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CHEMICAL CONTROL OF GIANT PIGWEED, SESBANIA PEA AND FIERCE THORNAPPLE IN SORGHUM

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SUMMARY

Giant pigweed (*Trianthema portulacastrum*) growing in sorghum (*Sorghum bicolor*) was controlled in the seedling stage by atrazine (2-chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine) at a rate of 0·14 kg ha^{-1}, but plants 5 cm in diameter required a rate of 1·12 kg ha^{-1}. Control of giant pigweed did not increase the yield of sorghum grain.

Sesbania pea (*Sesbania cannabina*) was susceptible to 2,4-D (2,4-dichlorophenoxyacetic acid) at the rate of 0·56 kg ha^{-1}, and atrazine applied post-emergence at a rate of 2·24 kg ha^{-1}. Control of sesbania pea resulted in a yield increase in one experiment.

Fierce thornapple (*Datura ferox*) was controlled by atrazine applied post-emergence at a rate of 1·12 kg ha^{-1}, 2,4-D at a rate of 0·56 kg ha^{-1} and 'Tordon 50-D' which contains picloram (4-amino – 3,5,6-trichloropicolinic acid 50 g l^{-1} and 2,4-D 200 g l^{-1} at a rate of 0·7 l ha^{-1}. The atrazine and 'Tordon 50-D treatment also gave residual control of fierce thornapple plants which germinated later and yield of sorghum grain was increased.

I. INTRODUCTION

Giant pigweed (*Trianthema portulacastrum*), sesbania pea (*Sesbania cannabina*) and fierce thornapple (*Datura ferox*) are common weeds of sorghum (*Sorghum bicolor*) in the Callide Valley and Dawson Valley districts of central Queensland.

Inter-row cultivation of sorghum is uncommon in central Queensland. If the weather remains fine for the first few weeks following planting, the crop can usually compete with any weed growth which may develop later but, if rain falls immediately after planting, weeds may emerge with the crop and offer competition.

Competition from giant pigweed has been shown to reduce yield of sorghum (Thomas, G. A., personal communication) and grower experience suggests that sesbania pea and fierce thornapple also compete with the crop. Heavy growth of sesbania pea interferes with harvest and contamination of sorghum grain by its seeds may reduce market value. Contamination of grain by seeds is the main objection to fierce thornapple in sorghum.

Local observation showed that giant pigweed was resistant to 2,4-D (2,4-dichlorophenoxyacetic acid) but could be controlled by atrazine (2-chloro – 4-ethylamino – 6-isopropylamino – 1,3,5-triazine) applied as a pre-emergence spray at a rate of 2·24 kg ha^{-1}. In exploratory studies, giant pigweed appeared to be susceptible to substantially lower rates of atrazine applied as a post-emergence spray.

Sesbania pea was known to be susceptible to 2,4-D but the optimum rates and times of application were not defined.

'Tordon 50-D' which contains picloram (4-amino – 3,5,6-trichloropicolinic acid) 50 g l^{-1} and 2,4-D 200 g l^{-1} each as the triisopropanolamine salt is recommended for the control of *Datura* spp. in sorghum in Queensland (Rawson *et al.* 1976). Bailey (1964) found that *Datura* spp. can be controlled by atrazine but 2,4-D at 0·56 kg ha^{-1} gave incomplete control.

The purpose of the investigation was to evaluate herbicides to control giant pigweed, sesbania pea and fierce thornapple in sorghum grown in central Queensland.

II. MATERIALS AND METHODS

Management data are given in table 1. Experiment 2 was located at Brigalow Research Station, latitude 24°45′S, longitude 149°50′E on grey to brown heavy clay soil. The other experiments were located at Biloela Research Station, latitude 24°22′S, longitude 150°31′E on alluvial clay loam soil.

Experiments 1 and 2 were situated in areas known to be heavily infested with the nominated weeds. Weed seed was broadcast before planting experiments 3 and 4.

The experimental layouts were randomized blocks replicated four times. Plots were four rows with the middle two rows being used for yield determination. There was no inter-row cultivation.

