

Tolerance of Sorghum Genotypes to Pre-emergence Application of Herbicides

By

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ABSTRACT

A pot culture investigation was carried out to find out the tolerance of four sorghum genotypes *viz.*, CSH 1, CSH 3, Swarna and GM 2-3-1 to pre-emergence application of atrazine and 2, 4-D at 0.5 to 2.5 and 0.5 to 2.0 kg a. i. per ha, respectively. Application of higher dose of herbicide reduced germination of all the genotypes. The reduction was more drastic with 2, 4-D even at lower concentrations. However, CSH 3 was found to be more tolerant to both the herbicides.

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) being a staple food and fodder crop, several genotypes have been developed to suit different agro-climatic regions. Atrazine and 2, 4-D are widely used for effective weed control in sorghum and they have gained more importance in the recent years. However, the tolerance of sorghum genotypes to these herbicides has not been thoroughly worked out. Sivaji Rao (1969) screened world collection of sorghum lines at Hyderabad to propazine and observed the presence of varietal differences. Adverse effect on germination of jowar to the pre-emergence application of atrazine at higher concentration has been reported by Phillips and Ross (1962). The tolerance is supposed to

be due to various factors like accumulation of absorbed herbicide or the quantity of dry matter produced under controlled condition or inactivation of herbicides in the leaf tissues or the prevention of series of reactions which mediate the acute toxicity of herbicide. An investigation was taken up to study the tolerance of commonly cultivated sorghum genotypes.

MATERIAL AND METHODS

A pot culture experiment was conducted to test the tolerance of sorghum genotypes *viz.*, CSH 1, CSH 3, Swarna and GM 2-3-1 to pre-emergence spray of atrazine at 0.5 to 2.5 kg a. i. per ha and 2, 4-D at 0.5 to 2.0 kg a. i. per ha with untreated control. Black cotton soil was collected from the field and

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filled in a wooden box of 45 x 45 x 60 cm. The boxes were watered and 25 seeds of each genotype were planted by making four compartments. Herbicide treatments were taken as main plot and sorghum genotypes as sub-plot treatments. They were replicated thrice. Ten square meter area was marked and pits were dug to accommodate wooden boxes. Boxes receiving same concentration of herbicides were placed in the pits. Herbicides required for 10 square meter area was calculated and sprayed uniformly with high volume sprayer on the date of sowing (30th August, 1970). Watering was done on alternate days sufficient to keep surface soil moist. Observations on seedling emergence at 20 and 30 days, height of plant, number of leaves and dry weight at 30 days after sowing per plant were recorded.

RESULTS AND DISCUSSION

Germination studies:

There were significant differences among herbicide treatments and genotypes (Table 1). Germination per cent of sorghum genotypes was reduced with increase in the dosage of herbicide. Atrazine at 2.5 kg a.i. per ha reduced the germination by 8, 6 and 18 per cent for CSH 3, Swarna and GM 2-3-1, respectively as compared to control. Similar observations were made by Phillips and Ross (1962) with atrazine and propazine 3.7 and 7.0 kg per ha and Sivaji Rao (1969) with 3 kg

propazine. Germination was also significantly reduced by 2, 4-D spray at all the doses. The reduction of germination per cent with application of 2, 4-D at 3 kg a.i. per ha was to the extent of 50, 53, 53 and 54 for CSH 1, CSH 3, Swarna and GM 2-3-1 respectively as compared to control. 2, 4-D injuries on sorghum genotypes have been reported by Lybenov (1969). The tolerance is supposed to be due to rapid accumulation of herbicides. (Wheeler and Hamilton, 1968). Among the genotypes CSH 3 and Swarna exhibited more tolerance than CSH 1 and GM 2-3-1.

