 Advanced Varietal Trial

Eight entries including 2 checks (CSV 15 and CSV 23) were tested across 14 locations under Zones I, II & III.

Zone I: Based on the performance of entries and data collected from Palem and Coimbatore, the following conclusions are drawn.

Yield traits

Grain yield of test varieties ranged between 2947-3758 kg/ha (Checks- CSV 15:3049 kg/ha and CSV 23:3814 kg/ha). None of the entries had any significant superiority over the checks CSV 15 and CSV 23. However, the entries SPV 1782, SPV 1822 and SPV 1823 had numerically superiority of 23%, 22% and 18% over CSV 15.

Stover yield ranged from 126-147q/ha in the test varieties (130 q/ha in the better check CSV 23) and none of the test varieties were significantly superior to either of the checks. SPV 1820 recorded a numerical superiority of 14% over both the checks while SPV 1782, SPV 1822 and SPV 1823 showed a numerically superiority of < 5% over the checks.

Biomass: All the test entries were statistically on par to the checks. SPV 1820 recorded a numerical superiority of 12 and 6% over the checks CSV 15 and CSV 23. The other
entries which had a numerical superiority of around 7% over CSV 15 were SPV 1782, SPV 1822 and SPV 1823.

Morpho-phenological traits

Days to 50% flowering: The test entries flowered around same time as the checks. However, the entries SPV 1781 and SPV 1823 were earlier by 2-4 days than checks.

Days to maturity: All the test entries were on par to the checks in maturity.

Plant height: SPV 1782 was the tallest followed by SPV 1779 and SPV 1820

Grain weight: All the test entries were on par to the checks.

Forage traits

Leaf length: None of the entries were superior to CSV 23. The test varieties which exhibited significant superiority over check CSV 15 were SPV 1820, SPV 1782 and SPV 1781.

Leaf width: SPV 1823 and SPV 1820 exhibited a significant superiority of 10% over both the checks.

No. of leaves: SPV 1823 and SPV 1822 recorded highest number of leaves at maturity.

Zone II: The data from Indore, Surat, Chamarajanagar and Mandya for different traits indicates the following results.

Yield traits

Grain yield: None of the entries were superior to the checks.

Stover yield: In this zone, maximum stover yield was recorded by SPV 1782 followed by SPV 1779 which were more than 30% numerically superior to the both the checks.
SPV 1820 was another promising variety with 27% numerical superiority over the checks.

Biomass: SPV 1782 followed by SPV 1779 and SPV 1820 were superior (numerical) to both the checks.

Morpho-phenological traits

Days to flowering: All the entries flowered similar to the checks

Days to maturity: The test entries matured similar to the checks.

Plant height: Variation for plant height was from 215-260 cm.

Grain weight: All the test entries were on par to the checks.

Forage traits

Leaf length: SPV 1782 (80 cm) followed by SPV 1820 (79 cm) recorded maximum leaf length.

Leaf width: SPV 1823 and SPV 1820 recorded maximum leaf width among the entries.

Number ofleaves: Test varieties were on par to the checks for this character.

Zone III: Based on data from Mauranipur, Pantnagar, Deesa, Udaipur, Ranchi, Gwalior Hisar, and Ludhiana for various characters, following conclusions are drawn.

Yield traits

Grain yield: None of the test varieties have recorded any superiority over the check CSV 15 while the variety SPV 1822 recorded a significant superiority of 37% over CSV 23.

Stover yield: The varieties SPV 1779 and SPV 1781 recorded significant superiority of 15-28% over both the checks while SPV 1782 and SPV 1820 were significantly superior (19-23%) over CSV 23 alone.

Biomass: Similar to stover yield, the variety SPV 1779 recorded a significant superiority of 17-28% over both the checks while SPV 1781 and SPV 1782 were significantly superior (21-23%) over CSV 23 alone.

Morpho-phenological traits

Days to flower: SPV 1781, SPV 1822, SPV 1779, SPV 1823 and SPV 1782 were significantly earlier than CSV 23 by 4-6 days.

Days to maturity: SPV 1781, SPV 1822, SPV 1823 and SPV 1779 were significantly earlier in maturity than CSV 23.

Plant height: SPV 1782 and SPV 1781 were significantly taller than both the checks.

