

# Sorghum Agronomy: *Kharif*, 2011

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## Executive summary

Field experiments were conducted during *kharif* 2011 at different AICSIP centres to evaluate the response of pre-released sorghum genotypes to fertility levels, and to develop improved agronomic practices for higher sorghum productivity and profitability.

### 1. Response of advanced/pre-released sorghum genotypes to fertility levels under rainfed conditions

Pre-released sorghum genotypes that were promoted to the second year of testing in AVHT under the breeding programme were evaluated for their response to fertility [Control, 50% RDF, 100%RDF (80:40:40 kg NPK/ha), and 150% RDF] across the sorghum growing zones of the country. The salient findings have been summarized as under (Table 1).

**Table 1. Response of promising pre-released sorghum genotypes to fertility levels.**

S.No.	Types of sorghum	Test entries	Checks	Locations	Promising treatments/entries
1KA.	Grain sorghum (Zone-I North)	SPH 1635 SPH 1641 SPH 1651	CSH 16, CSH 23	Udaipur, Mauranipur	At Udaipur, SPH 1635 produced 9.7% higher grain yield over CSH 23 and at Mauranipur, SPH 1641 and SPH 1651 produced 14.19 and 10.24 % higher grain yields over CSH 16 (check). Significant response was observed up to 100% RDF.
1KB.	Grain sorghum (Zone-I South)	SPH 1635 SPH 1641 SPH 1651	CSH 16, CSH 23	Coimbatore, Palem	At Coimbatore, test genotype, SPH 1635 was on a par with both the checks for grain yield. At Palem, SPH 1635 (2752 kg/ha) produced 13.67% and 22.3% higher grain yields over CSH 16 and CSH 23.
1KC.	Grain sorghum (Zone-II)	SPH 1635 SPH 1647 SPH 1648 SPH 1655	CSH 16, CSH 23	Parbhani, Dharwad, Indore, Surat	Test genotypes SPH 1647 (3499 kg/ha) being at par with SPH 1648 (3462 kg/ha) yielded 7.2% and 6.8% more over checks, CSH 16 and CSH 23, respectively. Significant response of increasing fertility levels was observed up to 100% RDF (80:40:40 kg N, P2O5 and K2O/ha).
1KE.	Sweet sorghum	SPSSV 39 SPSSV 40	CSV 19SS	Indore Pantnagar	Test genotype SPSSV 40 gave significantly higher grain yield (1926 kg/ha) and net returns (Rs. 32,104/ha) over check CSV 19SS (1062 kg/ha). Significant fertility response was observed up to 100% RDF.

### 2 K. Integrated Nutrient Management in *kharif* sorghum-chickpea cropping system

A long-term field experiment was initiated at Parbhani, Dharwad, Indore and Udaipur to find out the effect of integrated nutrient management practices on yield, economics and soil health in sorghum-chickpea cropping system. Treatments consisted of 4 organic sources of nutrients (FYM, Vermicompost, FYM+vermicompost and control) in main plot and 4 levels of fertility through inorganic fertilizers (native fertility, 50% RDF, 75% RDF and 100% RDF) in sub-plots. Integration of FYM 2.5t + vermicompost 1.25 t/ha or vermicompost 2.5 t/ha alone along with 100% RDF gave the maximum grain yields.

### 3K. Assessing the performance of sorghum genotypes in changing climate (increased sowing window)

Four sorghum cultivars (CSV 17, CSV 23, CSH 16 and CSH 23) were evaluated for their relative performance under varying sowing dates (15 June, 30 June, 15 July and 30<sup>th</sup> July) at Parbhani, Dharwad, Indore, Surat, Mauranipur, Udaipur and Akola. Interaction effect between dates of planting and cultivars shows that the performance of cultivars varies with dates of planting at

different locations. Sowing on 15 June gave the highest grain yield at Dharwad and Indore, however, at Parbhani, sowing on 30th June was the best.

#### **4K. Integrated Weed Management**

Rainfed *kharif* sorghum is heavily infested with weeds, resulting in reduced crop yields and higher cost of production. Field experiments were conducted at six locations (Coimbatore, Udaipur, Dharwad, Parbhani, Indore and Surat) to find out the effect of integrated weed management practices on weeds and yield and economics of grain sorghum. Results revealed that tank mixed application of atrazine.0.25kg/ha+ pendimethalin 0.5kg/ha as pre-emergence followed by 2,4-D 0.5kg/ha as post-emergence gave effective control of weeds, higher grain yields and benefits.

#### **5K. Evaluation of sweet sorghum genotypes for single-cut fodder at different nitrogen levels**

Being a high biomass producing crop, sweet sorghum can also be used as high yielding single-cut fodder. Field experiments were conducted at Hyderabad, Udaipur, Hisar, Pantnagar, Solapur, Dharwad, Coimbatore to evaluate the performance of 3 sweet sorghum genotypes (SSV 84, SSV 74 and SSV 19SS) along with HC 308 (popular SC fodder as check) for single-cut fodder with two nitrogen levels (80 and 120 kg/ha). Results revealed Sweet sorghum genotypes 'SSV 74' and 'CSV 19SS' yielded significantly higher than 'HC 308' across the locations and hence, can be used for single-cut fodder purpose.

## **Detailed report**

### **Agro-climatic situation and soil types at different AICSIP centers**

Overall, the country received 900 mm of rain against the long period average of 887.5 mm in 2011. The southwest monsoon season (June to September) rainfall over the country as a whole was 101% of its long period average (LPA). Season rainfall over North-eastern India was below its LPA by 14%. Season rainfall over south Peninsula was normal. However, the season rainfall over Central India and North-west India were 10% and 7% above their LPA values respectively. The monthly rainfall over the country as a whole during the season was 12% above LPA in June, 15% below LPA in July, 10% above LPA in August and 6% above LPA in September. Out of 603 meteorological districts for which data are available, 453 districts (76%) received excess/normal rainfall and the remaining 150 districts (24%) received deficient/scanty rainfall during the season. Advance of Southwest monsoon over the Andaman Sea was delayed by about 10 days. The monsoon set in over Kerala on 29th May, three days before its normal date of 1st June and covered the entire country by 9th July, 6 days earlier than its normal date of 15th July. The withdrawal of monsoon from west Rajasthan was delayed and it commenced only on 23rd September (IMD Report, 2011). The sowing details, physico-chemical properties of soil and weekly meteorological data on rainfall, temperature and relative humidity for *kharif* 2010 cropping season are presented in Annexure I and II.

#### **Zone-I (North)**

*Udaipur*: Crop received a total of 868 mm rainfall. The crop was sown during first week of July and received normal rains during its growth period (up to 15<sup>th</sup> Sep) and later faced moisture stress during reproductive phase due to withdrawal of monsoon after 3<sup>rd</sup> week of Sep. The soil was sandy loam in texture, medium in available N and P, and high in K with pH 7.9 and OM 0.32%.

*Pantnagar*: This centre received the highest rainfall (1922 mm) during crop season with high intensity in Aug and Sep months. Soil was silty loam, neutral (pH 7.2), medium in organic carbon (0.79%), medium in K (255 kg) and phosphorus (28.5) content. The experiments were sown on 14<sup>th</sup> June 2011.

*Hisar*: The crop received 708 mm rainfall with fair distribution from June-September. The soil was sandy loam in texture, low in available nitrogen and medium in P and K. Experiments were sown during 20<sup>th</sup> July 2011.

## Zone-I (South)

*Coimbatore:* The total rainfall received during kharif crop season (st. week 19 - 44) was 441 mm. The crop was sown on 28th June 2011. The crop faced severe drought at grain filling stage (2<sup>nd</sup> fortnight of Sep to first week of Oct). The soils were clay loam in texture, slightly alkaline (pH 8.05), and low in available nitrogen (219 kg/ha), medium in available phosphorus (32 kg/ha) and high in available potassium (616 kg/ha). Soils were sufficient in Fe (5.90 ppm) but deficient in Zn (0.94 ppm) content.

