THE IMPORTANCE OF WEEDS, AND THE CORRECT TIMING OF WEED CONTROL MEASURES, IN MAIZE CROPS

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Summary

Broadleaf weeds are normally troublesome in first and second maize crops after pasture. Grass weeds become prevalent in third and subsequent consecutive crops. Results of three trials which test the chemical control of broadleaf and grass weeds are presented. These result indicate:

(1) The importance of timing chemical applications and weed-free conditions in maize crops.
(2) Broadleaf weeds affect maize production more than grass weeds.
(3) Atrazine and butylate are complementary chemicals.
(4) Cyanazine gives good weed control, but can only be recommended as a pre-emergence weedicide.

The inter-relations between broadleaf and grass weed infestations and the timing of chemical control measures are discussed.

INTRODUCTION

THERE HAS BEEN a marked increase in the area of land planted in maize for grain in the past four years. Much of the land first planted has been continuously cropped for maize.

In 1967 when South Auckland farmers started the present swing to cropping and soils were first turned over for maize, willow weed and cornbind (*Polygonum* spp.), fathen (*Chenopodium album*), black nightshade (*Solanum nigrum*) and *Amaranthus* species were common broadleaf weeds. By the time that the second or the third consecutive crop was planted, three major grass species had become troublesome in the maize crops. These were summer grass (*Digitaria sanguinalis*), barnyard grass (*Echinochloa crus-galli*), and smooth witchgrass (*Panicum dichotomiflorum*).

Early trials (Cumberland *et al.*, 1970) were infested by more broadleaf weeds than grass weeds. And in these trials it was established:

(1) Good weed control increases grain yield.
(2) Chemical weed control can produce higher yields than hand-weeding and inter-row cultivation.
(3) Weed control increases the number of plants surviving to harvest, the average number of cobs per plant and the vigour and height of maize plants.

One of the 1969-70 trials and two trials conducted in the 1970-71 maize season were situated on crops where some grass weeds predominated and these three trials are discussed in this paper.

TECHNIQUE

Trial design and management techniques described by Cumberland *et al.* (1970) for the 1968-69 trials were again employed in the 1970 trials. Table 1 summarizes the site and crop details for the three trials discussed. Rainfall details for the trials are shown in Table 2; 1969-70 was a particularly dry season and little rain fell in November, January or February; 1970-71 was a wet season with rain being heavy on occasions and mostly well spread.

TABLE 1: MAIZE WEED TRIALS

	Trial 1 (*1969-70*)	*Trial 2* (*1970-1*)	*Trial 3* (*1970-1*)
Soil type	Ardmore silty peat	Clevedon silt loam	Ardmore silty peat
Soil organic matter (%)	40	8	40
Maize variety	W563	PX610	PX610
Date seed sown	Nov. 8, 1969	Nov. 2, 1970	Nov. 10, 1970
Grain moisture at harvest (%)	28	29	28
Plant Nos. at harvest per acre	22,000	28,500	28,500

TABLE 2: MONTHLY RAINFALL (INCHES) AND RAINY DAYS (in parentheses)

	Trial 1 (*1969-70*)	*Trial 2* (*1970-1*)	*Trial 3* (*1970-1*)
Oct.	1.60 (6)	1.87 (3)	5.00 (6)
Nov.	2.67 (4)	4.07 (7)	4.39 (6)
Dec.	6.66 (10)	1.25 (1)	3.30 (4)
Jan.	1.74 (4)	1.75 (3)	2.49 (2)
Feb.	0.70 (1)	3.60 (7)	5.07 (10)
Mar.	3.51 (9)	2.10 (2)	2.55 (4)
Apr.	2.77 (7)	6.05 (8)	6.02 (8)

RESULTS

The 1969-70 trial compared eight treatments with atrazine (1 lb) as a "treated control" (all rates in lb a.i. per acre). The treatments and the time of their application, are shown in Table 3. Weed control observations, weed cover and grain yield from this trial are shown. The weeds present on the trial were predominantly summer grass with some barnyard grass, wireweed (*Polygonum aviculare* agg.), willow weed and black nightshade.

The weed control observations show that cyanazine (6 lb) (Treat. 5) and butylate (3 lb) presowing, followed by atrazine (1 lb) (Treat. 9) give the best control of weeds early in December. The late post-emergence application of cypromid (1.5 lb) (Treat. 6) subsequently proved to be very effective in controlling weeds. These three treatments, as well as the atrazine (1 lb) and butylate (2 lb) combination (Treat. 4) have given the highest grain yields.

Atrazine (1 lb) (Treat. 1) used as a control, produced the lowest grain yield. Atrazine and oil, atrazine and propachlor, linuron alone and butylate alone (Treats. 2, 3, 7, 8, respectively) produced grain yields not significantly different from control.

Grain yields were higher from a mixture of atrazine and butylate (Treat. 4) than from atrazine alone (Treat. 1), even though weed control and weed cover results show little difference between the two treatments.

Butylate alone (Treat. 8) has produced less grain than where atrazine was added to and mixed with butylate (Treats. 9, 4). This suggests that butylate and atrazine may interact and are complementary to each other.