In experiment 1, hand weeding was carried out concurrently with the first and second post-emergence herbicide treatments, respectively. In the remaining experiments, the hand-weeded controls were maintained in a weed-free condition for the duration of the growing season.

The herbicide sprays were applied through equipment based on an 'Oxford Precision Sprayer', operated by compressed air. The operating pressure was 206 kPa and the spray volume was 273 l ha^{-1} in all situations except experiment 1 where it was 337 l ha^{-1}. Atrazine was applied as 'Gesaprim 50' or 'Gesaprim 80' wettable powder and 2,4-D as 'Farmco D50' dimethylamine salt.

III. RESULTS AND DISCUSSION

1. Giant pigweed (table 2).

Contrary to the findings of Thomas who recorded yield reductions of 29%, giant pigweed competition did not reduce the yield of sorghum grain. A possible explanation is that, at the critical early stage of growth, sufficient soil moisture was available for both crop and weeds. The trial was irrigated for 5 days following planting to encourage giant pigweed germination.

All the stage 1 atrazine treatments gave equivalent weed control to hand weeding but, at stage 2, even the 1·12 kg ha^{-1} rate gave only 84% control. No other treatment gave acceptable control.

The severe yield depression caused by 2,4-D at stage 1 is surprising since the sorghum plants were at the recommended height for spraying (Rawson *et al.* 1976). Possibly the addition of surfactant increased activity, although if this were the case the stage 2 application should also have caused yield depression, since by then the plants exceeded the recommended height for spraying. However, the stage 2 application did result in severe lodging.

TABLE 1
EXPERIMENT MANAGEMENT DATA

Experiment number	1	2	3	4
WEED	giant pigweed	sesbania pea	sesbania pea	fierce thornapple
Sorghum cultivar	Pacific 007	deKalb E57	Alpha	Alpha
Planting date	5 Mar 69	25 Jan 72	17 Jan 73	17 Jan 73
Row spacing (cm)	35·6	71·1	71·1	71·1
Row length (m)	4·6	11·0	12·0	12·0
PRE-EMERGENCE TREATMENTS				
Days from planting			0	0
Temperature 0900 h			26°C	26°C
R.H. 0900 h			66%	66%
Rain preceding 10 days			46 mm	46 mm
Rain following 10 days			6 mm	6 mm
STAGE 1 POST-EMERGENCE TREATMENTS				
Days from planting	14	17	15	20
Temperature 0900 h	26°C	26°C	30°C	28°C
R.H. 0900 h	62%	61%	56%	72%
Rain preceding 10 days	115 mm*	15 mm	6 mm	0
Rain following 10 days	14 mm	115 mm	0	69 mm
Sorghum height	15–23 cm	15–23 cm	15–25 cm	20–23 cm
Weed stage of growth	1 leaf	1 leaf	1–4 leaves	1–4 leaves
STAGE 2 POST-EMERGENCE TREATMENTS				
Days from planting	27	43	36	
Temperature 0900 h	23°C	21°C	27°C	
R.H. 0900 h	42%	74%	67%	
Rain preceding 10 days	14 mm	13 mm	90 mm	
Rain following 10 days	2 mm	0	60 mm	
Sorghum height	30 cm	76–107 cm	60 cm	
Weed stage of growth (first emergence)	dia. 5–15 cm	ht. 30–38 cm 10–12 leaves	ht. 22–42 cm 8–15 leaves	
Weed stage of growth (second emergence)		2–3 leaves	1 leaf	
STAGE 3 POST-EMERGENCE TREATMENTS				
Days from planting		63	50	
Temperature 0900 h		24°C	26°C	
R.H. 0900 h		68%	66%	
Rain preceding 10 days		0	0	
Rain following 10 days		13 mm	24 mm	
Sorghum height		91–107 cm (in flower)	80–90 cm (shot blade)	
Weed stage of growth (first emergence)		ht. 76 cm (in flower)	ht. 80–140 cm (in flower)	
Weed stage of growth (second emergence)		23 cm	15–30 cm	

Leaf numbers refer to the true leaves of giant pigweed and fierce thornapple and the compound leaves of sesbania pea.

* Sprinkler irrigation.