*Palem:* The soils were alfisols with sandy loamy texture having low available N (230 kg/ha) and medium in available P<sub>2</sub>O<sub>5</sub> (29 kg/ha) and K<sub>2</sub>O (335 kg/ha). The crop was sown on 23<sup>rd</sup> June 2011. The rainfall received during crop season was 563.5 mm. The crop faced moisture stress at grain filling stage (2<sup>nd</sup> fortnight of September).

## Zone-II

*Dharwad:* The soil was deep black clay, 75 cm deep, low in available N (195 kg/ha) and medium in available P<sub>2</sub>O<sub>5</sub> (33.5 kg/ha) and high in K<sub>2</sub>O (454 kg/ha) with pH (7.8). Total rainfall received during crop period was 768.6 mm with almost uniform distribution. The crop was during 8-16 June, 2011.

*Akola:* This centre received low rainfall (479.5 mm) during the crop season. The soil was medium-deep (>75 cm depth), clay loam in texture, low in organic matter (0.74%) and nitrogen (174 kg/ha), medium in phosphorus and high in available potassium content. The crop was sown on 7th July 2011.

*Parbhani:* The total rainfall received during growing season was 625 mm. The soils were clay loam in texture, low in available N (198 kg/ha) and P (16.5 kg/ha) and high in K (658 kg/ha) content with pH 8.24 and OC 0.42%. The crop was sown during 8-10 July 2011.

*Indore:* Crop received 1433 mm total rainfall during kharif season with fairly proper distribution up to 15<sup>th</sup> September. The crop was sown on 19-20 June 2011. Soil was neutral in reaction (pH 7.4), low in available N (200 kg/ha), medium on phosphorus (22 kg/ha) and high in potassium (540 kg/ha).

*Surat:* This centre received 1041 mm rainfall, of which, maximum was concentrated from July to 2<sup>nd</sup> week of September. Crop was sown on 1st July 2011. Soil was deep black, deep (>100 cm depth), low in OC (0.41%), and available N (229 kg/ha), medium in available P<sub>2</sub>O<sub>5</sub> (31 kg/ha), and K<sub>2</sub>O (376 kg/ha) with pH 7.74. The soil Zn and Fe contents were 1.1 and 5.2 ppm, respectively.

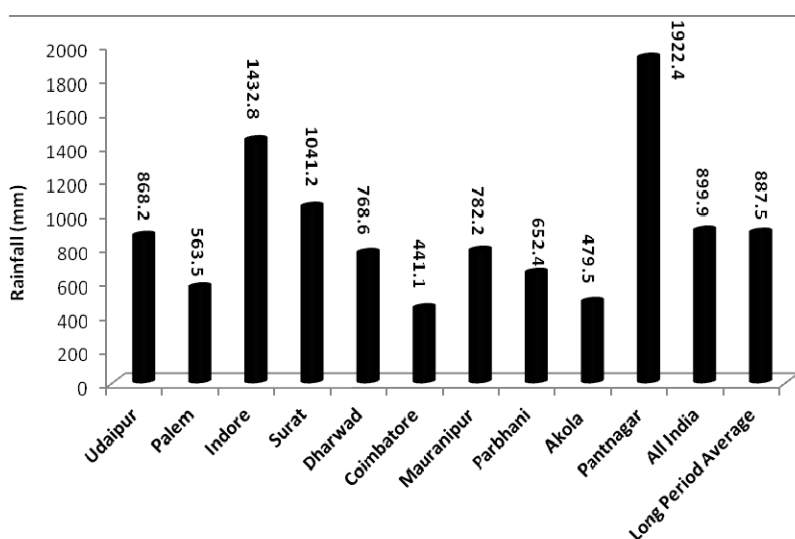


Fig. 1. Total rainfall (mm) received during crop season at various AICSIP centres

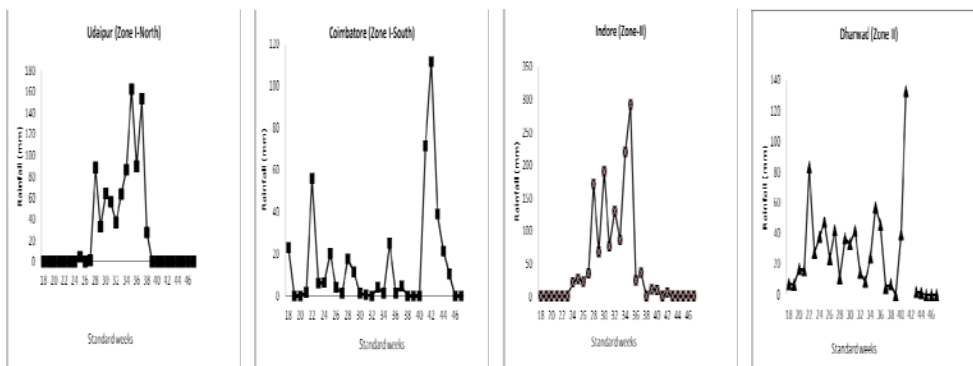


Fig. 2. Rainfall distribution during crop season in different zones

## Experimental results

### Trail 1K. Response of advanced/pre-released sorghum genotypes to fertility levels under rainfed conditions

#### 1 K(A) Grain sorghum (Zone-I North)

The experiment was conducted at Udaipur and Mauranipur. Significant response of increasing fertility levels was observed up to RDF (80:40:40) only (Table 1KA). On zonal mean basis, none of the test genotypes was significantly superior to checks. However, at Udaipur SPH 1635 gave significantly higher (9.7%) grain yield (4967 kg/ha) than CSH 23 (4536 kg/ha). At Mauranipur, SPH 1641(3519 kg/ha) and SPH 1651(3588 kg/ha) being on a par with each other produced significantly higher (14.19 and 10.24 %) grain yield over CSH 16 (3142 kg/ha). Dry fodder yield was significantly improved up to 100% RDF as compared to control. All the test genotypes were on a par with checks for dry fodder yields.

**Conclusion:** At Udaipur, SPH 1635 produced 9.7% higher grain yield over CSH 23 and at Mauranipur, SPH 1641 and SPH 1651 produced 14.19 and 10.24 % higher grain yields over CSH 16 (check). Significant response was observed up to 100% RDF.

Table1KA. Grain and stover yields (kg/ha) and economics of promising grain sorghum genotypes as influenced by different fertility levels

Treatment	Grain yield (kg/ha)			Stover yield (kg/ha)			100-seed wt (g)	Net returns (Rs/ha)
	Udaipur	Mauranipur	Mean	Udaipur	Mauranipur	Mean	Mean	Udaipur
<b>Fertility levels</b>								
Control	3636	1972	2804	9830	8343	9086	2.79	32745
50% RDF	4608	2963	3786	12230	9500	10865	2.87	43332
100% RDF (80:40:40)	5080	4278	4679	13963	10912	12438	2.94	48825
150% RDF	5135	4329	4732	14184	11153	12668	3.03	48485
LSD (P= 0.05)	461	196	1105	1242	824.8	1665	0.10	4285
CV (%)	11.17	6.47	19.41	11.07	9.25	10.38	2.36	11.06
<b>Genotypes</b>								
SPH 1635	4967	3275	4121	14074	9873	11973	2.76	48668
SPH 1641	4359	3519	3939	12204	9664	10934	2.89	40725
SPH 1651	4299	3588	3943	13641	9757	11699	2.98	42614
CSH 16	4927	3142	4035	12089	10122	11105	2.95	45079
CSH23	4524	3403	3963	10750	10469	10609	2.95	39648
LSD (P= 0.05)	342	162	474	1542	624.1	1719	0.27	3394
CV (%)	8.91	5.75	11.18	14.77	7.52	14.40	8.80	9.42

#### 1 K(B) Grain sorghum (Zone-I South)

This trial was conducted at Coimbatore and Palem. Increasing fertility levels up to 150% RDF significantly increased the grain yield from 1013 kg to 1779 kg/ha at Coimbatore, but at Palem, the response was significant up to 50% RDF level. At Coimbatore, test genotype, SPH 1635 was at a par with both the checks for grain

yield. At Palem SPH 1635 (2752 kg/ha) produced 13.67% and 22.3% higher grain yields over CSH 16 and CSH 23. All the test hybrids produced significantly higher stover yields and lower harvest index over both the checks (Table1KB).

