HELIA, **21**, Nr. 28, p.p. 97-106, (1998) UDC 631.524.01:633.854.78

EVALUATION OF SUNFLOWER GENOTYPES UNDER LATE SOWN RAINFED CONDITIONS

Maruthi V.*, Subba Reddy G., Vanaja M.

Central Research Institute for Dryland Agriculture, Santoshnagar, Hyderabad-500 059, India

Received: June 11, 1997
Accepted: March 31, 1998

SUMMARY

A field experiment was conducted to study the performance of sunflower as a better alternative crop under late sown rainfed conditions. Six sunflower genotypes of different durations were evaluated and their suitability in relation to rainfall distribution was assessed. Almost all cultivars sown late have faced moisture stress at grain filling with varied stress durations. Medium duration cultivars eventhough faced with terminal drought, performed better over other maturing groups. However, short-duration cultivars were also preferred due to their early maturing character. But long-duration cultivars which experienced moisture stress at almost all crucial periods like flowering, pollination and grain filling stages were sidelined.

Key words: Sunflower genotypes, rainfed, drought, stages.

INTRODUCTION

Alfisols, the third most important soil order in the world (Buringh, 1982) are prone to low and unstable production due to aberrant weather and soil related constraints. These shallow light textured soils with low water holding capacity and high infiltration rate, coupled with high moisture depletion (El-Swaify *et al.*, 1985) further aggravates the problem of water availability for crop production. Hence, the short periods available between two rainfall events should be exploited for sowing the seed in rainfed conditions. Therefore, environmental assessment like problems of variable periods and durations of drought was studied for improving productivity.

The dryland farmers in and around Hyderabad region of AP, India, traditionally grow castor as the popular dryland crop. Castor, when sown in July, normally yields around 1000 kg/ha and primaries contribute major share in this yield. Due to aberrant weather conditions like late onset, early withdrawal of monsoon and early onset but prolonged dryspell, the castor sowings would either be delayed or

* Corresponding author

affected. This results in reduced yields as well as monetary returns. Under these circumstances it is necessary to test sunflower as a better alternative contingent crop for its early maturing ability.

Sunflower is grown throughout the year due to its photo-in-sensitivity. There are chances that some genotypes of sunflower may escape drought due to their early maturing character, but some may be affected due to their moderately lengthy growing period (ICRISAT, 1988). Therefore, an experiment on late sowing of sunflower genotypes as an alternate strategy was planned to test their suitability and executed.

MATERIALS AND METHODS

The experiment was conducted in the *kharif* seasons (*kharif* starts in June and ends in October) of 1992 and 1993 at CRIDA Research Station, Hayathnagar, Hyderabad (17° 27'N and 78° 28'E) in India. It included testing of six genotypes of sunflower (Table 1) under rainfed conditions.

Table 1: Cultivars tested under field conditions

Cultivar		Maturation
Variety		
Morden	(80-85 days)	Short maturity group
EC 68414	(110-115 days)	Long maturity group
Hybrid		
BSH-1	(80-85 days)	Short maturity group
AH-3425]		
MSFH-8]	(95-100 days)	Medium maturity group
KBSH-1]		

The experimental soils were red sandy loams with the water holding capacity of around 10 per cent by volume. These soils were low in available nitrogen (210 kg/ha) medium in both available phosphorus (10 kg P_2O_5/ha) and available potassium (220 kg/ha). The sunflower genotypes were sown by applying $2/3^{rd}$ dose as basal in the form of diammonium phosphate and $1/3^{rd}$ dose as top dressing in the form of urea following fertilizer schedule of 50:30:0 for sunflower. In order to maintain uniformity in sowing for the comparison, the sowing of crop was done in the second fortnight of August in both years of the experiment. The plant population maintained in a hectare was 55,550 with the spacing of 60x30cm per plant. The genotypes were replicated thrice in a randomized block design.