Grain weight: All the test entries were on par to the checks.

Forage traits

Leaf length: SPV 1782 and CSV 15 recorded highest leaf length.

Leaf width: SPV 1781 and SPV 1820 were significantly superior compared to both the checks.

Number of leaves: SPV 1782 and SPV 1820 recorded maximum number of leaves (12) which was same as that of the check CSV 23.

National level

Yield traits

Grain yield: None of the test varieties were significantly superior to either of the checks while SPV 1822 had a numerical superiority of 6-8% over both the checks.

Stover yield: SPV 1779 and SPV 1782 recorded a significant superiority of 16-24 % over both the checks while SPV 1820 and SPV 1781 were significantly superior to CSV 23 by 17 -19%.

Biomass: The trend was similar to stover yield.

Morpho -phenological traits

Days to flower: SPV 1781 was early compared to other test varieties.

Days to maturity: SPV 1781 was earliest in maturity.

Plant height: SPV 1782, SPV 1781 and SPV 1779 were significantly taller compared to the checks.

Grain weight: All the test entries were on par to the checks.

Forage traits

Leaf length: SPV 1782 recorded highest leaf length.

Leaf width: SPV 1820 followed by SPV 1823 recorded maximum leaf width among the test varieties.

Number of leaves: SPV 1820, SPV 1782 and SPV 1823 recorded maximum number of leaves (11) which was same as that of the check CSV 23.

Conclusions for all zones:

1. The entries SPV 1779, SPV 1781 and SPV 1782 have completed 3 years of testing (2 years of testing under advanced trials) and may be considered for release if found promising over years compared to the checks.

2. SPV 1820 was on par to the checks for grain yield while it out yielded the checks for stover yield and total biomass in most of the zones.
3. SPV 1822 was another variety which was superior to one of the checks for grain yield in zone I, zone III and at national level and was on par with the checks for stover and total biomass yields.
4. With respect to resistance to shoot fly, stem borer and grain mold (field grade), the entries SPV 1779, SPV 1782 and SPV 1822 were promising.
5. SPV 1820 was promising for downy mildew resistance.

1.2 Initial Varietal Trial

Fifteen entries including 2 checks (CSV 23 and CSV 15) were tested across 11 locations under Zones I, II & III.

Zone I: Based on the performance of entries and data collected from Palem and Coimbatore, the following conclusions are drawn.

Yield traits

Grain yield: None of the test varieties were significantly superior compared to both of the checks. However, the entries SPV 1871 and SPV 1870 were numerically superior (8-33%) to both the checks. The other entries SPV 1867 and SPV 1868 were numerically superior to CSV 23.

Stover yield: In this zone, the varieties SPV 1868, SPV 1871, SPV 1870 and SPV 1861 recorded numerical superiority over both the checks.

Biomass: The range of biomass was 136 to 192 q/ha compared to the checks CSV 15 (154 q/ha) and CSV 23 (151 q/ha). The varieties SPV 1871, SPV 1868, SPV 1870 and SPV 1861 recorded a numerical superiority of 12-26 % over the checks.

Morpho-phenological traits

Days to flowering: CSV 15 and SPV 1872 were early (67 days) compared to the rest.

Days to maturity: The test entries matured similar to the check CSV 23 except CSV 15 which matured earlier than CSV 23 by 6 days.

Plant height: SPV 1863 and SPV 1869 were significantly taller than the checks.

Grain weight: The checks were bold seeded compared to the test varieties.

Forage traits

Leaf length: The maximum leaf length of 93.3 cm was recorded by the check CSV 23 followed by SPV 1871 (92.7 cm) and SPV 1862 (91.7 cm).

Leaf width: Maximum leaf width of 10 cm was recorded by SPV 1862, SPV 1865 and SPV 1873.

Number of leaves: SPV 1870 (11) recorded maximum number of leaves.

Zone II: The data from Indore, Surat, Chamarajanagar and Mandya for different traits indicates the following results.

Yield traits

Grain yield: None of the entries were significantly superior compared to the checks. However, the varieties SPV 1865 (17%), SPV 1862 (15%), SPV 1871 (14%), SPV 1870 (14%), SPV 1873 (12%) and SPV 1872 (12%) recorded numerical superiority
over the check CSV 23.