*Conclusion:* At Coimbatore, test genotype, SPH 1635 was at a par with both the checks for grain yield. At Palem SPH 1635 (2752 kg/ha) produced 13.67% and 22.3% higher grain yields over CSH 16 and CSH 23.

**Table1KB. Effect of fertility levels on yields and yield components and net returns of kharif genotypes**

Treatment	Grain yield (kg/ha)			Mean stover yield (kg/ha)	Mean harvest index (%)	Net return (Rs./ha)	B:C ratio
	Coimbatore	Palem	Mean				
<b>Fertility levels</b>							
Control	1013	2096	1555	6363	20.10	2967	1.34
50% RDF	1200	2474	1837	7794	18.92	3256	1.33
100% RDF (80:40:40)	1554	2617	2086	7589	21.98	4726	1.43
150% RDF	1779	2367	2073	7365	21.96	4943	1.41
CD (P= 0.05)	116	304	658	2184	7.56	818	0.08
CV (%)	9.34	14.24	24.48	21.09	25.61	23.04	6.30
<b>Genotypes</b>							
SPH 1635	1453	2752	2103	8217	19.94	5072	1.48
SPH 1641	1285	2256	1770	8622	16.80	3900	1.38
SPH 1651	1308	2263	1786	7632	19.64	4094	1.39
CSH 16	1506	2421	1963	6314	23.33	4008	1.38
CSH23	1380	2251	1815	5605	23.99	2792	1.27
LSD (P= 0.05)	110	785	301	1012	3.33	723	0.07
CV (%)	9.57	39.51	15.06	13.12	15.16	21.89	6.02

#### 1 K(C) Grain sorghum (Zone-II)

Field experiments were conducted at Parbhani, Dharwad, Indore and Surat. Based on mean yield of the 4 locations, it is clear that the significant response of increasing levels of fertility to grain yield was up to 100% RDF. However, at Dharwad and Surat, the significant response was up to 150% RDF. The stover yield responded significantly up to RDF only (Table 1KC 1). Among different genotypes, SPH 1647 (3499 kg/ha) being at par with SPH 1648 (3462 kg/ha) yielded 7.2% and 6.8% more over checks, CSH 16 and CSH 23, respectively. These two test genotypes proved better than the checks at Indore and at par with check at other centres. The interaction between fertility levels and genotypes for grain yield was significant at Parbhani, Dharwad and Indore. SPH 1647 gave the maximum grain yield (4567 kg/ha) at Parbhani at 100% RDF, but SPH 1648 yielded maximum (4383 and 5138 kg/ha) with 150% RDF at Dharwad and Indore centres, respectively.

*Conclusion:* Test genotypes SPH 1647 (3499 kg/ha) being at par with SPH 1648 (3462 kg/ha) yielded 7.2% and 6.8% more over checks, CSH 16 and CSH 23, respectively. Significant response of increasing fertility levels was observed up to 100% RDF (80:40:40 kg N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O/ha).

**Table1 KC-1: Grain and dry fodder yields of grain sorghum as influenced by different fertility levels and genotypes under rainfed conditions.**

Treatment	Grain yield (kg/ha)					Dry fodder yield (kg/ha)				
	Parbhani	Dharwad	Indore	Surat	Mean	Parbhani	Dharwad	Indore	Surat	Mean
<b>Fertility levels</b>										
Control	2577	2777	2199	1775	2332	14678	9891	8500	6979	10012
50% RDF	3288	3533	3399	2543	3191	16905	10165	10467	8290	11457
100% RDF	4281	3862	4138	2946	3807	20034	10752	11287	9897	12992
150% RDF	3926	4023	4432	3105	3871	19367	10766	12025	10252	13103
LSD (P= 0.05)	174	76	381	123	379	940	847	1030	573	1386
CV (%)	6.07	2.62	13.2	5.80	17.6	6.50	9.99	11.95	7.93	17.85
<b>Genotypes</b>										
SPH 1635	3357	3405	3115	2473	3088	16309	10398	10394	8118	11305
SPH 1647	3896	3599	4059	2443	3499	19081	10455	11538	8682	12439
SPH 1648	3551	3695	4039	2564	3462	18361	10636	12863	8951	12703

Treatment	Grain yield (kg/ha)					Dry fodder yield (kg/ha)				
	Parbhani	Dharwad	Indore	Surat	Mean	Parbhani	Dharwad	Indore	Surat	Mean
SPH 1655	2919	3544	3479	2884	3207	16098	10069	9858	9428	11364
CSH 16	3589	3630	3442	2393	3264	18056	10617	10162	8784	11905
CSH23	3795	3421	3119	2797	3283	18571	10185	8601	9165	11631
CD (P= 0.05)	263	149	320	187	274	1067	627	1462	481	995
CV (%)	9.05	5.09	11.0	8.76	11.7	7.28	7.31	16.76	6.58	11.84

Table 1 KC-2. Phenology and yield components and economics of grain sorghum as influenced by fertility levels and genotype (mean)

Treatment	Plant height (cm)	Panicles /m <sup>2</sup>	Panicle length (cm)	Grains /panicle	100- seed wt (g)	HI (%)	Net returns (Rs/ha)	B:C ratio
<b>Fertility levels</b>								
Control	208	10.38	26.41	2071	2.61	19.45	17075	1.85
50% RDF	217	11.09	27.38	2169	2.79	22.63	26213	2.66
100% RDF	221	11.57	29.35	2585	2.96	23.53	31543	2.84
150% RDF	225	11.51	29.48	2800	3.04	23.67	32492	2.76
LSD (P= 0.05)	13	1.19	1.67	119	0.19	1.56	5500	0.67
CV (%)	8.81	13.08	7.27	6.09	10.08	10.67	25.13	32.57
<b>Genotypes</b>								
SPH 1635	214	11.12	28.32	2440	2.57	21.91	24173	2.37
SPH 1647	215	11.05	26.06	2649	2.91	22.55	28482	2.66
SPH 1648	231	11.15	29.40	2455	2.92	21.85	29621	2.72
SPH 1655	221	11.09	29.04	2166	2.75	22.57	27530	2.54
CSH 16	215	11.03	29.09	2389	3.04	22.01	25871	2.47
CSH23	210	11.37	27.01	2336	2.92	23.02	25307	2.40
CD (P= 0.05)	8	0.54	1.29	185	0.17	1.19	3319	0.21
CV (%)	5.20	5.89	5.56	9.33	8.39	7.51	14.99	10.14

#### 1 K(E) Sweet sorghum

Field experiments were conducted at Indore and Pantnagar. At Indore, the stalk yield responded significantly up to 100% RDF, whereas at Pantnagar, the significant response was up to 150% RDF. On mean basis, increase in fertility levels from native to 100 % RDF significantly increased the stalk yield, but the grain yield increased significantly up to 150% RDF. (Table 1K(E)-1). None of the test genotypes was superior to check (CSV 19SS) for stalk yield at Indore, but at Pantnagar, both the test genotypes (SPSSV 39 and SPSSV 40) were on a par with check. SPSSV 40 produced significantly higher grain yield (1926 kg/ha) over SPSSV 39 (1322 kg/ha) and check CSV 19SS (1062 kg/ha) and net returns (Rs. 32104/ha).

**Conclusion:** Test genotype SPSSV 40 gave significantly higher grain yield (1926 kg/ha) and net returns (Rs. 32104/ha) over check CSV 19SS (1062 kg/ha). Significant fertility response was observed up to 100% RDF.

Table 1KE-1. Effect of fertility levels and genotypes on yield and quality parameters of sweet sorghum.

