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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. ever, the tolarance of sorghum genotypes to these herbicides has not been thoroughly worked out, Sivaji Rao (1969) screened world collection of sorghum lines at Hyderabad to propagine 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 medicate 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 v/z., 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 af 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. Tensquare 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 hareduced 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 propagine 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 percent 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. cer 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, CSH1 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 90 days after sowing

Treatments CSH 1 CSH 3 Swarns GM- Aver- CSH 1 CSH 3 Swarns Unspecial data (Area) ago (Area in per ha 66.15 75.00 65.15 77.71 74.14 66.15 83.85 68.15 74.22 69.90 66.15 75.00 66.15 74.22 69.90 66.15 75.00 66.15 74.22 69.90 66.15 75.00 66.15 74.22 69.90 66.15 75.00 72.79 68.85 68.15 74.22 77.71 74.14 66.15 83.85 68.15 77.71 74.14 66.15 83.85 66.15 74.22 77.71 74.14 66.15 83.85 66.15 74.22 77.71 74.14 66.15 83.85 66.15 74.22 77.71 74.14 66.15 83.85 66.15 74.22 77.71 74.14 66.15 83.85 66.15 74.22 77.72 74.14 66.15 83.85 66.15 74.22 77.22 7	,		2	0 days af	20 days after sowing				30 d	30 days after sowing	gniwo	
Germination percentage (Arcs in/parcentage transformed data) O.5 kg a.i. per ha 66.15 75.00 65.15 77.71 74.14 66.15 83.85 68.85 1.0 kg a.i. per ha 66.15 83.85 68.85 77.71 74.14 66.15 83.85 66.15 2.0 kg a.i. per ha 65.44 83.85 68.85 63.93 70.02 54.78 83.85 66.15 2.0 kg a.i. per ha 66.15 68.85 63.93 70.02 54.78 83.85 66.15 2.0 kg a.i. per ha 66.15 68.85 61.71 69.01 63.93 32.71 46.92 45.00 0.5 kg a.i. per ha 66.15 68.85 61.72 69.01 63.93 32.71 46.92 45.00 0.5 kg a.i. per ha 82.78 61.22 61.22 48.85 66.02 45.00 43.08 53.07 1.0 kg a.i. per ha 33.00 46.92 46.92 43.44 21.15 26.56 30.29 2.0 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 Average 55.30 69.13 60.34 59.58 61.19 44.60 53.21 47.25 15 per cant for main plots 15 st at the same lavel of main plot subplot N.S.	Trea	itments	CSH 1	CSH 3	Swarns		Aver- age	CSH 1	CSH 3	Swarna	GM. 2.3.1	Average
0.5 kg a.i. per ha 66.15 83.85 68.85 77.71 74.14 66.15 83.85 68.85 1.0 kg a.i. per ha 66.15 83.85 68.85 77.71 74.14 66.15 83.85 68.85 1.0 kg a.i. per ha 66.15 83.85 68.85 63.93 70.02 54.78 83.85 66.15 1.5 kg a.i. per ha 63.44 83.85 70.03 72.29 72.42 67.00 59.01 45.00 2.5 kg a.i. per ha 63.44 83.85 61.71 69.01 63.93 32.71 46.92 45.00 0.5 kg a.i. per ha 65.15 68.85 61.72 61.72 48.85 66.02 45.00 43.08 53.01 1.0 kg a.i. per ha 65.17 66.13 69.01 63.93 32.71 46.92 45.00 0.5 kg a.i. per ha 65.78 61.22 46.92 48.85 66.02 45.00 43.08 53.07 1.5 kg a.i. per ha 33.00 46.92 46.92 46.92 43.44 21.15 26.56 30.29 2.0 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 61.15 