Total seasonal rainfall received, number of rainy days and occurrence of drought during the crop growth period at different stages were worked out. Different phenological stages were recorded, dry matter accumulated (g/m^2) per unit area was calculated. Also, leaf area was recorded to calculate leaf area index along with the yields of different cultivars. Further, the post harvest observations included seed oil content (%) and calculations like harvest index.

RESULTS

Short- and long-duration varieties

Morden, an open pollinated, short duration cultivar faced late drought ranging from 12 days to 26 days. Nevertheless Morden yielded 652 kg/ha and 585 kg/ha in 1992 and 1993 respectively (Table 1). Further, the yields varied from year to year. When rainfall distribution was analyzed, this variety not only received maximum rainfall at vegetative stage (Figures 1 and 2) but also EC68414, a long duration variety (110-115 days) received similarly at vegetative stage. However, the reduced yields were recorded for Morden in 1993 over 1992 (169.1 mm) eventhough the amount of rainfall received was higher (414.6 mm).

Table 2: Yields of sunflower and its oil content as influenced by cultivar and late sowing

Cultivar	Seed yield (kg/ha)		Stalk yield (kg/ha)		Harvest index (%)		Oil content (%)	
	1992	1993	1992	1993	1992	1993	1992	1993
Variety								
Morden	652	585	645	900	0.50	0.30	31.6	31.8
EC-68414	781	581	1727	1128	0.31	0.34	34.1	34.0
Hybrid								
BSH-1								
AH-3425	818	602	1192	1160	0.41	0.34	31.8	35.3
MSFH-8	844	745	1112	1270	0.43	0.37	35.8	35.3
KBSH-1	850	822	1315	1480	0.39	0.36	33.4	34.6
	832	730	1467	1190	0.36	0.34	34.7	34.3
SEm ±	37.1	16.4	71.8	26.6	0.013	0.008	0.049	1.1
CD at 5%	111	47	217	80.1	0.04	0.024	1.5	3.3

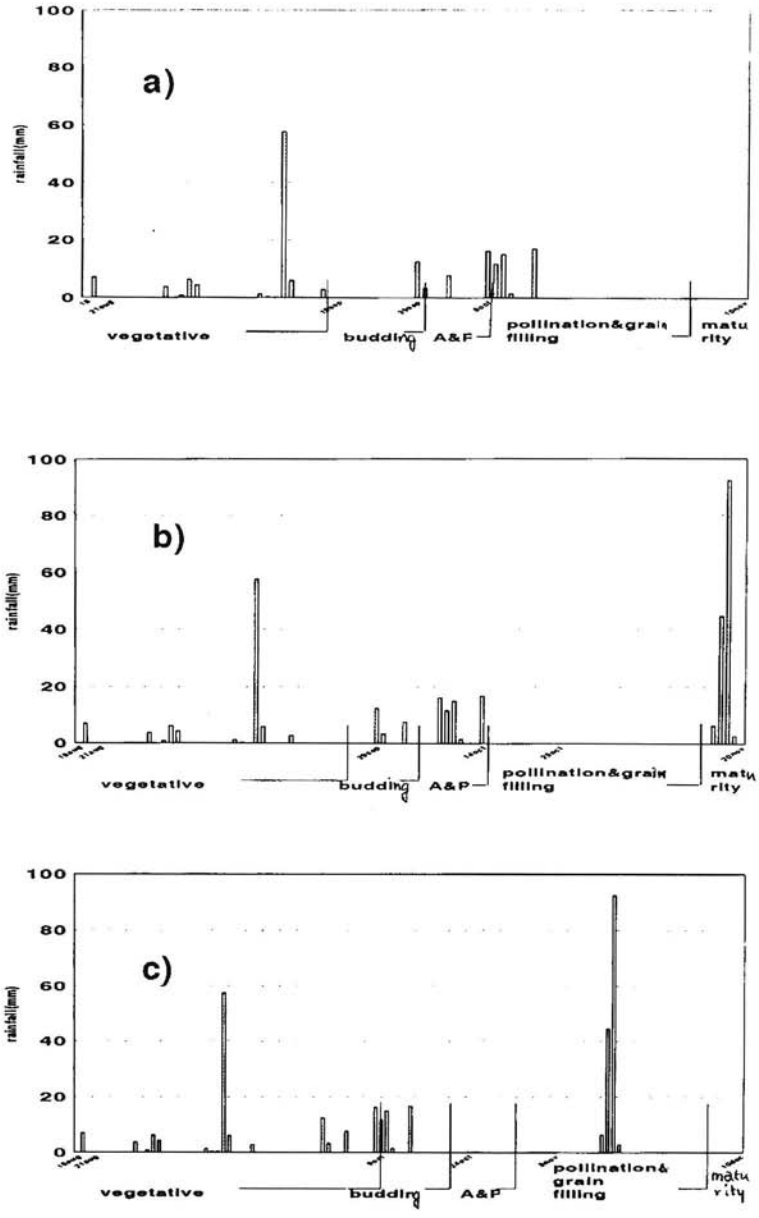
The accumulation of biomass in a variety like Morden was slow in early stages but attained higher rates at later stages. It was also observed that Morden recorded lowest leaf area index (Table 5). But the water use efficiency was highest in a comparatively low rainfall year of 1992 over 1993.