Treatment	Stalk yield (kg/ha)			Grain yield (kg/ha)			Plant height (cm)			Net returns (Rs/ha)		
	Indore	Pant nagar	Mean	Indore	Pant nagar	Mean	Indore	Pant nagar	Mean	Indore	Pant nagar	Mean
<b>Fertility levels</b>												
Control	25176	13521	19348	1059	836	948	311	233	272	22725	10963	16844
50% RDF	27524	18812	23168	1295	1287	1291	329	242	286	26042	20926	23484
100% RDF	33890	20811	27351	1686	1561	1623	332	244	288	34772	25422	30097
150% RDF	33527	24103	28815	2019	1750	1885	341	255	298	36250	29704	32977
CD (P= 0.05)	2922	2191	4529	227	383	259	21	6	10	3253	8068	6658
CV %	8.44	9.84	9.99	13.02	24.46	9.83	5.50	2.10	1.81	9.42	32.15	14.02
<b>Genotypes</b>												
SPSSV 39	26189	19048	22618	1550	1094	1322	328	242	285	26429	16760	21594
SPSSV 40	28313	19665	23989	1979	1872	1926	336	265	300	32409	31798	32104
CSV 19 SS	35585	19224	27404	1015	1108	1062	321	225	273	31004	16704	23854
CD (P= 0.05)	2925	1212	4134	198	266	242	11	9	13	3272	5704	5989
CV %	11.26	7.25	14.53	15.11	22.67	14.64	4.03	4.10	3.93	12.62	30.30	20.09

### Trial 2K Integrated Nutrient Management in kharif sorghum-chickpea cropping system

A long-term field experiment was initiated at Parbhani, Dharwad, Indore and Udaipur to find out the effect of integrated nutrient management practices on yield, economics and soil health in sorghum-chickpea cropping system. Treatments consisted of 4 organic sources of nutrients in main plot and 4 levels of fertility through inorganic fertilizers in sub-plots (Table 2K-1 ). Results revealed that FYM 2.5t + vermicompost 1.25 t/ha along with 100% RDF (4609 kg/ha) or vermicompost 2.5 t/ha with 100% RDF (4444 kg/ha) gave the maximum grain yields. Application of 75% RDF along with vermicompost (4154 kg/ha) or FYM+vermicompost (4020 kg/ha) was superior to FYM 5t/ha (3370 kg/ha).

*Conclusion:* Integration of FYM 2.5t + vermicompost 1.25 t/ha or vermicompost 2.5 t/ha alone along with 100% RDF gave the maximum grain yields.

**Table 2K-1. Interaction effect of organic sources and inorganic fertilizer doses on grain yield (mean of Parbhani, Dharwad, Indore and Udaipur)**

Treatments	Organic sources					
	<i>Inorganic sources</i>	<i>FYM 5t/ha</i>	<i>Vermicompost 2.5 t/ha</i>	<i>FYM 2.5t + vermicompost 1.25 t/ha</i>	<i>Control</i>	<i>Mean</i>
Control		2590	3057	2706	2505	2714
50%RDF		3038	3643	3580	3170	3358
75%RDF		3370	4154	4020	3596	3785
100%RDF		3607	4444	4609	3768	4107
Mean		3151	3825	3729	3260	
CD (P=0.05) for Organic sources		744			CD (P=0.05) for Inorganic sources	235
C.D. (P=0.05) AiBi-AiBj		471			C.D. (P=0.05) AiBi-AjBi	848

**Table 2K-2. Effect of organic sources and inorganic fertilizer doses on growth, yield attributes and economics (mean of Parbhani, Dharwad, Indore and Udaipur)**

Treatments	Stover yield (kg/ha)	Plant ht (cm)	Panicles /m <sup>2</sup>	Grains /panicle	Panicle length (cm)	HI (%)	100 seed wt (g)	Net returns (Rs/ha)	B:C ratio
<b>Organic sources</b>									
FYM 5t/ha	10010	212	10.54	2039	28.53	26.33	2.84	28734	2.41
Vermicompost 2.5 t/ha	11472	211	10.75	2401	28.50	29.32	3.11	28774	2.12
FYM 2.5t + vermicompost 1.25 t/ha	11212	214	10.81	2404	27.82	27.99	3.03	30284	2.34
Control	10560	206	11.07	2329	27.64	26.89	2.91	28004	2.65
CD (P=0.05)	2012	11	0.84	772	0.79	3.71	0.27	8080	0.54
CV (%)	23.3	6.5	7.82	21.2	2.81	16.80	11.38	27.94	22.75
<b>Inorganic sources</b>									
Control	9393	205	10.33	1888	26.24	25.61	2.81	21874	2.09
50%RDF	10500	209	10.85	2249	27.93	27.29	2.93	27774	2.34
75%RDF	11425	212	10.88	2498	28.78	28.38	2.99	31311	2.48
100%RDF	11936	217	11.12	2539	29.55	29.26	3.17	34836	2.60
CD (P=0.05)	629	4	0.43	260	1.21	1.92	0.10	3189	0.20
CV (%)	8.1	2.7	4.78	10.4	5.12	9.67	4.57	13.07	10.15

### Trial 3K Assessing the performance of sorghum genotypes in changing climate (increased sowing window)

Field experiments were conducted at Parbhani, Dharwad, Indore, Surat, Mauranipur, Udaipur and Akola to evaluate the relative performance of 4 sorghum cultivars with varying sowing dates (15 June, 30 June, 15 July and 30<sup>th</sup> July) (Table). Results revealed that early sowing on 15 June gave the highest grain yield at all the centres except at Parbhani, where sowing on 30th June gave the maximum grain yield. Further delay in sowing resulted in poor yields/no yields (at Dharwad) due to attack of shootfly. Among genotypes, CSV 17 and CSH 23 proved better than CSV 23 and CSH 23, respectively, irrespective of the locations. The interaction effect between dates of planting and cultivars for grain yield was significant at Parbhani, Dharwad and Indore Centres.



*Conclusion:* Interaction effect between dates of planting and cultivars shows that the performance of cultivars vary with dates of planting at different locations. Sowing on 15 June gave the highest grain yield at Dharwad and Indore, however, at Parbhani, sowing on 30th June was the best.

**Table 3K-1. Interaction effect of dates of planting and sorghum cultivars on grain yield**

Treatments	PARBHANI				
	Dates of planting				
Cultivars	15 June	30 June	15 July	30 July	Mean
CSV17	3318	3697	651	133	1950
CSV23	2700	2899	479	85	1541
CSH16	3154	3733	503	79	1867
CSH23	2719	3546	428	41	1684
Mean	2973	3469	515	85	
CD (P=0.05)	Dates of planting (D) =167	Cultivars (C) =167	D x C=335		
DHARWAD					
CSV17	3491	3627	1553	0	2168
CSV23	3957	3548	0	0	1876
CSH16	4675	3980	1682	0	2584
CSH23	4531	3262	1351	0	2286
Mean	4163	3604	1146	0	
CD (P=0.05)	Dates of planting (D) =114	Cultivars (C) =114	D x C=229		
INDORE					
CSV17	2654	1333	1176	668	1458
CSV23	2941	1325	864	635	1442
CSH16	4633	2099	1623	817	2293
CSH23	4078	2436	1511	763	2197
Mean	3577	1798	1294	724	
CD (P=0.05)	Dates of planting (D) =157	Cultivars (C) =157	D x C=314		

**Table 3K-2. Effect of dates of planting and cultivars on growth, yield attributes and economics (mean of Parbhani, Dharwad, Indore, Surat and Mauranipur)**

Treatments	Grain yield (kg/ha)	Stover yield (kg/ha)	Plant ht (cm)	Panicles /m <sup>2</sup>	Grains /panicle	HI (%)	100 seed wt (g)	Net returns (Rs/ha)	B:C ratio
Dates of planting									
15 June	3471	11284	205	11.53	1763	26.85	2.95	33279	2.56
30 June	3157	11045	201	10.77	2012	24.40	3.07	24748	1.99
15 July	1702	6621	170	7.13	1069	19.50	2.48	9544	1.11
30 July	751	3804	141	5.79	460	14.91	1.96	1729	0.56
CD (P=0.05)	469	1836	23	1.93	473	5.10	0.35	5823	0.43
CV (%)	32.6	35.4	20.4	26.33	33.4	37.63	21.32	40.31	33.38
Cultivars									
CSV17	2176	6710	148	9.08	1351	23.51	2.41	11851	1.28
CSV23	1978	9761	206	8.66	1195	16.73	2.58	18154	1.58
CSH16	2551	8197	191	8.77	1380	23.37	2.78	20351	1.73
CSH23	2377	8085	172	8.71	1377	22.05	2.69	18945	1.64
CD (P=0.05)	469	1836	23	1.93	473	5.10	0.35	5823	0.43
CV (%)	32.6	35.4	20.4	26.33	33.4	37.63	21.32	40.31	33.38

#### Trial 4K Integrated Weed Management

Field experiments were conducted at six locations (Coimbatore, Udaipur, Dharwad, Parbhani, Indore and Surat) to find out the effect of integrated weed management practices on weeds and yield and economics of grain sorghum.