8.86 61.15 1.5 kg a.i. per ha 33.00 46.92 46.92 43.44 21.15 26.56 30.29 2.0 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 61.15 8.86 61.15 1.5 kg a.i. per ha 34.01 1.0 kg a.i. per ha 35.01 10.85 60.34 8.95 61.19 44.60 53.21 47.25 1.5 kg a.i. per ha 35.00 10.85 60.34 10.07 10.85 61.19 44.60 53.21 47.25 61.35 61.19 44.60 65.21 47.25 61.35 61.19 44.60 65.21 47.25 61.35 61.19 44.60 65.21 47.25 61.35 61.19 44.60 65.21 47.25 61.35 61.19 61.19 44.60 65.21 47.25 61.35 61.19				Germin	ation percel	ntage (An	ss in/perce	ntage transfo	irmed data)			
0.5 kg a.i. per ha 66.15 83.85 68.85 77.71 74.14 66.15 83.85 68.85 66.15 1.0 kg a.i. per ha 66.15 83.85 66.15 75.00 72.79 68.85 83.85 66.15 1.5 kg a.i. per ha 63.44 83.85 66.15 70.03 72.29 72.42 67.00 59.01 45.00 22.5 kg a.i. per ha 62.78 61.22 61.22 48.85 66.02 45.00 59.01 45.92 45.00 6	Unspraye	77	66.15	75.00	69.15	72.29	69.90	66,15	75.00	66.15	72.29	69.40
1.0 kg a.i. per he 66.15 83.85 66.15 75.00 72.79 68.85 83.85 66.15 1.5 kg a.i. per ha 63.44 83.85 68.85 63.93 70.02 54.78 83.85 50.77 50.03 72.29 72.42 67.00 59.01 45.00 20.5 kg a.i. per ha 66.15 68.85 61.71 69.01 63.93 32.71 46.92 45.00 45.00 0.5 kg a.i. per ha 62.78 61.22 61.22 48.85 66.02 45.00 43.08 53.07 1.0 kg a.i. per ha 33.00 46.92 46.92 45.92 43.44 21.15 26.55 30.29 2.0 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 47.05 1.5 kg a.i. per ha 32.71 35.01 30.78 59.58 61.19 44.60 53.21 47.25 1.5 kg a.i. per ha 32.71 35.01 30.78 59.58 61.19 44.60 53.21 47.25 1.5 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 1.5 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 1.5 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 1.5 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 47.25 1.5 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 1.5 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 47.25 1.5 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 47.25 1.5 kg a.i. per ha 32.71 35.01 30.78 1.30 32.87 6.13 44.60 53.21 47.25 1.5 kg a.i. per ha 32.71 1.0 kg a.i. per ha 32.71 35.01 30.78 1.30 32.87 6.13 44.60 53.21 47.25 1.5 kg a.i. per ha 32.71 35.01 30.78 1.5 kg a.i. per ha 32.71 35.01 30.78 1.5 kg a.i. per ha 32.71 35.01 30.78 1.30 32.87 6.13 44.60 53.21 47.25 1.5 kg a.i. per ha 32.71 35.01 30.78 1.5 kg a.i. per ha 32.71 30.78 1.5 kg a.i. per ha 32.7	Atrazina	0.5 kg a, i. per ha	66,15	83.85	68.85	77.71	74.14	66,15	83.85	68.85	17.71	74.19
1.5 kg a. i. per ha 63.44 83.85 68.85 63.93 70.02 54.78 83.85 50.77 2.0 kg a. i. per ha 63.44 83.85 70.03 72.29 72.42 67.00 59.01 45.00 2.5 kg a. i. per ha 66.15 68.85 61.71 69.01 63.93 32.71 46.92 48.85 66.02 45.00 45.00 45.00 0.5 kg a. i. per ha 62.78 61.22 61.22 48.85 62.71 50.77 56.33 28.08 41.07 41.07 1.5 kg a. i. per ha 33.00 46.92 46.92 43.44 21.15 26.56 30.29 2.0 kg a. i. per ha 32.71 36.78 33.00 32.87 6.15 8.86 6.15 Average 55.30 69.13 60.34 59.58 61.19 44.60 53.21 47.25 15 55.30 69.13 60.34 59.58 61.19 44.60 53.21 47.25 15 15 40.	Atrazine		66.15	83,85	66.15	75.00	72.79	68.85	83.85	66,15	75.00	73,46