Stover yield: SPV 1871 significantly out yielded the checks CSV 15 and CSV 23 by 24% and 18%. The other entries which were significantly superior over CSV 15 were SPV 1867 (18%) and SPV 1870 (16%).

Biomass: The highest biomass was recorded by SPV 1871 which was significantly superior to CSV 15 by 19%. The other entries which were promising were SPV 1870 and SPV 1867.

Morpho-phenological traits

Days to flowering: The test varieties flowered similar to the checks.

Days to maturity: The test varieties matured similar to the checks.

Plant height: SPV 1871 and SPV 1863 showed significant superiority over the checks.

Grain weight: All the varieties were on par to the check.

Forage traits

Leaf length: SPV 1871 (75.5 cm) followed by SPV 1861 (73.2 cm) recorded more leaf length compared to the checks.

Leaf width: SPV 1871 (7.6 cm) and SPV 1870 (7.2 cm) recorded more leaf width than the checks.

Number of leaves: SPV 1861 and SPV 1868 recorded significantly more number of leaves than CSV 23.

Zone III: Based on data from Mauranipur, Deesa, Udaipur, Ranchi and Hisar for various characters, following conclusions are drawn.

Yield traits

Grain yield: None of the entries were significantly superior to either of the checks. Among the varieties, SPV 1870 (16%) followed by SPV 1865 (15%) and SPV 1862 (14%) recorded numerical superiority over the check CSV 23.

Stover yield: Highest stover yield was recorded by SPV 1862 (186 q/ha) which was significantly superior to the check CSV 23 by 22%. The other entries with more than 10% numerical superiority over CSV 23 were SPV 1865 and SPV 1870.

Biomass: Highest and significant biomass yield was recorded by SPV 1862 (184 q/ha) which was significantly superior to the check CSV 23 by 25%. The other entries with more than 10% numerical superiority over CSV 23 were SPV 1865, SPV 1871 and SPV 1870.

Morpho-phenological traits

Days to flowering: SPV 1865, SPV1869 and SPV 1872 were early (75 days).

Days to maturity: SPV 1865 and SPV 1872 were early maturing (112 days).

Plant height: SPV 1863 followed by SPV 1871, SPV 1868, SPV 1861 and SPV 1870 were significantly taller compared to the checks.

Grain weight: SPV 1870 and CSV 23 were the most bold seeded genotypes (3.08 g/100 grain).

Forage traits

Leaf length: SPV 1863 (79 cm) recorded maximum leaf length followed by SPV 1871 (76.7 cm).

Leaf width: SPV 1864 and SPV 1867 (8.5 cm) recorded more leaf width.

Number of leaves: CSV 23 (12) recorded more number of leaves.

National level

Yield traits

Grain yield: None of the entries had any significant superiority over the checks CSV 15 and CSV 23. However, the entries with more than 10% numerical superiority over CSV 23 were SPV 1870 (19%), SPV 1871 (16%), SPV 1862 (11%) and SPV 1872 (10.3%).

Stover yield: SPV 1871 and SPV 1870 were significantly superior to both the checks by 13-16%. SPV 1862 was another promising variety with more than 10% numerical superiority over both the checks.

Biomass: SPV 1871 significantly out yielded the checks CSV 15 and CSV 23 by 12 and 16%. The other entries with significant superiority over CSV 23 alone were SPV 1870 (14%) and SPV 1862 (13%).

Morpho-phenological traits

Days to flower: SPV 1872 and SPV 1869 were significantly early than CSV 23.

Days to maturity: SPV 1872 was significantly early than CSV 23.

Plant height: SPV 1863 (254 cm) followed by SPV 1871 (246 cm) recorded maximum and significant plant heights compared to the checks.

Grain weight SPV 1870 and CSV 23 were the most bold seeded genotypes (2.92 g/100 grain).

Forage traits

Leaf length: SPV 1871 (78.8 cm) and SPV 1863 (78.1 cm) recorded maximum leaf length.

Leaf width: SPV 1864 recorded higher leaf width as compared to the checks.

Number of leaves: CSV 23, SPV 1870, SPV 1867 and SPV 1861 recorded more number of leaves (11).