Dry matter production per plant:

Significant differences in dry matter were observed among treatments (Table 2). Control treatment had maximum dry matter production as compared to any other herbicide treatments except in case of atrazine at 0.5 and 1.0 kg a.i. per ha for Swarna and GM 2-3-1. Dry matter was reduced significantly above 1 kg a.i. per ha atrazine and drastically reduced in all 2, 4-D treatments. Maximum dry weight in control in decreasing order was in CSH3, Swarna, CSH 1 and GM 2-3-1. The varieties which produce the lowest quantity of dry matter are supposed to be killed at high concentration of herbicide. Miller and Bovey (1969) observed a similar trend while testing 40 varieties of sorghum. CSH 3 and CSH 1 relatively accumulated more

TABLE 1. Effect of pre-emergence spray of herbicides on seedling emergence of four sorghum genotypes at 20 and 30 days after sowing

Treatments	20 days after sowing				30 days after sowing				Aver- age	
	CSH 1	CSH 3	Swarna	GM- 2-3-1	Aver- age	CSH 1	CSH 3	Swarna		GM- 2-3-1
	Germination percentage (Arcs in/percentage transformed data)									
Unsprayed	66.15	75.00	66.15	72.29	69.90	66.15	75.00	66.15	72.29	69.40
Atrazine 0.5 kg a. i. per ha	66.15	83.85	68.85	77.71	74.14	66.15	83.85	68.85	77.71	74.19
Atrazine 1.0 kg a. i. per ha	66.15	83.85	66.15	75.00	72.79	68.85	83.85	66.15	75.00	73.46
Atrazine 1.5 kg a. i. per ha	63.44	83.85	68.85	63.93	70.02	54.78	83.85	50.77	46.92	59.10
Atrazine 2.0 kg a. i. per ha	63.44	83.85	70.03	72.29	72.42	67.00	59.01	45.00	51.14	53.04
Atrazine 2.5 kg a. i. per ha	66.15	68.85	61.71	59.01	63.93	32.71	46.92	45.00	34.92	39.89
2, 4-D 0.5 kg a. i. per ha	62.78	61.22	61.22	48.85	56.02	45.00	43.08	53.07	39.15	45.06
2, 4-D 1.0 kg a. i. per ha	42.99	68.85	62.71	50.77	56.33	28.08	41.07	41.07	35.22	36.36
2, 4-D 1.5 kg a. i. per ha	33.00	46.92	46.92	46.92	43.44	21.15	26.56	30.29	23.85	25.46
2, 4-D 2.0 kg a. i. per ha	32.71	35.01	30.78	33.00	32.87	6.15	8.86	6.15	6.15	6.33
Average	55.30	69.13	60.34	59.58	61.19	44.60	53.21	47.25	46.24	48.32

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C. D. at 5 per cent for main plots
 Sub-plots
 Sub-plots at the same level of main plot
 Main plots at the same level of subplot
 N. S. = not significant.

7.54
 4.19
 13.25
 13.31

TABLE 2. Effect of pre-emergence spray of herbicides on dry matter of four sorghum genotypes at 30 days after sowing

Treatments	Dry weight per plant in mg (log x transformation)				
	CSH 1	CSH 3	Swarna	GM 2-3-1	Average
Unsprayed	1.99	2.13	2.01	1.93	2.02
Atrazine 0.5 kg a. i. per ha	1.96	2.02	1.96	1.92	1.97
Atrazine 1.0 kg a. i. per ha	1.93	2.02	1.91	1.91	1.94
Atrazine 1.5 kg a. i. per ha	1.75	1.96	1.62	1.63	1.74
Atrazine 2.0 kg a. i. per ha	1.49	1.70	1.44	1.50	1.53
Atrazine 2.5 kg a. i. per ha	1.31	1.45	1.35	1.29	1.35
2, 4-D 0.5 kg a. i. per ha	1.49	1.65	1.43	1.42	1.50
2, 4-D 1.0 kg a. i. per ha	1.42	1.56	1.25	1.22	1.36
2, 4-D 1.5 kg a. i. per ha	1.34	1.44	1.20	1.08	1.27
2, 4-D 2.0 kg a. i. per ha	0.96	1.67	0.97	0.87	1.12
Average	1.56	1.76	1.51	1.48	1.58

C. D. at 5 per cent for main plots

0.06

Sub plots

0.05

Sub plots at the same level of main plot

N.S.