The obvious occurrence of terminal drought was the characteristic difference observed with the long duration cultivars like EC-68414. Also there are fair chances of dry spell occurring during anthesis as well. The long duration cultivar produced more biomass at almost all stages with the partitioning efficiency varying with the moisture availability. It was also observed that the water use efficiency of this particular group was lower than in the other groups.

Table 3: Rainfall received at different growth stages (mm) of different sunflower cultivars

Genotype	Growth stage										Total rainfall (mm)		Rainfall use efficiency (kg/ha/mm)	
	Vegetative		Budding		Anthesis		Pollination & grain filling		Physiological maturity					
	1992	1993	1992	1993	1992	1993	1992	1993	1992	1993	1992	1993	1992	1993
Short														
Morden	82.8	161.7	12.4	160.7	27.1	69.4	44.8	37.6	-	-	167.1	429.4	3.9	1.4
BSH-1	(7)	(10)	(1)	(2)	(3)	(4)	(3)	(3)			(14)	(19)	4.9	1.4
Medium														
AH-3425	82.8	326.5	23.3	19.5	61.0	32.6	-	36.0	146.2	-	313.4	414.6	2.7	1.8
MSFH-8	(7)	(12)	(3)	(1)	(4)	(3)		(3)	(4)		(17)	(19)	2.7	2.0
KBSH-1														
Long														
EC-68414	135.9	371.6	33.2	13.2	-	24.4	146.2	32.2	-	-	315.3	442.1	2.5	1.3
	(12)	(16)	(2)	(2)		(1)	(4)	(2)			(18)	(21)		

* Numbers in parentheses indicate the number of rainy days



A&P : Anthesis and Pollination

Figure 1: Rainfall distribution at different phenological stages of a) short, b) medium and c) long duration sunflower genotypes (1992)

