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EFFECT OF MOISTURE STRESS ON GROWTH AND YIELD OF SUNFLOWER GENOTYPES

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ABSTRACT

A field experiment was conducted during 1993 and 1994 *kharif* to assess the effect of moisture stress on sunflower cultivars under rainfed situation. Cultivars with varied lengths of growing period were sown and their performance was evaluated. The combination of the stress at vegetative and flowering stages affected the yields more than the combination of stress at vegetative and grain filling stages.

Keywords : Moisture stress, growth, yield, Sunflower genotypes.

INTRODUCTION

Moisture stress is a common occurrence in rainfed crops. The growth and yields of rain dependant crops are influenced strongly by the duration of moisture stress, degree of its intensity, and stage of crop growth at which the crop experiences moisture stress during its life cycle. The moisture stress effects on productivity of crops in rainfed environment can be minimised by selecting a crop or a variety, with matching effective growing season, tolerant to moisture stress and also by developing suitable management practices during the crop growth (Subba Reddy *et al.* 1993).

Sunflower (*Helianthus annus* L.) is becoming an alternative oilseed crop to castor in rainfed Alfisols under late sown conditions. The intermittent dryspells during the crop growth in rainy season, cause variation in its growth and yields (Hegde and Havanagi, 1989). There is thus a need to assess the effect of moisture stress on sunflower and on the recovery after stress release to compensate the loss of growth. In this direction, an experiment involving several genotypes with varied durations under different levels of moisture stress was conducted on rainfed Alfisols.

MATERIALS AND METHODS

The experiment was conducted at Cenral Research Institute for Dryland Agriculture (CRIDA), at Hayathnagar Research Farm, Hyderabad, during *kharif* seasons of 1993 and 1994. The experimental site was sandy loam in texture, neutral in pH (6.8), low in available Nitrogen (215 kg/ha) and Phosphorus (10 kg P_2O_5/ha and medium to high in available Potassium (280 kg K_2O/ha). The sunflower genotypes viz. Morden, EC- 68414, MSFH-8, BSH-1, and KBSH-1 with 0.75 lakh/ha of population with a row spacing of 60 cm were sown in four replications in RBD in the month of July and 10 kg N 30 kg P_2O_5/ha at the time of sowing and 40 kg N/ha after 30 days of sowing in the form of urea was applied to all the cultivars. Whenever crop experienced dry spells of > 12 days, 5 cm of water has been given at each dry spell as the water holding capacity of the soil is 10% by volume. The effect of moisture stress on growth and productivity of various cultivars was quantified by comparing their performance with cultivars under stressed environments.

The dry matter, leaf area index, yield and yield components were estimated in both the years.

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Quantum and distribution of rainfall (mm) during different growth stages of sunflower genotypes.

Genotypes	1993			1994		
	Vegetative Stage	Flowering Stage	Grain filling stage	Vegetative Stage	Flowering Stage	Grain filling stage
Short duration						
Morden	122.2 (10 days)	74.3 (no stress)	156.4 (18 days)	58.7 (10 days)	Nil (13 days)	167.5 (no stress)
BSH-1	122.2 (10 days)	74.3 (no stress)	156.4 (18 days)	58.7 (10 days)	Nil (13 days)	167.5 (no stress)
Medium duration						
MSFH-8	155.9 (10 days)	63.2 (no stress)	134.4 (20 days)	58.7 (10 days)	53.7 (18 days)	281.1 (no stress)
KBSH-1	155.9 (10 days)	63.2 (no stress)	134.4 (20 days)	58.7 (10 days)	53.7 (18 days)	281.1 (no stress)

Figures in parenthesis indicate consecutive moisture stress days

RESULTS AND DISCUSSION

Potential of sunflower genotypes

Among the cultivars, medium duration hybrid MSFH-8 gave the highest and stable seed yields (1978 kg/ha in 1993 and 1478 kg/ha in 1994) under rainfed conditions. Similar significant trend was noticed under stressfree conditions also. The short duration Morden variety on an average produced seed yield of 423 kg/ha lesser than MSFH-8 over the years in rainfed environment (Table 1). The reduction in seed yields of various genotypes in rainfed system over stressfree conditions was due to reduction in growth components such as drymatter, leaf area (Fig.1), besides yield components such as head weight, head diameter, test weight of seeds and also rainfall use efficiency (Hegde and Havangi, 1989).