The significant reduction in yield in the atrazine at 1·12 kg ha^{-1} treatments is also unexpected since this was only half the recommended rate. The low yield from 'Tordon 50-D' at 0·7 l ha^{-1} at stage 1 cannot be explained.

In this experiment there was no advantage in using a herbicide and some treatments were clearly detrimental.

TABLE 2

GRAIN YIELD, LODGING AND GIANT PIGWEED POPULATION, EXPERIMENT 1

Treatments	Grain Yield ($kg\ ha^{-1}$)	Lodging (%)	Lodging trans. data *	Giant Pigweed Population at Crop Maturity ($plants\ m^{-2}$)	Giant Pigweed Population at Crop Maturity trans. data **
Stage 1 post-emergence					
2,4–D 0·56 kg ha^{-1}	1 505	36·6	0·65	1·84	1·70
Tordon 50–D 0·7 *l* ha^{-1}	1 953	3·3	0·18	2·38	1·90
Tordon 50–D 1·4 *l* ha^{-1}	2 619	1·7	0·13	2·28	1·86
atrazine 0·14 kg ha^{-1}	2 806	11·0	0·34	0·33	1·97
atrazine 0·28 kg ha^{-1}	2 210	6·5	0·26	0	0·71
atrazine 0·56 kg ha^{-1}	2 436	3·1	0·18	0·15	0·84
atrazine 1·12 kg ha^{-1}	1 939	2·0	0·14	0	0·71
Hand weed control	2 786	1·0	0·10	0·15	0·84
Stage 2 post-emergence					
2,4–D 0·56 kg ha^{-1}	2 529	21·1	0·48	4·35	2·48
Tordon 50–D 0·7 *l* ha^{-1}	2 926	1·9	0·14	6·25	2·94
Tordon 50–D 1·4 *l* ha^{-1}	2 735	26·0	0·53	3·83	2·34
atrazine 0·14 kg ha^{-1}	2 008	6·7	0·26	5·11	2·67
atrazine 0·28 kg ha^{-1}	2 521	4·9	0·22	2·78	2·03
atrazine 0·56 kg ha^{-1}	2 234	0·2	0·05	2·55	1·95
atrazine 1·12 kg ha^{-1}	1 889	8·3	0·29	1·01	1·35
Hand weed control	2 459	6·1	0·25	0	0·71
Untreated control	2 622	1·0	0·10	6·35	2·96
L.S.D. 5%					
From untreated control	641		0·21		0·43
Other comparisons	811		0·26		0·54

* inverse sine transformation.

** square root (x $+\frac{1}{2}$) transformation.

All the spray mixtures contained non-ionic surfactant at a concentration of 1 in 200.

2. Sesbania pea (table 3).

In experiment 2, a sesbania pea population of 28 plants m^{-2} reduced the yield of sorghum grain by 19%. Several of the 2,4-D treatments in experiment 2 appear to have suppressed the sesbania pea plants sufficiently to result in grain yields close to those of the hand-weeded control, although only the stage 2 treatments reduced the number of sesbania pea plants. The stage 1 treatments were applied before the second emergence of sesbania pea and, by stage 3, many of the sesbania pea plants were advanced enough to withstand 2,4-D.

Most of the herbicide treatments in experiment 3 achieved some reduction in the sesbania pea population, but since the weed numbers were small this small reduction in 'weed count' due to herbicide treatment did not result in a significant grain yield increase.

In experiment 3 pre-emergence atrazine was less effective than the post-emergence treatments and this may be explained by degradation of the chemical during 4 weeks of hot, dry weather following application. The very low number of sesbania pea plants following post-emergence atrazine at 2·24 kg ha^{-1} indicates that residual activity controlled the second emergence, about 2 weeks after treatment.

