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Studies on the Effect of Different Cropping Systems and Weeding Intervals on the Weed Infestation and Grain Yield of Sorghum

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ABSTRACT

The influence of different cultural management factors such as cropping systems, planting patterns and weeding intervals on weed infestation and grain yield of sorghum were studied at Agricultural College Farm, Hyderabad during rainy seasons of 1979-80 and 1980-81. Sole sorghum cropping system was found to be poor competitor with weeds, and cowpea intercropping with sorghum reduced the weed growth and weed dry matter considerably requiring weed free situation upto 15 days for obtaining optimum grain yield as well as net monetary returns. However, weed free period upto 30 days was essential when sorghum was intercropped with mungbean or groundnut. The planting patterns had no impact on weed infestation and total grain yield.

INTRODUCTION

Yield potential in hybrid sorghum is fairly high, which is very often hampered due to lack of proper crop sanitation and proper nutrition. Under crop sanitation battle against weeds is most important. The sorghum crop suffers mainly due to its initial slow growth and establishment and also because of growing under less favourable condition of rainy season where highly efficient weeds very often get established prior to crop, resulting into poor yields. The percentage of yield reduction due to weeds in sorghum ranges from 6 to 40 (Gopal Krishna 1977), and total loss of sorghum yield due to weeds alone is estimated as one million tonnes annum in India. (Shetty 1976). No doubt the chemical method of weed control can be adopted, but it requires high technical efficiency and more intial investment. But for the small farmers having low capital investment ability and low technological skills, the use of herbicides becomes a limiting factor.

The non-conventional weed control methods or agronomical manipulations suitable for the small farmers can be satisfactorily employed in weed management. Among several methods suggested, the intercropping is one which prevents use of vacant space by weeds and reduce weed growth by competition and also substitutes it with a profitable intercrop (Greetz 1963, Webster and Wilson 1966, Walters 1971 and Enyi 1973 a). Though the intercropping is one of the recent recommended practices for dry land farming area, but it can be a method of weed management, if a suitable inter-crop component with proper agronomic manipulations is grown. With these points in view the present experiment was undertaken

MATERIALS AND METHODS

Field trials were conducted at Agricultural College Farm, Hyderabad, during

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rainy seasons of 1979-80 and 1980-81. The soil of the experimental field was sandy loam, neutral in reaction with low N and P content but high in K. The experiment was laid out in split plot design in both the years with three replications. In the first year the main plot treatments were five weeding intervals (No weeding, weed free up to 15, 30, 45 days and harvest) and sub plot treatments were four cropping systems (*Sole sorghum*, *Sorghum* + *Groundnut*, *Sorghum* + *Mungbean* and *Sorghum* + *Cowpea*). During the second year, two planting patterns (Normal and paired) with similar cropping patterns as main plots and three weeding intervals (No weeding, weed free upto 15 and 30 days) as sub plot treatments were tried. The varieties used in both the years for sorghum, mungbean, groundnut and cowpea were CSH-5, PS-16, TMV-2 and C-152 respectively. The spacing adopted for sorghum in normal planting was 45 x 15 cm and for paired planting was 30-60-30 x 15 cm. One and two rows of intercrops were included in between two rows of normal and paired sorghum respectively in second year. In all the treatments 100 percent population of sorghum and 66 percent of intercrop population was maintained except in sole sorghum treatments. The total rainfall of 633 and 345 mm as compared to normal rainfall of 811 mm occured during crop growth period in 1979-80 and 1980-81 years. The recommended fertilizer dose of 80:40 : 40.N, P and K kg ha^{-1} were applied. Half the dose of nitrogen along with entire dose of P and K was applied as basal and the remaining nitrogen was applied at 30 days after sowing.

RESULTS AND DISCUSSION

In the present study, eighteen weed species were identified. Among them, *Lagasca mollis*, *Digitaria sanguinalis*, *Echinochloa colonum*, *Cyperus rotundus*, *Cynodon dactylon* and *Celosia argentea* constituted the maximum. They occupied 23.4, 22.5, 21.6, 11.5, 8.2 and 2.1 percent respectively.