Moisture stress in relation to growth and yield

Soil moisture stress at early vegetative stage followed by grain filling phase in 1993 caused seed yield reduction by 150, 372, 262 and 180 kg/ha in Morden, MSFH-8, BSH-1 and KBSH-1, respectively compared to the yields obtained under stressfree conditions. Among the cultivars, short duration Morden contributed 32,9,47 and 12 per cent stem, leaf, head and root for total biomass respectively at harvest, while hybrids like MSFH-8 had 25, 14,46 and 16 per cent contribution from stem, leaf, earhead and root respectively for its total biomass (Fig.2). The genotype of KBSH-1 eventhough of similar duration as MSFH-8 showed higher root shoot ratio upto 45 days after sowing, while MSFH-8 produced the highest root shoot ratio from 45 days to harvest in 1993 (Fig.3). Among the genotypes, BSH-1 and KBSH-1 were

Table 1 : Yield and yield components of sunflower genotypes as influenced by the stress environment

Genotypes	Yield (kg/ha)				Head weight (g/m^2)		Head diameter (cm)		Harvest index		Test weight of seeds(g)		Rainfall Use Efficiency (kg/ha/mm)			
	Seed		Stalk										Seed		Total dry matter	
	1993	1994	1993	1994	1993	1994	1993	1994	1993	1994	1993	1994	1993	1994	1993	1994
Stressed																
Morden	1210	1400	1133	1020	285	229	12.5	15.1	29.29	27.34	45.94	50.40	3.41	3.93	9.40	6.81
MSFH-8	1978	1478	2163	1505	400	249	20.6	19.6	33.62	29.91	48.96	53.12	4.32	4.16	8.14	10.10
BSH-1	1420	1410	1884	1481	269	203	15.3	14.4	28.39	24.07	45.93	47.20	3.65	3.97	8.14	9.42
KBSH-1	1670	1371	1980	1650	180	189	16.1	12.9	27.62	30.29	44.75	46.36	3.20	3.87	8.50	9.10
Stress free																
Morden	1360	1688	1180	1470	310	261	15.9	16.8	28.60	31.29	46.82	52.98	2.83	3.10	6.54	8.16
MSFH-8	2350	1886	2446	2338	424	312	25.6	28.4	34.62	31.72	51.32	56.12	4.77	5.14	12.20	9.30
BSH-1	1682	1650	2015	1650	317	218	21.3	18.1	29.78	26.72	48.75	53.15	3.32	3.63	9.90	7.25
KBSH-1	1850	1713	1860	1790	281	285	19.6	14.6	28.40	28.92	46.12	52.78	3.01	3.93	10.10	7.70
CD (0.05)																
Moisture stress (S)	54	41	36	36	4.0	5.2	4.2	2.9	-	-	3.15	4.62	-	-	-	-
Geno-types (G)	92	64	66	57	6.3	8.0	9.0	6.3	-	-	4.82	5.92	-	-	-	-
Moisture Stress x Genotypes	131	NS	94	80	9.0	11.6	NS	NS	-	-	7.50	8.40	-	-	-	-