Main plots at the same level of sub plot

N.S.

N. S. = Not-significant

dry matter which may be responsible for higher tolerance to herbicides.

Number of leaves per plant :

Number of leaves per plant were more with atrazine application upto 0.5 kg a. i. per ha as compared to control in all the genotypes (Table 3). Maximum number of leaves were found in CSH 3. In 2, 4-D treatments number of leaves were significantly less as compared to control and atrazine treatments. This was due to delay in emergence. Vari-

ties having high germination rate indices and rapid seedling development at the early stages of the growth were found to be the indicators for breeders to select best competitive hybrids (Güneşli *et al.*, 1969). Maximum number of leaves were found in CSH-3 followed by GM 2-3-1, CSH 1 and Swarna.

Height of plants :

Height of plant measured at 30 days after sowing is presented in Table 3. The height of plant was significantly more in atrazine treatments upto

TABLE 3. Effect of Pre-emergence spray of herbicides on number of leaves per plant and height of plant of four sorghum genotypes at 30 days after sowing

Treatments	Number of leaves per plant					Height of plant in cm				
	CSH 1	CSH 3	Swarna	GM-2-3-1	Average	CSH 1	CSH 3	Swarna	GM-2-3-1	Average
Unsprayed	4.20	5.00	4.06	4.26	4.38	2.67	3.17	2.62	2.58	2.76
Atrazine 0.5 kg a. i. per ha	4.40	5.06	4.40	4.38	4.67	2.59	3.18	2.50	2.52	2.70
Atrazine 1.0 kg a. i. per ha	4.23	5.20	4.06	4.06	4.39	2.88	3.19	2.35	2.31	2.66
Atrazine 1.5 kg a. i. per ha	4.06	5.00	3.65	3.53	4.06	2.42	3.30	1.55	1.49	2.19
Atrazine 2.0 kg a. i. per ha	3.93	5.00	3.20	3.80	3.98	2.04	2.43	1.16	1.51	1.78
Atrazine 2.5 kg a. i. per ha	4.00	4.26	3.06	3.80	3.78	1.49	1.94	1.16	1.36	1.49
2, 4-D 0.5 kg a. i. per ha	2.13	2.60	2.06	2.40	2.30	0.48	0.76	0.25	0.25	0.43
2, 4-D 1.0 kg a. i. per ha	2.00	2.00	2.00	2.00	2.00	0.36	0.74	0.20	0.25	0.59
2, 4-D 1.5 kg a. i. per ha	1.60	2.00	1.46	2.00	1.76	0.30	0.81	0.20	0.28	0.40
2, 4-D 2.0 kg a. i. per ha	1.00	1.33	1.00	1.26	1.15	0.25	0.43	0.20	0.21	0.27
Average	3.16	3.75	2.90	3.19	3.25	1.55	1.99	1.22	1.27	1.51

C. D. at 5 per cent for main plots

Sub plots

Sub plots at the same level of main plot

Main plots at same level of sub plots

1.26
0.04
0.25
0.230.19
0.07
0.21
0.20

1 kg a. i. per ha than in control. CSH 3 registered maximum height with atrazine at 1.5 kg a. i. per ha, while in other genotypes it was significantly more upto 1 kg a. i. per ha. Atrazine at 2 kg a. i. per ha and 2, 4-D at all concentrations reduced the height of plant drastically. 2, 4-D delayed the emergence hence slow growth. Similarly in high concentration of atrazine, CSH 3 had significantly more height compared to other genotypes, hence it registered better tolerance.

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