It is clear from table 1,2, that weed number and weed dry matter production/m^2 were significantly influenced by cropping systems and weeding intervals in both the years. Intercropping with mungbean, groundnut or cowpea reduced the weed population by 17.8, 23.4 and 51.5 percent respectively compared to sole crop of sorghum at 90th day. Among the intercrops, cowpea was more efficient in controlling weeds compared to other legumes, due to its quick and well developed canopy structure, similarly weed dry matter was also influenced due to these treatments. Cowpea intercropped with sorghum recorded the lowest dry matter of weeds in both the years followed by mung bean intercrop. (Table 1). These results are in accordance with Bantilan *et al* 1974.

The weed number and weed dry matter was also significantly reduced with increase in weed free duration in both the years. It was observed that the emergence of weeds was less after 30 days of weed free period and by the time crop growth was also aggressive due to which the dry matter of weed was reduced drastically in intercropping system particularly with sorghum + cowpea (Table 2).

The interaction of cropping systems and weeding intervals in relation to weed dry matter production was found to be significant in both the years (Table 3). The maximum dry matter of weeds was recorded in sole sorghum without weeding, and this was significantly inferior to rest of the treatments. While it was vice versa in

Table 1. Weed density and biomass sorghum growth parameters and grain equivalent as influenced by different cropping systems in 1979-80 and 1980-1981

Cropping systems	No. of weeds/m²		Dry matter of weeds (t/ha)		L.A.I of Sorghum at 60th day		Shoot drymatter of Sorghum (t/ha)		Sorghum grain equivalent (t/ha)	
	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81
Sole Sorghum	108	108	2.10	5.38						
	(9.76)	(10.28)			5.46	4.51	19.73	14.93	4.39	3.10
Sorghum + Gronndnut	91	73	1.77	4.54						
	(8.57)	(8.55)			5.14	4.42	19.48	14.83	4.68	3.04
Sorghum + Green Gram	93	83	1.79	4.30						
	(9.01)	(9.09)			5.11	4.43	19.49	14.93	5.08	3.04
Sorghum + Gowpea	64	40	1.12	4.72						
	(7.13)	(6.35)			4.29	4.00	17.23	14.37	5.76	3.81
S.Em +/−	0.15	0.20	0.40	1.73	0.06	0.05	1.50	0.57	0.52	0.42
C.D at 5%	0.44	0.60	5.21	4.33	0.19	0.16	4.33	1.73	1.52	1.26

Table 2. Weed density and biomass, sorghum growth parameters and grain equivalents as influenced by different weeding intervals during 1979-80 and 1980-81.

Weeding intervals	No. of weeds/m²		Dry matter of weeds (t/ha)		L.A.I. of Sorghum at 80th days		Shoot dry matter (t/ha)		Sorghum grain equivalent (t/ha)	
	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81
No weeding till harvest	211	126	3.82	7.81	3.34	3.19	11.46	8.47	2.49	1.55
	(14.48)	(11.23)								
Weed Free up to 15 days	76	65	1.80	3.30	4.67	4.71	17.19	16.52	4.78	3.41
	(8.60)	(8.05)								
Weed free up to 30 days	39	41	0.72	1.59	5.47	5.12	21.76	19.30	5.78	4.03
	(6.10)	(6.43)								
Weed free up to 45 days	29	-	0.36	-	5.69	-	22.18	-	5.91	-
	(5.29)									
Weed free up to harvest	-	-	-		5.83	-	22.33		5.93	-
S. Em +/−	0.18	0.14	0.50	1.38	-	0.05	2.08	0.59	0.76	0.39
C.D. at 5%	0.64	0.40	1.77	3.97	-	0.13	6.80	1.70	2.49	1.14

Table 3. Weed drymatter production and sorghum grain equivalent (t/ha) as influenced due to interaction of planning, cropping systems and weeding intervals