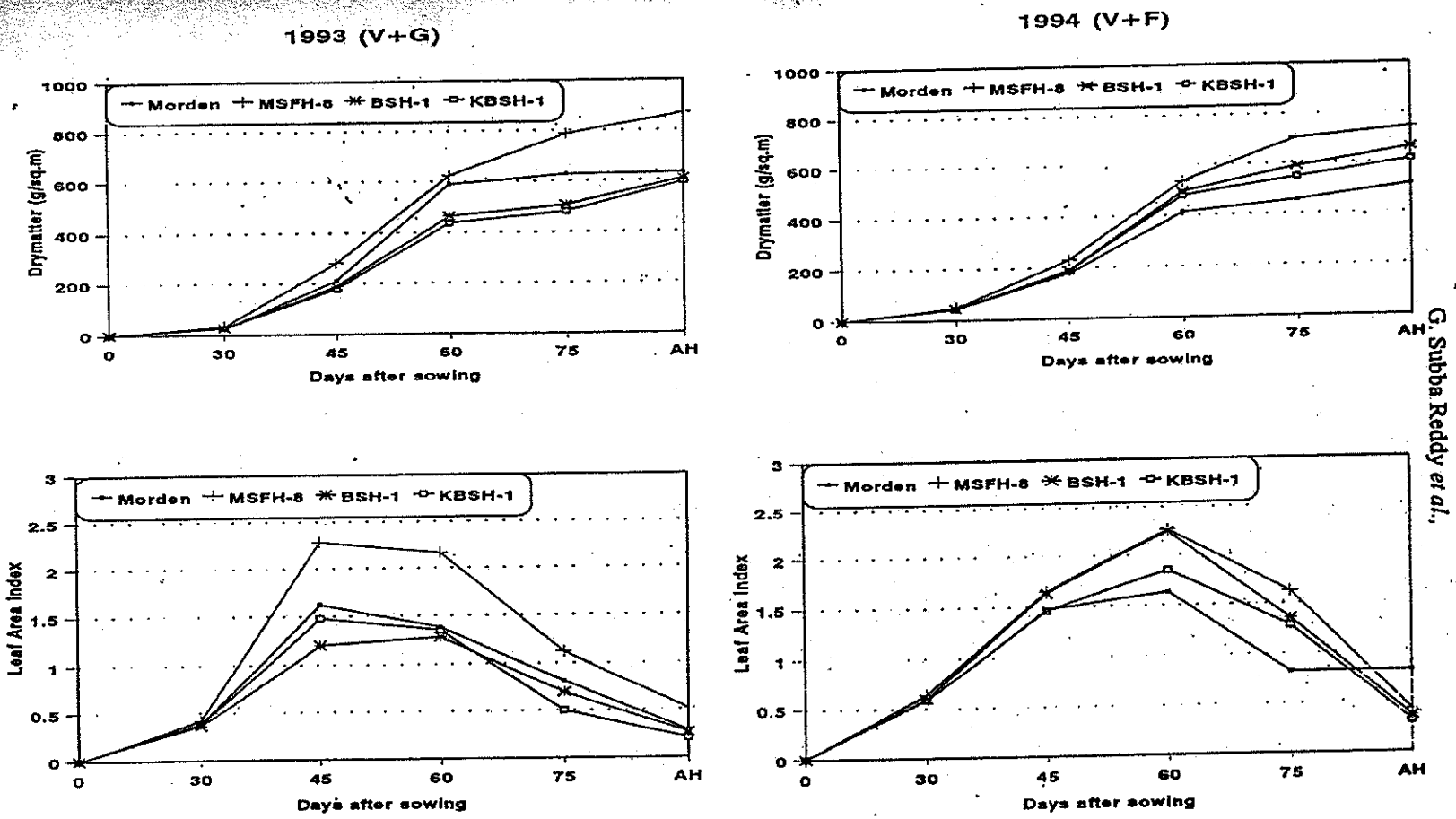


Fig.1 : Effect of moisture stress on growth components of