*Effect on weeds:* The weed flora varied with locations (Table 4K-1). Application of weed control treatments significantly reduced the population and dry matter accumulation of weeds as compared to control (weedy check). Among different treatments, atrazine 0.25 kg/a as pre-em +2HW at 30 and 45DAS was most effective.

*Yield and yield attributes:* Overall, infestation of weeds throughout the crop growth period caused 48% reduction in grain yield. However, the losses due to weeds varied over locations. The highest mean grain yield (3658 kg/ha) was recorded with atrazine 0.25 kg/a as pre-em +2HW at 30 and 45DAS which was at par with

Atrazine 0.25+ Pendimethalin 0.5kg as pre.+2,4-D 0.5kg/ha as post.em (3529 kg/ha), Atrazine 0.50 kg +1HW 30DAS (3497 kg/ha) and Pendimethalin 0.5kg+1HW30 DAS (3393 kg/ha). Infestation of weeds also reduced the plant height, harvest index and yield attributes of sorghum.

*Economics:* The highest net returns (Rs 31,601/ha) was recorded with tank mixed application of atrazine.0.25kg/ha+ Pendimethalin 0.5kg/ha as pre-emergence followed by 2,4-D 0.5kg/ha as post.em. The highest B:C ratio (2.86) was obtained with atrazine 0.25kg/ha as pre.em fb2,4-D 0.50kg as pos.em.

*Conclusion:* Tank mixed application of atrazine.0.25kg/ha+ pendimethalin 0.5kg/ha as pre-emergence followed by 2,4-D 0.5kg/ha as post-emergence gave effective control of weeds, higher grain yields and benefits.

**Table 4K-1. Major weeds of grain sorghum**

Location	Major weeds
Udaipur	<i>Cynodon dactylon</i> , <i>Echinochloa colona</i> , <i>Cyperus rotundus</i> , <i>Parthenium hysterophorus</i> , <i>Amaranthus viridis</i> , <i>Digera arvensis</i> , <i>Commelina benghalensis</i> , <i>Trianthema monogyna</i> .
Dharwad	<i>Panicum eschane</i> , <i>Cyperus rotundus</i> , <i>Dinebra retroflexa</i> , <i>Acalifa indica</i> , <i>Commelina benghalensis</i> , <i>Corchorus spp.</i> , <i>Mulugo spp.</i> , <i>Phyllanthus madarapratensis</i> , <i>Desmodium diffusum</i> , <i>Alternanthera sessilis</i> , <i>Ageratum conizoides</i> .
Coimbatore	<i>Rotboellia cochinchinensis</i> , <i>Cynodon dactylon</i> , <i>Panicum javanicum</i> , <i>Digera arvensis</i>
Indore	<i>Cyperus rotundus</i> , <i>Echinochloa colona</i> , <i>Parthenium hysterophorus</i> , <i>Digera arvensis</i> , <i>Commelina benghalensis</i> , <i>Euphorbia geniculata</i> , <i>Eclipta alba</i> , <i>Cyanotis axillaris</i> , <i>Amaranthus viridis</i> .
Surat	<i>Abutilon indicum</i> (Linn.) Sweet, <i>Ageratum conyzoides</i> L., <i>Alternanthera sessilis</i> (L.) DC, <i>Convolvulus arvensis</i> (L.), <i>Corchorus olitorius</i> Lamk., <i>Cynodon dactylon</i> (L.) Pers., <i>Cyperus rotundus</i> L., <i>Echinochloa colona</i> (L.) Link, <i>Phyllanthus urinaria</i> L., <i>Sida acuta</i> Burm. F.
Parbhani	<i>Cyperus rotundus</i> , <i>Brachiaria eruciformis</i> , <i>Cynodon dactylon</i> , <i>Amisochloa cucullata</i> , <i>Amaranthus polygamus</i> , <i>Celosia argentea</i> , <i>Euphorbia drounculride</i> , <i>Convolvulus arvensis</i> , <i>Pseudothia viscidue</i> , <i>Commelina benghalensis</i> , <i>Merremia emarginata</i> , <i>Parthenium hysterophorus</i> , <i>Vicia indica</i> , <i>Alysicarpus rugosus</i> , <i>Abutilon indicum</i>

**Table 4K-2. Effect of weed control methods on weeds, growth, yield and economics in sorghum**

Treatment	Weed population at harvest (No./m <sup>2</sup> )	Weed dry weight (g/m <sup>2</sup> )	Grain yield (kg/ha)	Plant height (cm)	Panicles /m <sup>2</sup>	Grains/ panicle	100- seed weight (g)	Harvest index (%)	Net returns (Rs./ha)	B:C ratio
<b>Weed control measures</b>										
Atrazine 0.50 kg +1HW 30DAS	42.22	78.54	3497	221	11.84	2817	3.14	23.06	29059	2.55
Atrazine 0.25 kg +2HW 30 and 45DAS	20.78	24.20	3658	224	11.69	2679	3.08	24.01	30753	2.54
Pendimethalin 0.5kg+1HW30 DAS	36.61	69.43	3393	225	11.18	2299	3.12	23.18	29358	2.52
Oxyfluorfen 0.15kg +1HW30 DAS	34.89	63.30	3058	217	10.33	2194	3.03	22.98	25050	2.18
Atrazine 0.25kg +Pendi 0.25kg	42.83	79.27	2922	217	10.75	1912	3.08	22.75	25952	2.49
Atrazine 0.25 kg +Pendi 0.5kg/ha as pr.e	40.39	70.51	3151	219	10.96	2170	3.07	22.54	27618	2.59
Atrazine 0.25 kg +Oxy. 0.15kg/ha as pr.e	39.67	68.56	3036	222	10.55	2393	3.05	22.69	26196	2.45
Atra. 0.25+Oxyf. 0.15kg+2,4-D 0.5kg/ha as post.em	33.00	59.82	3227	225	10.98	2608	3.07	23.22	27144	2.47
Atra. 0.25+ Pendi 0.5kg as pre.+2,4-D 0.5kg/ha as post.em	33.83	64.86	3529	222	11.12	2564	3.15	23.65	31601	2.83
Atra. 0.25kg/ha pre.em+2,4-D 0.50kg as pos.em	41.78	67.16	3351	226	11.17	2432	3.11	22.64	30313	2.86
Atra. 0.25kg pre fb Pend. 0.50 kg/ha at 30DAS (Layby)	35.61	58.31	3258	221	10.16	2011	2.97	22.84	29737	2.67
Weedy check	96.00	312.44	1900	202	9.88	1544	2.73	19.33	14814	1.81
CD (P=0.05)	21.11	97	396	11	1.62	985	0.16	1.67	6247	0.48
CV (%)	44		10.8	4.4	9.36	20.3	4.44	6.34	13	12

### Trial 5K Evaluation of sweet sorghum genotypes for single-cut fodder at different N levels

Field experiments were conducted at Hyderabad, Udaipur, Hisar, Pantnagar, Solapur, Dharwad, Coimbatore to evaluate the performance of 3 sweet sorghum genotypes (SSV 84, SSV 74 and SSV 19SS) along with HC 308 (popular SC fodder as check) for single-cut fodder with two nitrogen levels (80 and 120 kg/ha). Results revealed that sweet sorghum genotypes evaluated for single-cut fodder responded significantly upto 120 kg N/ha. All three sweet sorghum genotypes SSV 84, SSV 74 and CSV 19SS yielded significantly better over HC 308 at Hyderabad, Solapur and Coimbatore; however, at Udaipur, CSV 19SS yielded lower green fodder yield than HC 308. At Pantnagar, CSV 19 SS was significantly superior to HC 308 and other sweet sorghum cultivars. On overall mean basis, SSV 74 (52.25 t/ha) being on a par with CSV 19SS (51.23 t/ha) yielded significantly higher (7.5-9.6%) than HC 308.