Treatments	No weeding				Weed free upto 15 days				Weed free upto 30 days				Weed free upto 45 days		WFH	Mean			
	WDM	Grain Yield	WDM	Grain Yield	WDM	Grain Yield	WDM	Grain Yield	WDM	Grain Yield	WDM	Grain Yield	WDM	Grain Yield	Grain Yield	WDM	Grain Yield	WDM	Grain Yield
	79-80	79-80	80-81	80-81	79-80	79-80	80-81	80-81	79-80	79-80	80-81	80-81	79-80	79-80	80-81	79-80	79-80	80-81	80-81
Normal Planting of Sor	-	7.35	-	1.73	-	3.21	-	3.92	-	1.55	-	4.68		-	-	-	4.03		3.45
Paired Sorghum Sole		8.28		1.74	-	3.39	-	3.86		1.62		4.77					4.43		3.46
Sorghum	4.29	9.21	1.99	1.69	2.54	4.69	3.85	3.25	1.06	2.23	5.05	4.35	5.21	5.43	5.95	2.10	5.38	4.39	3.10
Sorghum + G Nut	4.15	6.71	2.07	1.52	1.94	4.18	4.41	3.71	0.72	1.81	5.47	4.88	2.88	5.72	5.71	1.77	4.54	4.68	3.37
Sorghum + M Bean	3.86	7.97	2.31	1.69	1.68	3.37	4.87	3.94	0.79	1.57	6.13	8.78	4.25	6.01	6.11	1.69	4.30	5.08	3.47
Sorghum + Cowpea	2.96	6.47	3.58	2.04	1.02	0.97	5.99	4.64	0.30	0.73	6.47	4.89	2.03	6.48	6.27	1.12	2.72	5.76	3.86
Mean	3.82	7.81	2.49	1.74	1.89	3.30	4.78	3.89	0.72	1.59	5.78	4.73	3.59	5.91	5.93	-	—	—	—

	Weed Drymatter				Sorghum grain equivalent			
	1979-80		1980-81		1979-80		1980-81	
	S Em	C D	S Em	C D	S Em	C D	S Em	C D
a) Difference between 2 sub plots at the same level of main plot	0.80	2.31	2.76	7.94	1.18	3.40	0.81	2.33
b) Difference between 2 main plots at the same level of sub plot	0.85	2.66	2.84	8.18	1.27	3.85	0.79	2.28

c) Weed free upto harvest.

intercropping of sorghum + cowpea with weed free upto 30 days. However this treatment was also at par with weed free treatment upto 15 days of cowpea intercropping. This might be due to the increase in total plant population per unit area and also their quick coverage of ground compared to sole sorghum, resulting in higher competition against weeds. Similar effects due to intercropping of mungbean was also reported by Moody (1978).

The other characters such as leaf area index (LAI) and dry matter production of sorghum were also influenced by the treatments. The LAI and sorghum dry matter production was maximum in sole sorghum cropping system and minimum in cowpea intercropping. This might be due to competition of cowpea with sorghum (Table 1). Similar competition of cowpea with sorghum was also reported by Enyi (1973 b).

With increase in weed free duration, there was significant increase in LAI and dry matter production of sorghum (Table 2). This can be attributed to increased availability of nutrients, moisture and light to the crop plants due to removal of weeds.

The paired planting pattern had no influence on total grain yield, net monetary returns and yield attributing characters except shoot dry matter production of sorghum (Table 4, 5).

In both the years total grain yield (Sorghum grain equivalent) was significantly influenced due to cropping systems, weeding intervals and their interaction. The maximum grain yield of 5.76, 3.86 t/ha were recorded in both the years respectively in sorghum + cowpea croppingsystem and this was significantly superior to rest of the cropping systems. While sole sorghum treatement recorded the lowest. The increase in total grain yield was in order of 6.5, 8.7, 15.7, 12.0, 31.1, and 24.5 percent with groundnut, mungbean and cowpea intercropping with sorghum over sole sorghum (Table 1). These results further indicated that the sorghum + cowpea system can suppress weeds better than other cropping systems which was evident from the lesser number and low dry matter production of weeds.