sunflower genotypes

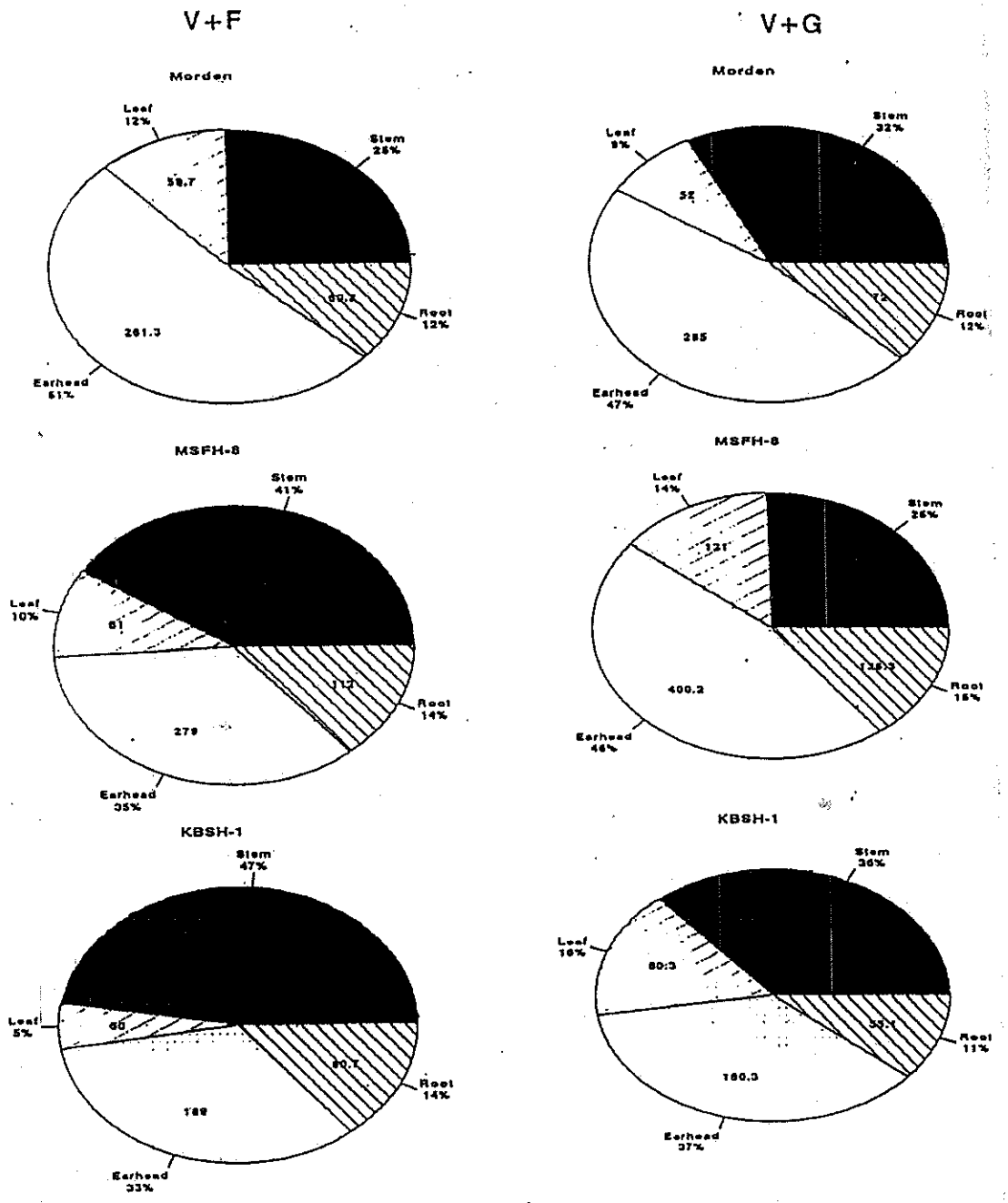
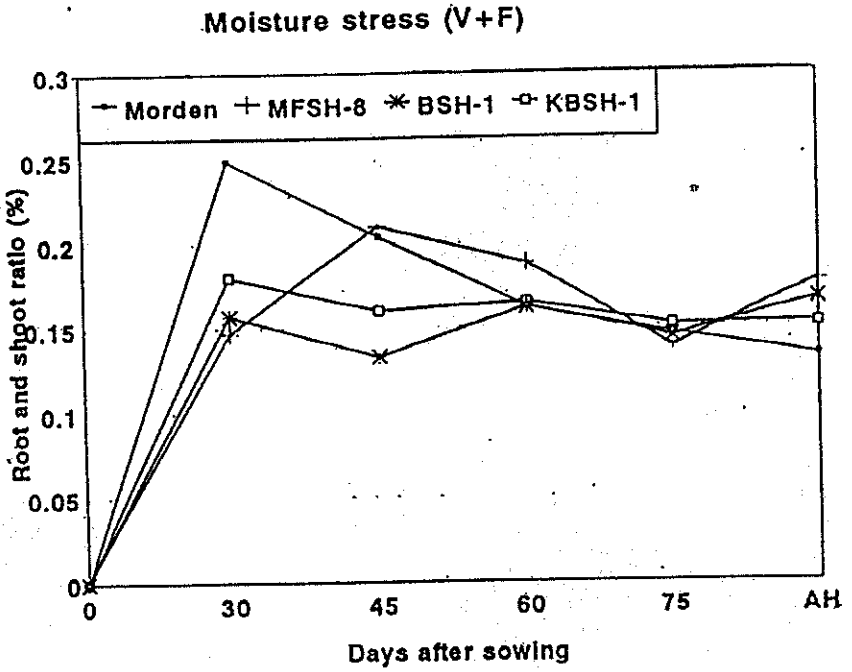