*Conclusion:* Sweet sorghum genotypes 'SSV 74' and 'CSV 19SS' yielded significantly higher than HC 308 across the locations and hence, can be used for single-cut fodder purpose.

Table 5K-1. Effect of nitrogen and sweet sorghum genotypes on green fodder yield

Treatment	Green fodder yield (t/ha)						
	Hyderabad	Solapur	Dharwad	Coimbatore	Udaipur	Pantnagar	Mean
<b>Nitrogen levels (kg/ha)</b>							
N80	71.59	38.72	53.6	28.76	44.58	45.89	47.19
N120	83.28	47.81	56.89	29.73	48.1	50.69	52.75
CD (P=0.05)	6.16	5.34	1.68	0.88	2.93	3.31	
<b>Cultivars</b>							
SSV 84	75.29	45.18	56.04	31.52	44.99	38.76	48.63
SSV 74	88.96	46.73	53.93	30.71	58.44	34.71	52.25
CSV 19SS	78.3	42.91	54.99	29.76	38.65	62.75	51.23
HC 308	67.18	37.6	56.02	25.00	43.29	56.94	47.67
CD (P=0.05)	8.71	7.55	NS	1.24	4.14	4.68	

Table 5K-2. Interaction effect of cultivars and N levels on green fodder yield (t/ha) at Hyderabad

Cultivars	N levels (kg/ha)		
	80	120	Mean
SSV 84	67.65	82.94	75.29
SSV 74	80.16	97.76	88.96
SSV 19SS	75.53	81.08	78.30
HC 308	63.01	71.35	67.18
Mean	71.59	83.28	

LSD (P=0.05) for comparison of means (NxV)=12.32

### Publications

#### Udaipur

- Singh, P. and Sumeriya H.K. 2010. Effect of nitrogen levels on fodder and economics of multi-cut forage sorghum (*Sorghum bicolor* (L.) Moench) genotypes. *Forage Research*, 36 (1): 15-18.
- Kumar, R., Singh, P. and Sumeriya, H. K. 2010. Effect of integrated nutrient management on growth and productivity of forage sorghum [*Sorghum bicolor* (L.) Moench]. *Forage Research*, 36 (1): 19-21.
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- Choudhary, S.K.; Jat, M.K.; Sharma, S.R. and Singh, P. 2011. Effect of INM on soil nutrient and yield groundnut field of semi - arid area of Rajasthan. *Legume Research*, 34(4):283-287.

Annexure 1: Physico-chemical properties of soils at different centers (Kharif 2011)

S.No	Particulars	Palem	Coimbatore	Dharwad	Parbhani	Akola	Indore	Udaipur	Maurani pur	Hisar	Pant nagar	Solapur	Surat
1	Soil texture	Sandy loam	Clay loam	Medium deep black (Clay)	Medium black (Clay loam)	Medium-deep black (Clay)	Medium black (Clay loam)	Sandy clay loam	Medium deep black	Sandy loam	Silty loam	Shallow and medium	Deep black
2	Soil depth (cm)	30	100	deep	deep	75	deep					30-75	>100
3	Soil pH value (1:2.5 soils: water)	7.6	8.05	7.8	8.24	7.82	7.8	7.9	7.4	7.0-7.3	7.2	8.61	7.74
4	Field capacity (%)	14	23.5	32				18.1					32
5	Wilting point (%)	6	11.7	15				6.8					16
6	Bulk density(g/cc)	1.29	1.22	1.31		1.37		1.46					1.38
7	EC (1:2.5 soils: water) (d/Sm)	0.14	0.47		0.14	0.36	0.21	0.40		0.23-0.29			0.31
	Soil organic carbon (%)	0.30	0.57	0.57	0.42	0.43	0.40			0.32-0.35	0.79		0.41
8	Soil organic matter (%)		0.982			0.74	0.69	0.32					0.71
9	Available Nitrogen (kg/ha):	230	219	194.8	198.1	174	200	276	124	165		181	229
10	Available P <sub>2</sub> O <sub>5</sub> (kg/ha)	12.6	32	33.5	16.5	15.4	21.98	32	25.5	11	28.5	23	31
11	Available K <sub>2</sub> O (kg/ha)	335	616	454.2	658	372	540	459	270	240	255	295	376
12	Available Fe (ppm)		5.90					1.61				3.72	5.2
13	Available Zn (ppm)		0.94					1.37				0.44	1.1
14	Available Mn (ppm)							2.79				18.15	
15	Available Cu (ppm)							3.34				1.28	
16	Date of sowing	23 June 2011	28 June 2011	8-16 June, 11	8-10 July, 11	7 July, 11	19-20 June, 11	4th Jul, 11	8 July, 11	20 July, 2011	14 June, 11	9th July, 2011	1st Jul, 11
17	Rainfall received during crop period (mm)	563.5	441.1	768.6	625	479.5	1432.8	868.2	782.2		1922.4		1041.2

Annexure II: Weekly weather data at different centres, Kharif 2011

Coimbatore :Lat: 11 <sup>o</sup> N Long:77 <sup>o</sup> E										Palem (AP) Latitude: 16' 35 <sup>o</sup> N; Long: 78'1 <sup>o</sup> E; Altitude: 642 m (MSL)							
Std week	Dates	Evaporation (mm/day)	Rain fall (mm)	RH (%)		Temperature (°C)		Solar radiation ((MJ/m2/day)	Sun shine hours/day	Rainy days (no)	Rain fall (mm)	Temperature (°C)		RH (%)		Sun shine (hrs/day)	Evaporation (mm)
				AM	PM	Max	Min					Max.	Min.	AM (7.30h)	PM (14.30h)		
18	Apr 30-May 6	4.7	23.2	92	60	33.2	23.1	385.3	7.6								
19	May,7-13	5.2	-	88	49	33.6	21.2	441.8	10.6	0	0.0	39.4	25.4	82.1	35.7	8.2	9.6
20	14-20	5.0	-	90	49	34.6	23.7	393.8	9.1	1	7.0	39.6	26.0	78.1	34.3	6.7	7.3
21	21-27	4.9	1.6	85	53	34.2	23.8	365.1	6.5	1	35.0	38.3	25.4	79.7	43.9	8.3	7.4
22	28-03	4.8	55.8	88	65	32.3	23.2	303.4	5.5	3	89.0	36.9	24.1	82.0	52.7	6.3	5.3
23	Jun 04-10	4.5	6.0	85	59	30.5	23.6	382.6	5.6	0	0.0	33.7	24.7	81.0	50.7	7.0	7.0
24	11-17	5.0	6.6	78	59	30.3	23.9	308.6	4.0	2	25.0	34.1	23.3	80.5	49.4	5.7	7.6
25	18-24	4.9	20.5	84	52	30.6	21.6	401.1	7.1	3	18.0	34.4	24.0	85.6	43.3	7.6	4.9
26	25-01	4.8	4.1	86	51	31.4	22.9	361.4	4.8	2	7.8	33.9	23.7	79.7	45.0	3.7	6.3
27	Jul 02-08	5.3	1.2	86	51	31.7	23.1	358.4	5.3	1	13.5	31.8	23.0	81.3	55.1	3.7	5.7
28	09-15	5.5	17.6	84	62	31.6	23.4	298.6	6.3	3	27.4	31.8	21.9	83.4	54.6	7.2	5.3
29	16-22	5.7	11.6	75	60	30.2	23.3	332.2	3.0	3	33.2	33.1	23.0	82.9	54.6	3.4	5.4
30	23-29	5.0	1.5	86	50	30.8	23.1	283.4	3.7	3	25.8	31.0	22.3	86.7	64.7	5.4	3.8
31	30-05Aug	4.6	0.8	77	58	30.5	23.2	315.2	3.2	4	56.6	30.3	22.0	89.1	66.2	2.9	3.9
32	Aug 6-12	5.6	-	91	51	32.1	22.7	283.4	5.0	2	18.4	31.6	22.7	87.1	58.4	4.5	4.6
33	13-19	4.2	4.0	93	58	31.5	22.6	315.2	3.6	1	9.0	31.8	22.9	89.4	55.6	3.4	5.2
34	20-26	3.8	1.5	92	60	30.8	22.5	298.0	3.2	5	94.0	30.1	22.3	91.3	74.0	3.3	4.9
35	27-02	6.1	25.2	80	65	30.3	23.0	284.2	3.9	4	43.6	28.8	21.4	89.9	70.3	1.7	4.2
36	Sep 3-9	5.6	1.4	86	51	30.7	22.8	312.3	5.6	2	26.8	30.2	21.6	91.0	66.7	3.6	5.0
37	10-16	4.7	4.7	91	52	30.8	22.3	347.1	4.9	1	18.2	31.0	22.0	89.3	51.7	3.9	4.2
38	Sep17-23	5.5	-	89	54	31.7	21.8	285.0	7.4	0	0.0	31.1	22.0	91.1	62.7	4.5	4.6
39	24-30	5.5	-	88	49	32.4	21.6	394.2	8.9	0	0.0	33.0	21.8	88.0	50.4	6.4	4.6
40	Oct 01-07	5.5	-	88	49	33.4	22.5	395.3	8.8	2	6.0	33.0	21.7	88.9	58.0	5.6	4.9
41	08-14	5.0	71.5	87	54	33.0	22.9	422.4	7.8	1	8.4	32.9	22.0	91.0	69.1	5.0	5.0
42	15-21	3.8	111.4	95	60	31.6	22.6	371.8	6.4	1	6.8	33.4	22.0	88.4	57.3	6.6	4.8
43	22-28	3.7	39.0	91	68	29.7	22.6	341.0	4.0	0	0.0	32.3	22.0	87.6	57.0	4.4	4.8
44	29-04 Nov	2.4	21.4	95	62	27.7	21.9	282.7	3.3	0	0.0	31.3	21.1	86.3	68.1	6.0	5.1
45	Nov 5-11	3.3	10.5	93	60	28.9	19.4	382.0	7.0	0	0.0	32.4	18.5	82.1	37.9	9.6	5.4
46	12-18	3.6	-	89	56	30.7	20.8	405.2	7.9								
47	19-25	3.8	-	81	53	29.1	20.6	374.6	6.4								
<b>Total</b>			<b>441.1</b>							<b>45</b>	<b>563.5</b>						