Among the weeding intervals maximum grain yield was noticed in those treatments where weed free crop period was maintained upto 30 days or beyond upto harvest, which were at par with each other and significantly superior over the rest of the weeding intervals. The mean yield increase from no weeding to weed free treatment upto 30 days and 45 days was 2.28 and 2.72 times more respectively (Table 2). This might be because of weed free environment kept during crop growth period, which might have influenced the yield of intercrops as well as main crop of sorghum favourably.

Among the interaction of cropping systems and weeding intervals, Sorghum + Cowpea intercropping was significantly superior to sole sorghum treatment at all weeding intervals. The total grain yield difference was at par where ever the Sorghum + Cowpea was maintained weed free upto 30, 45 days or upto harvest. Weed free period till 15 days of the same intercrops also recorded as much grain equivalent as that of weed free till harvest under sole crop of sorghum (Table 3).

These results showed that though the weed free condition was better for the crop growth, the weeding must not be extended beyond certain age of the crop. This

Table 4. Weed density and biomass, sorghum growth parameters and grain equivalent as influenced by different planting patterns in 1980-81

Parameters	Planting patterns			
	Normal Planting	Paired Planting	S.Em +/−	C.D. at 5%
Weed number/m² at 90 days	71	76	0 14	–
Dry matter of weeds (t/ha)	(8 41) 4.04	(8 74) 4.43	1 30	–
Shoot dry matter of Sorghum (t/ha)	14.68	14 85	0 41	–
LAI of sorghum 60th days	4.34	4.34	0 04	–
Sorghum grain equivalent (t/ha)	3 00	2.99	0.30	–

Table 5 Net monetary returns (Rs/ha) as influenced by different treatments ,

Treatments	No weeding		Weed free upto 15 days		Weed free upto 30 days		Weed free upto 45 days		Weed free upto harvest		Mean	
	1979 1980	1980 1981	1979 1980	1980 1981	1979 1980	1980 1981	1979 1980	1980 1981	1979 1980	1980 1981	1979 1980	1
Planting Patterns												
Normal planting		3022	–	6495	–	7547	–	–		–	–	5
Paried planting	-	3034	–	6383	–	7691	-	–	-	–	-	5
Cropping systems												
Sole sorghum	2195	3105	3885	5594	4886	7205	5186	–	5335	–	4297	5
Sorghum + Groundnut	2192	2427	4254	5937	5107	7600	5229	–	5141		4385	5
Sorghum + Mungbean	2515	3069	4777	6617	5697	7809	5528	-	5570	-	4817	5
Sorghum + Cowpea	3434	3513	5551	7609	5909	7864	5852	–	5622	-	5274	6
Mean	2584	3028	4617	6439	5400	7619	5449	–	5417	–		

	1979-80		1980-81	
Cropping system X weeding intervals	S.Em	C.D	S.Em	C.D.
a) Difference between 2 sub plots at the same level of main plot.	95	273	138	396
b) Difference between 2 main plots at the same level of sub plots.	98	293	135	388
Planting patterns X weeding intervals				
a) Difference between 2 sub plots at the same level of main plots.			97	NS
b) Difference between 2 main plots at the same level of sub plots			15	NS

is because weeding after 30th day in mungbean and after 40th day in groundnut, which will be at flowering and pod formation stage, may effect adversely resulting into less yields. The cowpea was effective in suppressing weeds due to its early establishment and covering of maximum area in the field, indicating more competitive ability against weeds.

Maximum net monetary returns of Rs.5,274, Rs.6,329 ha^{-1} were obtained from sorghum + cowpea intercropping systems in both the years respectively followed by sorghum + mungbean intercrop. Though the sorghum + groundnut intercrop recorded significantly higher total grain yield compared to sole crop of sorghum, they were at par with each other in relation to net monetary returns (Table 5). This was due to the higher cost of groundnut seed. Sorghum + Cowpea intercrop system with 15 days weed free environment also recorded higher monetary returns compared to sole crop of sorghum with weed free till harvest (Table 5).

Thus these results conclusively proved that weed free situation till 45 and 30 days were essential if sole sorghum or sorghum in association with mungbean or groundnut is taken up. While in sorghum and cowpea intercropping, weed free upto 15 days may be sufficient for obtaining maximum grain yields as well as net monetary returns.

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