Conclusions for all zones

1. In Zone I, SPV No's 1871, 1870 and 1868 were promising for grain, stover and biomass yields
2. In Zone II, 1870 and 1871 maintained their superiority for grain, stover and biomass yields over the checks
3. In Zone III, SPV 1870, 1865 and 1862 were promising for grain, stover and biomass yields
4. At national level, SPV 1870, SPV 1871 and SPV 1862 maintained the consistency and were promising for grain, stover and biomass yields
5. For shoot fly resistance, SPV 1873 (53.7% SFDH) was less susceptible while SPV 1871 (62.2% SFDH) and SPV 1864 (62.7 % SFDH) were on par to the checks CSV 15 (63.2 % SFDH) and CSV 23 (63.9 % SFDH).
6. SPV 1870, SPV 1864 and SPV 1866 were more tolerant to stem borer than other test varieties including checks.
7. All the test entries were highly susceptible to grain molds and none were found to have any resistance to grain molds as indicated by overall mean field grade (4.2).
8. SPV 1871 and SPV 1872 were promising for anthracnose, leaf blight and downy mildew resistances.

Table 1: Performance of varieties and checks for yield traits in Advanced and Initial dual-purpose trials at National level-Kharif 2008

Trial No.	1			2		
Name	AVT (DP)			IVT (DP)		
Traits	Grain yield (kg/ha)	Stover yield (q/ha)	Total biomass (q/ha)	Grain yield (kg/ha)	Stover yield (q/ha)	Total biomass (q/ha)
Mean	2621	150	171	2582	149	164
Min.	2500	133	153	2382	124	139
Max.	2837	165	187	2831	167	182
CD (0.05)	369	18.5	20.3	344	17.6	18.1
CV (%)	16.54	13.27	13.1	13.9	11.8	11.7
CSV 15 ©	2685	140	161	2697	145	162
CSV 23 ©	2623	133	153	2382	146	157
Lines signi. > check Lines > checks	Nil SPV 1822	SPVNo`s:1779, 1782, 1781 & 1820	SPVNo`s:1779, 1782, 1781 & 1820	Nil SPVNo`s:1862, 1870, 1871 & 1872	SPVNo`s:1871, & 1870 SPV 1862	SPVNo`s:1871, 1870 & 1862 SPV 1863
Data from locations (no)	14	12	12	11	9	9
Loc. for national average (no)	11	11	11	10	8	9

Annexure-I: Compliance report on receipt of data- Kharif -2008

S.No/ Trial		AVT			IVT		
	Locations	**Date of sowing**	**Dead line of data receipt (Date)**	**Data received on**	**Date of sowing**	**Dead line of data receipt (Date)**	**Data received on**
1	Coimbatore	6-Jun	1-Nov	22-Nov	6-Jun	1-Nov	22-Nov
2	Palem	28-Jun	1-Nov	10-Dec	28-Jun	1-Nov	10-Dec
1	Surat	10-Jul	1-Nov	19-Dec	10-Jul	1-Nov	19-Dec
2	Mandya	23-May	1-Nov	5-Dec	23-May	1-Nov	5th Dec
3	Indore	25-Jun	1-Nov	8-Dec	25-Jun	1-Nov	8th Dec
1	Mauranipur	17-Jul	1-Nov	6 -Dec	17-Jul	1-Nov	6 -Dec
2	Pantnagar	27-Jun	1-Nov	26-Nov	-	1-Nov	--
3	Deesa	3-Jul	1-Nov	26-Nov	3-Jul	1-Nov	26th Nov
4	Udaipur	1-Jul	1-Nov	18-Nov	1-Jul	1-Nov	18th Nov
5	IGFRI-Jhansi	22-Jul	1-Nov	10-Jan	22-Jul	1-Nov	10-Jan
6	Avikanagar	**Not sown**	1-Nov		**Not sown**	1-Nov	
7	Ranchi	21-Jun	1-Nov	27-Nov	21-Jun	1-Nov	27th Nov
8	Gwalior	25-Jun	1-Nov	14-Dec	25-Jun	1-Nov	14-Dec
9	Hisar	3-Jul	1-Nov	15- Dec	3-Jul	1-Nov	15th Dec
10	Ludhiana	25-Jul	1-Nov	24-Dec	--	1-Nov	-
11	Kanpur	24-Aug	1-Nov	11-Feb	24-Aug	1-Nov	11-Feb