2.0 kg a.i. per ha 63.44 83.85 70.03 72.29 72.42 67.00 59.01 45.00 2.5 kg ari. per ha 66.15 68.85 61.71 59.01 63.93 32.71 46.92 45.00 0.5 kg ari. per ha 62.78 61.22 61.22 48.85 66.02 45.00 43.08 53.07 1.0 kg ari. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.86 61.15 44.60 53.21 47.25 48.95 61.19 44.60 53.21 47.25 1.5 kg ari. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.86 61.15 8.86 11.15 ta the same lavel of main plots is at the same lavel of subplot at a same lavel at a same l	Atrazine		63,44	83.85	68.89	63.93	70.02	54.78	83.85	50.77	46.92	59.10
1.0 kg a.i. per ha 66.15 68.85 61.71 69.01 63.93 32.71 46.92 45.00 0.5 kg a.i. per ha 62.78 61.22 61.22 48.85 66.02 45.00 43.08 53.07 1.0 kg a.i. per ha 33.00 46.92 46.92 46.92 43.44 21.15 26.56 30.29 2.0 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 and 2.0 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.16 8.88 6.15 and 5 per cent for main plots at the same level of main plot at the same level of subplot at the same level at the same level of subplot at the same level at the same level at	Atrazine		63.44	83.85	70.03	72,29	72.42	67.00	59.01	45 00	51,14	53.04
0.5 kg a.i. per ha 62.78 61.22 61.22 48.85 66.02 45.00 43.08 53.07 1.0 kg a.i. per ha 42.99 68.85 62.71 50.77 56.33 28.08 41.07 41.07 1.5 kg a.i. per ha 33.00 46.92 46.92 46.92 46.92 45.95 67.15 26.55 30.29 2.0 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.86 6.15 Average 55.30 69.13 60.34 59.58 61.19 44.60 53.21 47.25 at 5 per cant for main plots 10 tots 44.03 44.60 53.21 47.25 Plots at the same level of main plot N.S.	Atrezine		66.15	68.85	61,71	59.01	63.93	32.71	46.92	45.00	34 92	39.89
1.5 kg a.i. per ha 33.00 46.92 46.92 43.44 21.15 26.56 30.29 2.0 kg a.i. per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 Average 55.30 69.13 60.34 59.58 61.19 44.60 53.21 47.25 lots at 5 per cent for main plots fots at the same level of main plot plots at the same level of subplot N.S.	2, 4-D	0.5 kg a.i. per ha	52.78	61.22	61.22	48.85	56.02	45.00	43.08	53.07	39.15	45.06
1.5 kg a. i' Per ha 33.00 46.92 46.92 43.44 21.15 26.56 30.29 2.0 kg a. i: per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.88 6.15 Average 55.30 69.13 60.34 59.58 61.19 44.60 53.21 47.25 at 5 per cant for main plots fots at the same level of main plot plots at the same level of subplot N.S.	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	36.38
2.0 kg a. i: per ha 32.71 35.01 30.78 33.00 32.87 6.15 8.86 6.15 Average 55.30 69.13 60.34 59.58 61.19 44.60 53.21 47.25 fots at 5 per cent for main plots fots at the same level of main plot plots at the same level of subplot N.S.	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
69.13 60.34 59.58 61.19 44.60 53.21 47.25 7.52 4.03 N.S. N.S.	2, 4.0	2.0 kg a. i. per ha	32.71	35.01	30.78	33.00	32.87	6.15	8.85	6,15	6.15	6.83
		Average	55.30	69,13	60.34	59.58	61.19	44,60	53.21	47.25	46.24	48.32
	C. D.	t 5 per cent for main	plots				7.52					7,54
4	Sub-plo	st					4.03					4.19
	Sub-plc	its at the same level	of main plot				s.					13,25
	Main p	ots at the same lave	l of subplot				S. S.					(8.3)