**Annexure II (Cont..)**

Parbhani :										Surat (Gujarat): Altitude: 11.34 m (above MSL), Lat: 20°12'N, Longitude: 72°52'E							
Std week	Dates	Evaporation (mm/day)	Rain fall (mm)	RH (%)		Temperature (°C)		Rainy days (no)	Sun shine hours/day	Rainy days (no)	Rain fall (mm)	Temperature (°C)		RH (%)		Sun shine (hrs)	Evaporation (mm)
				AM	PM	Max	Min					Max.	Min.	AM (7.30h)	PM (14.30h)		
18	Apr 30-May 6	10.8	15.2	57	20	40.5	22.8	2.0	10.9								
19	May,7-13	11.7	0.5	42	16	41.2	24.4	0.0	9.5								
20	14-20	12.4	0.0	45	17	42.0	26.7	0.0	8.2								
21	21-27	12.0	0.7	55	24	40.7	27.0	0.0	10.6								
22	28-03	12.3	3.0	56	25	41.3	26.9	1.0	9.2								
23	Jun 04-10	7.0	11.8	82	40	36.5	24.4	1.0	8.6	0	0.0	31.4	27.5	76.0	69.5		
24	11-17	8.5	0.0	75	36	36.4	24.6	0.0	8.6	2	15.0	34.2	27.3	77.8	70.7		
25	18-24	10.4	5.6	73	40	36.3	25.5	1.0	6.1	0	0.0	33.7	27.8	80.1	69.1		
26	25-01	5.6	15.9	84	57	32.7	23.6	3.0	3.3	0	0.0	24.6	28.6	79.0	75.0		
27	Jul 02-08	5.8	64.2	85	57	32.8	23.6	4.0	4.2	2	126.0	29.2	26.6	83.8	62.0		
28	09-15	4.4	75.4	90	68	30.5	22.6	4.0	5.1	3	65.0	30.5	25.2	86.4	72.0		
29	16-22	3.9	17.8	87	62	31.6	23.5	3.0	3.7	2	75.0	31.5	25.5	76.8	60.1		
30	23-29	4.3	93.7	93	66	31.8	23.0	4.0	5.1	3	64.0	31.1	22.5	90.0	70.2		
31	30-05Aug	3.6	65.0	92	63	30.8	23.0	4.0	4.4	3	39.8	31.5	26.0	86.8	79.0		
32	Aug 6-12	4.4	2.8	85	56	31.6	22.9	1.0	4.5	4	70.0	30.8	26.4	85.1	82.0		
33	13-19	4.6	39.3	89	63	32.1	22.7	4.0	4.9	6	101.0	32.1	26.3	84.5	74.5		
34	20-26	3.9	61.3	92	80	29.9	21.9	4.0	3.1	5	90.0	30.7	25.0	84.4	73.8		
35	27-02	3.7	36.7	94	75	28.8	49.0	4.0	2.4	5	195.0	30.6	24.8	90.7	82.5		
36	Sep 3-9	4.5	29.3	91	61	30.8	21.5	2.0	5.7	4	76.4	30.7	25.4	84.8	77.8		
37	10-16	4.3	50.0	80	66	32.0	22.2	2.0	6.8	4	124.0	30.0	25.2	89.0	72.0		
38	Sep17-23	5.2	35.0	90	56	32.3	21.4	1.0	8.3	0	0.0	31.2	25.0	88.2	78.7		
39	24-30	4.8	10.0	88	46	31.3	21.9	1.0	6.6	0	0.0	32.2	24.7	84.5	74.2		
40	Oct 01-07	5.2	16.4	82	45	33.2	20.8	1.0	9.4	0	0.0	33.7	24.3	84.5	75.0		
41	08-14	5.0	2.8	85	48	33.6	21.3	1.0	7.5	0	0.0	36.2	25.0	81.5	60.4		
42	15-21	5.5	0.0	80	36	34.8	19.8	0.0	9.4	0	0.0	36.5	24.6	89.5	68.2		
43	22-28	6.9	0.0	70	23	33.5	14.1	0.0	10.6	0	0.0	36.4	20.6	78.0	73.5		
44	29-04 Nov	6.3	0.0	70	28	32.4	14.0	0.0	10.3	0	0.0	36.1	23.0	68.7	56.1		
45	Nov 5-11	5.8	0.0	72	26	32.7	13.8	0.0	10.0	0	0.0	37.4	20.0	72.6	70.0		
46	12-18	3.1	0.0	40	23	19.0	8.9	0.0	5.4	0	0.0	36.2	20.2	65.3	62.4		
47	19-25	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0.0	35.3	19.4	60.4	58.6		
<b>Total</b>			<b>652.4</b>							<b>43</b>	<b>1041.2</b>						