TABLE 3

GRAIN YIELD AND SESBANIA PEA POPULATION, EXPERIMENTS 2 AND 3

Treatments	Grain Yield (kg ha⁻¹)		Sesbania Pea Population at Crop Maturity			
			(Plants m⁻²)		Transformed data*	
	expt 2†	expt 3	expt 2	expt 3	expt 2	expt 3
PRE-EMERGENCE						
atrazine 2·24 kg ha⁻¹		3 578		1·7		3·54
STAGE 1 POST-EMERGENCE						
atrazine 1·12 kg ha⁻¹		3 642		1·0		2·77
atrazine 2·24 kg ha⁻¹		3 650		0·1		0·91
2,4–D 0·14 kg ha⁻¹ ..	1 654		31·3		4·86	
2,4–D 0·28 kg ha⁻¹ ..	1 303	3 474	30·5	3·8	4·81	5·22
2,4–D 0·56 kg ha⁻¹ ..	1 742	3 658	28·8	1·4	4·66	3·20
STAGE 2 POST-EMERGENCE						
2,4–D 0·14 kg ha⁻¹ ..	1 512		17·0		3·62	
2,4–D 0·28 kg ha⁻¹ ..	1 781	3 170	4·7	2·0	2·00	3·78
2,4–D 0·56 kg ha⁻¹ ..	1 746	2 795	0·6	0·7	0·93	2·33
STAGE 3 POST-EMERGENCE						
2,4–D 0·14 kg ha⁻¹ ..	1 612		37·4		5·31	
2,4–D 0·28 kg ha⁻¹ ..	1 663	3 146	37·0	2·3	5·30	4·12
2,4–D 0·56 kg ha⁻¹ ..	1 435	3 306	25·6	0·3	4·41	1·51
Hand weeded control	1 857	3 538	0	0	..	..
Untreated control ..	1 507	3 426	28·4	4·7	4·65	5·79
L.S.D. 5%						
From untreated control ..	283	360			1·20	0·88
Other comparisons ..	327	416			1·39	1·01

* Square root $(x + \frac{1}{2})$ transformation.

† Adjusted for stand variation using covariance analysis.

The post-emergence atrazine spray mixtures contained non-ionic surfactant at a concentration of 1 in 800.

3. Fierce thornapple (table 4).

Experiment 4 was laid down adjacent to experiment 3 and pre-emergence atrazine gave a similar poor performance. All post-emergence treatments controlled fierce thornapple plants over 1 metre tall at crop maturity, these plants would mostly have emerged before application. Only the atrazine and 'Tordon 50-D' treatments had sufficient residual activity to control smaller plants which emerged later.

2,4-D at 0·56 kg ha^{-1} significantly reduced grain yield whereas the same rate in the adjacent sesbania pea trial applied 5 days earlier had no effect. (table 3 stage 1)

A fierce thornapple population of 6 plants m^{-2} reduced the yield of sorghum grain by 31%.

TABLE 4

GRAIN YIELD AND FIERCE THORNAPPLE POPULATION, EXPERIMENT 4

Treatments	Grain Yield (kg ha^{-1})	Thornapple Population at Crop Maturity				
		(Plants m^{-2})	under 1 m		Total	
			(Plants m^{-2})	Transformed data*	(Plants m^{-2})	Transformed data*
PRE-EMERGENCE						
atrazine 2·24 kg ha^{-1}	2 903	1·07	1·04	1·22	2·11	1·51
POST-EMERGENCE						
atrazine 1·12 kg ha^{-1}	3 126	0	0·15	0·51	0·15	0·51
atrazine 2·24 kg ha^{-1}	3 008	0	0	..	0	..
Tordon 50–D 0·7 *l* ha^{-1}	3 440	0·01	0·49	0·92	0·50	0·93
Tordon 50–D 1·4 *l* ha^{-1}	2 845	0	0·06	0·29	0·06	0·29
2,4–D 0·56 kg ha^{-1}	2 512	0	6·14	1·97	6·14	1·97
2,4–D 1·12 kg ha^{-1}	2 462	0	7·04	2·03	7·04	2·03
Hand weeded control	3 509	0	0	..	0	..
Untreated control	2 428	2·08	4·05	1·79	6·13	1·97
L.S.D. 5%						
From untreated control	490	..	..	0·32	..	0·29
Other comparisons	566	..	..	0·36	..	0·34

* Log (x + 1) transformation.

The post-emergence atrazine spray mixtures contained non-ionic surfactant at a concentration of 1 in 800.

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