N. S. = not significant,

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

Unsprayed Atrazine 0.5 kg a. i. per ha	9) - '-::-	1.99	CSH 3	Swarna	GM 2-3-1	Average
Atrazine 0.5 kg a.i. per ha	,, ::	1.99	1411. ozupi 4	2		
PATRICIA DE LA PARTICIONA DE LA CONTRA DELIGIA DE LA CONTRA DELIGIA DE LA CONTRA DE			2.13	2.01	1,93	2.02
and the second s	7	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 he		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

N.S.

N. S. = Not-significant

dry matter which may be responsible .

for higher tolerance to herbicides.

Main plots at the same level of sub plot

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. Varie-

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 competative hybrids (Guneyli 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-amergance spray of harbicides on number of leaves per plant and height of plant of four sorghum genotypes at 30 days after sowing

Unsprayed Atrazine 0.5 kg a.i. per ha 4.20 5.00 4.06 4.26 4.38 2.67 3.17 2.62 2.58 2.76 Atrazine 1.0 kg a.i. per ha 4.20 5.00 4.06 4.38 4.67 2.59 3.18 2.50 2.50 2.70 Atrazine 1.0 kg a.i. per ha 4.06 5.00 3.66 3.53 4.06 2.42 3.30 1.55 1.49 2.19 Atrazine 2.0 kg a.i. per ha 4.00 4.26 3.06 3.20 3.80 3.98 2.04 2.43 1.16 1.51 1.78 Atrazine 2.0 kg a.i. per ha 4.00 4.26 3.06 3.20 3.30 3.78 1.49 1.94 1.16 1.51 1.78 Atrazine 2.0 kg a.i. per ha 2.13 2.60 2.00 2.00 2.00 2.00 0.36 0.36 0.74 0.20 0.25 0.43 2.40 2.40 1.0 kg a.i. per ha 1.60 2.00 1.46 2.00 2.00 2.00 0.36 0.36 0.37 0.38 0.74 0.20 0.25 0.43 0.40 2.40 1.0 kg a.i. per ha 1.60 2.00 1.46 2.00 1.76 0.30 0.48 0.76 0.25 0.25 0.40 2.40 2.40 1.0 kg a.i. per ha 1.60 2.00 1.46 2.00 1.76 0.30 0.48 0.76 0.25 0.25 0.40 2.40 2.40 1.46 1.46 1.46 1.46 1.46 1.46 1.46 1.46				Nan	nber of les	Number of leaves per plant	ų.		Ĭ	Height of plant in cm	ant in cm	
ped 6.5 kg a.i. per ha 4.20 5.00 4.06 4.26 4.38 2.67 3.17 2.62 2.58 2 1.0 5 1.0 kg a.i. per ha 4.40 5.06 4.06 4.38 4.67 2.59 3.18 2.50 2.52 2.51 2 1.0 kg a.i. per ha 4.06 5.00 3.66 3.63 4.06 2.42 3.30 1.55 1.49 2 2.5 kg a.i. per ha 4.00 4.26 3.00 3.20 3.80 3.98 2.04 2.43 1.16 1.51 0.5 kg a.i. per ha 2.13 2.60 2.00 2.00 2.00 2.00 0.36 0.36 0.36 0.36 0.36 0.36 0.36 0		Treatments		CSH 3	Swarna	GM-2-3-1	Average	CSH 1	CSH 3	Swarna	1 1	Average
4.40 5.06 4.40 4.38 4.67 2.59 3.18 2.50 2.52 4.23 5.20 4.06 4.39 2.88 3.19 2.35 2.31 4.06 5.00 3.66 3.53 4.06 2.42 3.30 1.55 1.49 2.33 5.93 5.00 3.20 3.80 3.98 2.04 2.43 1.16 1.51 4.00 4.26 3.06 3.80 3.98 2.04 2.43 1.16 1.51 1.31 2.13 2.60 2.06 2.40 2.30 0.48 0.76 0.25 0.25 1.60 2.00 2.00 2.00 2.00 0.36 0.74 0.20 0.25 1.60 1.00 1.33 1.00 1.26 1.15 0.25 0.43 0.20 0.21 1.00 1.33 1.00 1.26 1.15 1.55 1.55 1.55 1.20 0.20 0.21 1.20 0.21 1.20 0.21 1.20 0.20 0	Unsprayed			5.00	4.06	4.26	4.38	2,67	3.17	2,62	2,58	2.76