**Annexure II (Cont..)**

Indore :Lat: 11° <sup>0</sup> N Long:77° <sup>0</sup> E										Pantnagar							
Std week	Dates	Evaporation (mm)	Rain fall (mm)	RH (%)		Temperature (°C)		Wind speed (km/h)	Rainy days (no)	Rainy days (no)	Rain fall (mm)	Temperature (°C)		RH (%)		Sun shine (hrs)	Evaporation (mm)
				AM	PM	Max	Min					Max.	Min.	AM (7.30h)	PM (14.30h)		
19	May,7-13	14.6	0	78.7		42.2	21.8	4.8									
20	14-20	13.9	0	74		43.3	28	6.8									
21	21-27	14.3	0	82.8		43.5	28.4	11.2									
22	28-03	14.4	0	83.4		40.7	26.6	13.1									
23	Jun 04-10	10.9	0	81.1		37.1	25.7	11.1		1	16.8	36.1	23.3	75	52	10	
24	11-17	9.9	21.8	73.8		39.2	25.9	5.5		2	26.8	32.9	23.8	77	60	7.8	
25	18-24	7.3	27.2	84.4		37	25.4	7.7		3	60	34.1	25.6	82	61	5.8	
26	25-01	6.5	22.8	87.1		36	23.8	5.8		5	241	32.1	24.9	90	78	2	
27	Jul 02-08	5.5	35.6	88.5		31.5	23.3	4.5		1	2.6	33	26.1	86	70	5.3	
28	09-15	5.9	171.2	89.7		31.5	24	10.2		5	237.2	33.5	25.5	89	64	5.3	
29	16-22	5.4	68.4	92		31.1	25.8	4.3		5	123.2	30.9	24.6	88	72	3.5	
30	23-29	5.3	190.2	88		31.1	23.6	6.7		7	195	31.7	25.5	89	77	3.6	
31	30-05Aug	4.3	77	91.2		28	22.7	4.9		6	178.4	31.9	25.5	91	70	3	
32	Aug 6-12	3.3	129.9	91		27.1	21.7	6.5		4	85.4	32.7	25.8	87	71	5.1	
33	13-19	6.3	86.2	92		29.7	22.6	4.4		6	458	29.2	24.5	93	85	2.6	
34	20-26	4.4	220.2	91		28.2	22.1	5.6		4	111.8	31.7	24.9	91	70	6.9	
35	27-02	4.2	293.2	90		29.5	23.5	3.5		0	0	34.4	25.9	83	62	8.3	
36	Sep 3-9	3.6	24.9	93		28.2	23.2	7.1		4	164.2	32.6	24.7	87	74	6	
37	10-16	4.3	36.8	91		28.8	22.1	4.9		3	102.4	32.5	24.4	91	68	5.8	
38	Sep17-23	5.5	0	89		30.6	22.2	5.6		1	1.2	31.6	23.2	91	66	7.5	
39	24-30	5	11.2	81		31.5	20.2	2		1	3.8	31.5	22.2	92	67	6.7	
40	Oct 01-07	6.7	10.2	78		32.6	18.7	2.1		-	0	31.6	21.4	92	63	6.1	
41	08-14	5.4	0	88.5		33	20.3	3.1		-	0	33.3	19.4	90	57	8.5	
42	15-21	5.1	6	88		32.6	20.7	4.2		-	0	31.6	15.9	90	58	8.5	
43	22-28	4.8	0	87.2		32.3	19.4	2.8		-	0	30.8	14.4	89	48	8.1	
44	29-04 Nov	5.5	0	76		30.9	15.8	2.6		-	0	28.5	14.1	88	47	5.7	
45	Nov 5-11	4.6	0	68		30.9	14.2	3.6		-	0	27.2	13.9	88	54	3.6	
46	12-18	3	0	88		30.2	17.5	2.4		-	0	26.7	14.1	90	57	2.1	
47	19-25	2.6	0	85		26.4	16.6	2.9		-	0	27.1	11.9	91	49	4.8	
<b>Total</b>			<b>1432.8</b>							<b>58</b>	<b>1922.4</b>						

**Annexure II (Cont..)**

Udaipur: Latitude: 24°35'0"N; Longitude: 73°42'0"E										Dharwad							
Std week	Dates	Evaporat ion (mm)	Rain fall (mm)	RH (%)		Temperature (°C)		Wind speed (km/h)	Sun shine hours	Rainy days (no)	Rain fall (mm)	Temperature (°C)		RH (%)		Sunshine (hrs/ day)	Evapor ation (mm)
				AM	PM	Max	Min					Max.	Min.	AM(7.30h)	PM (14.30h)		
18	Apr 30-May 6	9.4	0.0	60	32	37.7	25.3	7.7	9.2	1	7.2	35.50	21.42	84.28	31.71		
19	May,7-13	10.1	0.0	53	36	38.9	24.8	7.8	9.6	1	6.6	35.08	21.05	83.71	28.28		
20	14-20	9.1	0.0	67	39	39.7	24.2	6.0	8.8	1	17.2	35.21	21.84	89.57	35.28		
21	21-27	9.4	0.0	79	49	37.5	26.3	9.3	10.4	1	15.8	34.35	21.30	85.00	40.00		
22	28-03	10.3	0.0	66	42	38.7	26.1	8.1	10.2	3	83.4	32.74	21.24	91.71	57.14		
23	Jun 04-10	9.0	0.0	70	44	40.9	27.0	6.6	7.9	5	27.2	27.02	21.42	94.57	81.85		
24	11-17	6.7	0.0	23	56	37.8	25.9	8.4	8.3	3	38.0	26.34	20.84	92.85	78.85		
25	18-24	7.0	4.4	87	61	33.7	25.4	9.0	5.8	3	47.6	27.07	21.15	92.42	71.28		
26	25-01	5.4	0.0	91	70	31.9	25.1	9.1	2.5	3	23.6	27.72	21.32	93.14	71.42		
27	Jul 02-08	5.1	1.0	91	71	33.4	24.7	3.8	3.2	5	42.2	27.55	20.40	93.28	72.57		
28	09-15	5.2	88.7	93	73	32.1	23.9	4.8	4.0	2	11.0	27.11	20.27	94.14	75.28		
29	16-22	4.2	32.6	90	83	31.1	24.8	5.8	2.8	4	36.8	25.92	21.05	94.57	81.85		
30	23-29	2.8	64.2	96	84	30.0	23.3	3.7	3.4	2	33.0	26.71	20.77	94.57	77.42		
31	30-05Aug	3.9	56.6	91.4	78.9	31.6	24.2	3.3	4.3	3	41.8	26.18	20.41	94.85	82.85		
32	Aug 6-12	2.9	37.0	90.7	86.9	28.7	23.2	4.4	1.7	3	14.2	26.65	21.20	93.57	77.00		
33	13-19	2.4	63.4	96.9	83.0	28.2	22.7	3.3	2.6	1	8.4	26.85	20.68	93.28	76.71		
34	20-26	1.8	86.6	96.4	86.7	30.7	22.7	1.4	3.7	2	24.4	28.24	20.47	93.00	71.52		
35	27-02	2.4	162.4	98.7	86.0	30.4	22.7	2.9	4.2	6	57.2	24.91	20.64	97.0	89.71		
36	Sep 3-9	2.2	90.0	97.4	85.1	27.8	22.9	5.5	2.1	5	45.8	26.04	20.68	95.28	80.71		
37	10-16	3.0	153.5	92.4	74.1	28.8	23.2	3.3	3.9	1	4.8	28.87	20.32	91.42	66.85		
38	Sep17-23	2.4	27.8	90.1	66.7	29.3	21.2	3.3	5.0	1	7.0	28.20	19.54	90.00	64.14		
39	24-30	3.8	0.0	86.1	55.9	30.6	19.2	3.1	8.7	-	-	30.02	18.58	87.88	53.28		
40	Oct 01-07	3.9	0.0	77.9	44.3	31.4	18.3	2.8	9.5	2	39.2	30.0	19.5	89.71	63.71		
41	08-14	4.5	0.0	70.2	37.1	33.4	19.3	1.7	8.5	3	132.8	29.94	20.2	92.00	58.42		
42	15-21	4.3	0.0	66.4	29.7	33.5	17.3	1.9	8.7	-	-	29.98	19.72	91.28			
43	22-28	3.4	0.0	66.3	28.1	32.4	15.2	1.9	8.3	-	2.0	29.81	19.01	84.42	49.71		
44	29-04 Nov	2.8	0.0	72.3	29.7	30.7	14.8	1.7	7.1	-	1.4	31.15	18.27	88.00	50.42		
45	Nov 5-11	2.9	0.0	74.0	34.1	32.3	15.7	1.6	7.7	-	-	30.62	15.67	69.85	31.28		
46	12-18	2.8	0.0	74.4	34.1	31.9	14.7	1.6	8.7	-	-	30.32	14.95	62.71	31.42		
47	19-25	1.8	0.0	80.0	45.7	30.1	12.6	2.3	8.5	-	-	29.62	12.97	68.14	27.14		
<b>Total</b>			<b>868.2</b>							<b>61</b>	<b>768.6</b>						