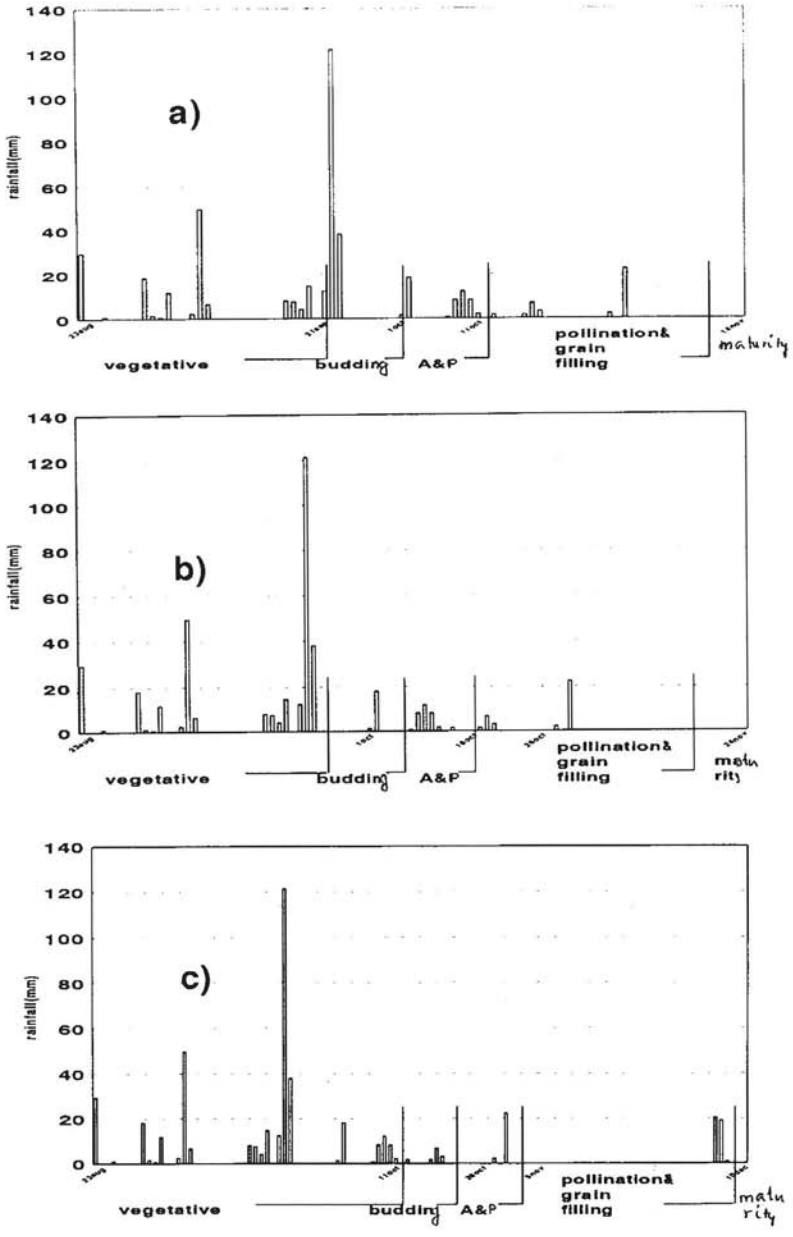


Figure 2: Rainfall distribution at different phenological stages of a) short, b) medium and c) long duration sunflower genotypes (1993)

Short- and medium-duration hybrids

BSH-1, a short-duration hybrid, has similarities with Morden in attainment of different phenological stages. It yielded 818 kg/ha and 602 kg/ha in 1992 and 1993, respectively. The trend of biomass accumulation was steady throughout the growth period. However, leaf area index was comparable with LAI of medium duration hybrids. Oil content (%) recorded by BSH-1 was higher in 1993 than in 1992.

Hybrids like MSFH-8, AH-3425 and KBSH-1 come under medium-duration hybrid group. An increased difference of around 101 mm was observed in the total rainfall received during the crop season of 1993 over 1992. From rainfall distribution, it was observed that in 1993, vegetative stage received maximum rainfall (326.5 mm), contrary to 1992, and maximum rainfall was received (146.2 mm) during pollination and grain filling for 21 days and 22 days in 1992 and 1993 respectively (Table 3). In spite of this, the hybrids in this group performed differently in these two years.

Table 4: Recorded total dry matter (g/m^2) at different periods during the crop growth of genotypes

Genotype	Total dry matter					
	30 DAS		60 DAS		At harvest	
	1992	1993	1992	1993	1992	1993
Morden	19.8	52.7	152.4	221.2	218.8	241.6
BSH-1	27.4	48.6	213.7	230.0	224.9	264.5
AH-3425	22.3	59.9	210.0	275.5	247.6	319.4
MSFH-8	32.9	64.0	256.1	304.0	315.9	349.2
KBSH-1	33.7	53.2	222.5	234.4	249.5	273.4
EC-68414	29.4	52.8	240.9	248.2	363.1	294.1
SEm ±	1.1	1.9	5.7	4.4	6.9	2.7
CD (0.05)	3.4	5.7	18.0	13.4	21.9	8.1