Fig. 2: Effect of moisture stress on drymatter distribution in sunflower genotypes at harvest.



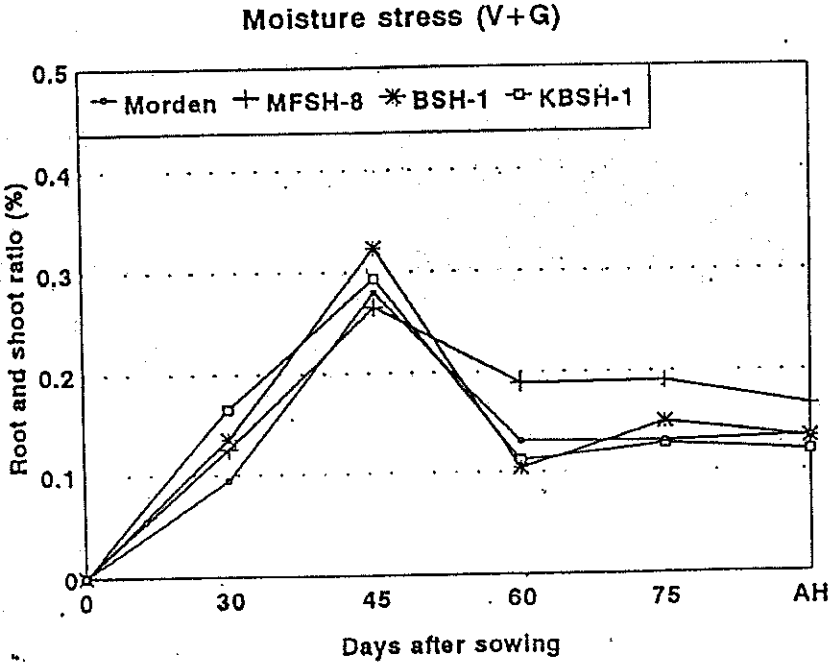


Fig. 3: Effect of moisture stress on root/shoot ratio in sunflower genotypes

sensitive to moisture stress at grain filling in terms of head weight, seed yield and seed filling (Rawson and Turner, 1982; Jones, 1984).

In 1994, soil moisture stress at vegetative and flowering phases reduced the seed yields by 208, 240 and 342 kg/ha in Morden, MSFH-8, BSH-1 and KBSH-1, respectively than their corresponding seed yields under stressfree environment. The soil moisture stress at vegetative and flowering periods reduced the biomass by 5,8.2, 8.6 and 5.5 per cent in respect of Morden, MSFH-8, BSH-1 and KBSH-1, respectively.

MSFH-8 among medium duration cultivars and BSH-1 among short duration cultivars offered higher dry matter compensation after relief of moisture stress during flowering. But due to low partitioning efficiency and low root biomass BSH-1 exhibited lesser yield potential than MSFH-8. Morden produced highest root-shoot ratio upto 60 days. MSFH-8 showed highest accumulation of drymatter, leaf area and partitioning efficiency (Amir and Khalifa 1991, Ravishankar et al., 1991). Further more, MSFH-8 utilised moisture from deeper layers during dryspells more efficiently because of higher root biomass and also utilised the available rainfall effectively compared to other cultivars during favourable rainfall periods as indicated by rainfall use efficiencies (Table 1).

Thus the study clearly indicated that soil moisture stress at vegetative phase followed by flowering severely affected the growth and development (formation of seeds) of sunflower and yield. Whereas moisture stress at both vegetative and grain filling stages affected the test weight of seeds. Among the cultivars, MSFH-8 produced higher growth and yield components in stressfree and stressed environment due to higher root biomass.

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