4.23 5.20 4.06 4.06 4.06 4.39 2.88 3.19 2.35 2.31 4.06 5.00 3.66 3.53 4.06 2.42 3.30 1.55 1.49 3.93 5.00 3.20 3.80 3.98 2.04 2.43 1.16 1.51 4.00 4.26 3.06 3.80 3.78 1.49 1.94 1.16 1.36 2.13 2.60 2.06 2.30 0.48 0.76 0.26 0.25 2.00 2.00 2.00 0.36 0.34 0.20 0.25 1.60 2.00 1.76 0.30 0.81 0.20 0.25 1.00 1.33 1.00 1.26 1.57 1.27 1.27 3.16 3.75 2.90 3.19 3.25 1.57 1.22 1.27 1.00 1.33 1.00 1.26 0.25 0.43 0.20 0.21 2.10 2.50 3.19 3.25 1.57 1.27 1.27 2.00 2.00 </td <td>Afrazine 0</td> <td>).5 kg a.i. per ha</td> <td>4,40</td> <td>5.06</td> <td>4.40</td> <td>4.38</td> <td>4.67</td> <td>2.59</td> <td>3,18</td> <td>2,50</td> <td>2.52</td> <td>2.70</td>	Afrazine 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
4.06 5.00 3.66 3.53 4.06 2.42 3.30 1.55 1.49 2 3.93 5.00 3.20 3.80 3.98 2.04 2.43 1.16 1.51 4.00 4.26 3.06 3.80 3.78 1.49 1.94 1.16 1.51 2.13 2.60 2.06 2.30 0.48 0.75 0.25 0.25 2.00 2.00 2.00 2.00 0.36 0.74 0.20 0.25 1.60 1.33 1.00 1.26 1.15 0.25 0.20 0.28 1.00 1.33 1.00 1.26 1.56 1.59 1.22 1.27 3.16 3.75 2.90 3.19 3.25 1.56 1.22 1.27 of main plot of main plots	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	2.56
3.93 5.00 3.20 3.80 3.98 2.04 2.43 1.16 1.51 4.00 4.26 3.06 3.80 3.78 1.49 1.94 1.16 1.38 2.13 2.60 2.06 2.40 2.30 0.48 0.76 0.25 0.25 2.00 2.00 2.00 2.00 0.36 0.74 0.20 0.25 1.60 2.00 1.46 2.00 1.76 0.30 0.81 0.20 0.28 1.00 1.33 1.00 1.26 1.15 0.25 0.43 0.20 0.21 3.16 3.75 2.90 3.19 3.25 1.57 1.99 1.22 1.27 Of main plot	Atrazine 1	.5 kg a.i. per ha	4.06	5.00	3,66	3.53	4.06	2.42	3,30	1,55	1.49	2,19
4.00 4.26 3.06 3.80 3.78 1,49 1,94 1,16 1.38 2.13 2.13 2.50 2.30 0.48 0.76 0.25 0.25 0.25 2.00 2.00 2.00 0.36 0.74 0.20 0.25 0.25 1.60 2.00 1,76 0.30 0.81 0.20 0.28 1.00 1.33 1.00 1.26 1.15 0.25 0.43 0.20 0.21 3.16 3.75 2.90 3.19 3.25 1.55 1.99 1.22 1.27 0.004 0.004	Atrazine 2	2.0 kg a.i. per ha	3.93	6.00	3.20	3.80	3.98	2.04	2.43	1.16	1.51	1.78
2.13 2.60 2.08 2.40 2.30 0.48 0.76 0.25 0.25 2.00 2.00 2.00 0.36 0.74 0.20 0.25 6.160 2.00 2.00 2.00 0.36 0.74 0.20 0.25 6.160 2.00 1.76 0.30 0.81 0.20 0.28 1.00 1.33 1.00 1.26 1.15 0.25 0.43 0.20 0.21 3.16 3.75 2.90 3.19 3.25 1.55 1.99 1.22 1.27 6.004 0.004 0.25 0.25 0.25 0.25 0.25 0.004	Atrazine 2	2.5 kg a. i. per ha	4.00	4.26	3,06	3.80	3,78	1,49	1.94	1.16	1.38	1.49
2.00 2.00 2.00 2.00 0.36 0.74 0.20 0.25 1.60 1.60 2.00 1.76 0.30 0.81 0.20 0.28 1.00 1.33 1.00 1.26 1.15 0.25 0.43 0.20 0.21 1.20 1.35 1.60 3.75 2.90 3.19 3.25 1.55 1.55 1.99 1.22 1.27 1.26 0.04 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25).5 kg a. i. per ha	2.13	2.60	2.06	2,40	2,30	0.48	92.0	0.25	0.25	0.43
1.60 2.00 1.46 2.00 1.76 0.30 0.81 0.20 0.28 1.00 1.33 1.00 1.26 1.15 0.25 0.43 0.20 0.21 3.16 3.75 2.90 3.19 3.25 1.55 1.99 1.22 1.27 of main plot		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	0.33
3.16 3.75 2.90 3.19 3.25 1.55 1.99 1.22 1.27 of main plot		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
3.16 3.75 2.90 3.19 3.25 1.55 1.99 1.22 1.27	4-D	20 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
1,26 0.04 of main plot 0,25 sub plote	T	Axerage	3.16	3.75	2.90	3,19	3,25	1.55	1.99	1.22	1,27	1.51
plot 0.25	Sub plot	cent for main plots					1,26				-	0.13
	Sub plot	is at the same level		lot			0.25					0.21

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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