Table 5: Leaf area index (LAI) of different genotypes

Genotype	Total dry matter					
	30 DAS		60 DAS		At harvest	
	1992	1993	1992	1993	1992	1993
Morden	0.25	0.49	0.78	0.64	0.02	0.21
BSH-1	0.26	0.59	1.02	0.98	0.08	0.02
AH-3425	0.24	0.58	0.91	1.24	0.03	0.42
MSFH-8	0.34	0.68	1.23	1.46	0.12	0.46
KBSH-1	0.03	0.54	1.07	0.59	0.06	0.15
EC-68414	0.28	0.42	1.09	0.19	0.18	0.36
SEm ±	0.015	0.019	0.072	0.04	0.005	0.01
CD (0.05)	0.05	0.06	0.23	0.12	0.02	0.03

Normal trend of increasing biomass production with the growth of the crop was observed in these three medium-duration cultivars (Table 4). The rate of biomass accumulation was maximum up to 60 DAS and later it decreased. Further, highest

leaf area index was recorded (Table 5) by MSFH-8 over the other two cultivars like AH-3425 and KBSH-1. The water use efficiency of this group falls in between the long and short duration maturity groups.

DISCUSSION

The reduced yields recorded by Morden in 1993, eventhough maximum rainfall was received, might be due to the coincidence of heavy rains at flowering and this was reflected in low harvest index. These heavy rains might have washed away the pollen grains as well as the stigmal secetions and reduced the insect or bee activity.

Eventhough a positive relationship between maximum leaf area and seed yield are valid under intermittant moisture stress conditions, as was stressed by Rawson and Turner (1982, 1983), the reduced yields in Morden in both years might not be only due to low leaf area index but also depends on the efficient translocation of photosynthates to the sink which plays a major role in yield realization (Amir and Khalifa, 1991).

Medium duration cultivars despite facing terminal drought fared better compared with short- (Ravishankar *et al.*, 1991) and long-duration maturity groups. Eventhough no rainy day was recorded during pollination and grain filling, the yields were not affectd due to the rainfall received (61 mm) just before flowering which might have helped in overcoming the terminal drought. The length of the season was same for these three cultivars, but they performed differently in the two years. This could be attributed to their drought tolerance and effect of drought on yield potential. It is also likely that the intrinsic genotypic variation does not exist for performance under moisture stress with a duration category (Ravishankar *et al.*, 1991). Similarly Fereres *et al.* (1986) also confirmed that there was substantial variability among genotypes both in dryland yield potential and yield.

The long-duration genotypes produced higher biomass throughout the crop growth period. And this was expressed still more under drought conditions. According to Gimenez and Fereres (1986), the greater water extraction capacity of the long-duration cultivars helps in achieving higher biomass during drought periods. Nevertheless, this was not reflected in the ultimate yield. In this case, prolonged dryspell might have restricted the grain filling due to the exhaustion of photosynthates for the maintenance of the crop. Moreover, the long-duration cultivar like EC-68414 an open pollinated variety has to invariably encounter a dry spell at anthesis, pollination as well as at grain filling stages under late sown conditions. This was in conformity with Rawson and Turner (1982) as they observed that long duration is no advantage in a crop grain on stored soil moisture. Also the lesser yields recorded by this cultivar in 1993 may be attributed to the longest dry spell that occurred at pollination and grain filling.

CONCLUSION

The short-duration cultivars yielded less compared with medium-duration cultivars, but due to their early maturing character and high water use efficiency coupled with high partitioning ability can fit better into the cropping system than the other duration cultivars. As it was observed by Singh & Subba Reddy (ICRISAT, 1988), the short-duration and low-water requiring crops and cultivars should be preferred under receding soil moisture conditions but this is in contrast to the suggestion of Ravishankar *et al.* (1991) as they observed that mid- to late-duration types are to be preferred over early types under drought conditions. But medium-duration cultivars probably were recommended provided they were not caught in heavy rains at flowering and they remain to be the better choice. Obviously, the long-duration cultivars are to be sidelined as an alternative for late sown rainfed conditions. Ultimately, the rainfall distribution over an area and the phenology of sunflower genotypes should match each other when sown late to realise sustainable yields in drylands.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, CRIDA for guidance and B. Kistaiah for the assistance provided in carrying out this experiment.

REFERENCES

Amir, H.A. and Khalifa, F.M., 1991. Performance and yield of sunflower cultivars under rainfed and irrigated conditions in Sudan. Journal of Agriculture Science. Cambridge 116: 245-261.

Buringh, P., 1982. Potentials on world soils for agricultural production. Transactions of the 12th International Congress of Crop Science, 8-16 Feb 1982, New Delhi, India. IARI. pp.33-41.

EL-Swaify, S.A., Pathak, P., Rego, T.J. and Singh, S., 1985. Soil management for optimized productivity under rainfed conditions in the semi-arid tropics. Advances in Soil Science 1:1-64.

Fereres, E., Gimenez, C. and Fernandez, J.M., 1986. Genetic variability in sunflower cultivars under drought 1.Yield relationships. Australian Journal of Agricultural Research 37(6): 573-382.

Gimenez, G. and Fereres, E., 1986. Genetic variability in sunflower cultivars under drought 2. Growth and water relations. Australian Journal of Agricultural research 37(6) : 583-597.

ICRISAT (International Crops Research Institute for Semi-Arid Tropics)(Singh, R.P and Reddy, G.S.), 1988. Drought research priorities for the dryland tropics (Bidinger, F.R., and Johansen, C., eds.). Patancheru, AP. 502342 India : ICRISAT.

Rawson, H.M. and Turner, N.C., 1982. Recovery from water stress in five sunflower cultivars 1. Effects of timing of water application in leaf area and seed production. Australian Journal of Plant Physiology 9: 437-448.

Ravishankar, K.V., Uma Shankar, R., Ravishankar, H.M., Udaya Kumar, M. and Prasad, T.G., 1991. Development of drought tolerant sunflower for semi arid tracts of India. Duration of genotypes influence their performance under imposed moisture stress. Helia 14(5): 77-86.

EVALUACIÓN DE GENOTIPOS DE GIRASOL BAJO CONDICIONES DE SIEMBRA TARDÍA

RESUMEN

Se llevó a cabo un experimento de campo para estudiar el comportamiento del girasol como cultivo alternativo en condiciones de siembra tardía. Seis genotipos de girasol de diferente ciclo fueron evaluados y su estrés salino y llenado de grano con varios periodos de estrés. Los cultivares de ciclo medio, aunque aguantaron la sequía terminal, tuvieron un comportamiento mejor que otros grupos de maduración. Sin embargo los cultivares de ciclo largo que experimentaron estrés hídrico en casi todos los periodos cruciales como floración, polinización y llenado de grano fueron descartados.

EVALUATION DE GÉNOTYPES DE TOURNESOL EN CONDITIONS PLUVIALES ET DE SEMIS TARDIF

RÉSUMÉ

Un essai au champ a été réalisé pour étudier les performances du tournesol comme culture alternative en conditions pluviales et de semis tardif. Six génotypes de précocité différente ont été évalués et leur intérêt précisé vis à vis de la épartition des précipitations. Presque tous les cultivars en semis tardif ont subi un stress hydrique de durée variable lors de la phase de remplissage du grain. Les cultivars à précocité intermédiaire, bien que soumis à une sécheresse de fin de cycle, ont été plus performants que ceux appartenant aux autres groupes de maturité. Pourtant, on préfère les cultivars précoces pour leur caractère de maturation précoce. Les cultivars tardifs ayant subi un stress hydrique à presque tous les stades critiques tels que la floraison, la pollinisation et le remplissage du grain se sont révélés moins performants.