Treatments 8 and 9 received butylate (3 lb) on November 5, 1969, before the maize was planted. This chemical was very effective in maintaining the treatments free of grass weeds for three to five weeks. However, the flat weeds, which because of dry conditions were germinating slower in this particular year, then became more dominant. The developing dominance of flat weeds was stopped on Treat. 9 by the application of atrazine (1 lb) on November 26. This removal of flat weeds allowed a subsequent and late germination of grass weeds to develop (with rain in mid-December) and dominate on this treatment at harvest time. Where the late November flat weed development was not curtailed with atrazine (Treat. 8), late germinations of grass weeds did not develop under these conditions, and flat weeds were dominant at harvest.

The effects of Treatments 8 and 9 described, suggest that dense infestations of grass weeds have less effect on the grain yield of maize than a similar infestation of broadleaf weeds. At the time of harvest, Treatment 8 had only 4% of grass weeds and 92% broadleaf weeds. It yielded 58 bushels or 16 bushels less (sig. 5%) that Treatment 9, where there were 75% grass weeds and 7% broadleaf weeds at harvest.

Trial 2, laid down in 1970 on the Clevedon silt loam site, suffered an accident when the area was sprayed with a basal treatment of atrazine (1 lb). The treatments, their time of application, weed control observations and grain yields are shown in Table 4. All plots yielded extremely well and there were few significant differences in terms of grain yields between treatments.

Treatments 4 and 9, both of which received pre-emergence treatments with cyanazine, showed good weed control throughout. However, these treatments and three others (2, 5 and 6) which received post-emergence cyanazine were generally lower yielding (not significant) than other treatments. Phytotoxic symptoms resulting from chemical burning of lower leaves of maize were noted on all post-emergence cyanazine treatments. Grass weeds (notably smooth witchgrass) dominated at harvest on treatments (5, 6, 7, 8, 11) which received post-emergence light rates of atrazine only. Broadleaf weeds (black nightshade) dominated at harvest on other treatments where grass weeds were controlled by pre-plant or pre-emergence applications of cyanazine or butylate.

The third trial compared treatments, similar to those included in the second trial, with an untreated control. The whole trial was relatively weed-free throughout and grain yields were high. Weeds present were summer grass, wire weed and willow weed, with some black nightshade appearing later in the crop's life. The treatments, their time of application, weed control observations and grain yields are shown in Table 5.

Generally, results of this trial were inconclusive. Weeds were not present in important numbers. Both the treatments which received cyanazine as a pre-emergence spray (Treats. 4, 9) produced high grain yields. (Main effects analysis shows pre-emergence cyanazine to be superior (sig. 1%) to control). Where lighter rates of the same chemical were applied post-emergence (Treats. 2, 5, 6), grain yields are lower.

DISCUSSION

It has been widely reported that the timing of herbicide applications, in relation to the stage of development of weeds, and the effectiveness of the chemical is of the utmost importance (Patterson, 1960, 1961; Gregory

TABLE 3: TRIAL 1, ARDMORE SILTY PEAT

Treatment No.	Treatment (lb) 5/11/69	10/11/69	26/11/69	5/12/69	Weed Control* 5/12/69	6/1/70	20/4/70	Harvest Weed Cover % Bare Ground	Grass Weeds	Broadleaf Weeds	Yield (Grain 15% Moisture) (lb/ac)
1			atrazine 1		4 cdBC	2	3	4	90	6	5440 dD
2			atrazine 2 + Oil		7 abcABC	4	5	14	80	6	6550 bcdAB
3			atrazine 1/ propachlor 3		5 bcdABC	4	4	22	54	24	5820 cdB
4			atrazine 1/ butylate 2		4 cdBC	2	4	12	84	4	8540 aA
5		cyanazine 6			9 aA	7	7	48	38	14	7320 abcAB
6				Cypromid 1.5	0 eD	6	8		40	12	7670 abAB
7		linuron 2			5 bcdABC	3	4	17	51	32	5930 cdB
8	butylate 3				3 dC	2	1	4	4	92	5760 cdB
9	butylate 3	atrazine 1			8 abAB CV 36%	4	5	18	75	7	7170 abcAB CV 17.0%

*0-10 scale—0 = no weed control, 10 = good weed control.

TABLE 4: TRIAL 2, CLEVEDON SILT LOAM

Treatment No.	Treatment (lb) 27/10/70	4/11/70	12/11/70	4/12/70	Weed Cover (% Ground) 16/12/70	3/3/71	23/4/71	Dominant Weeds at Harvest	Grain yield (lb/ac)
1	butylate 3		atrazine 1		8	28 abcAB	21	Grass	11,100 abA
2	butylate 3		atrazine 1	cyanazine 2	4	18 bcAB	11	Grass & Broadl.	10,300 abA
3	butylate 3		atrazine 1+1		0	10 cB	5	Broadl.	11,100 abA
4	butylate 3	cyanazine 4	atrazine 1		0	10 cB	5	Broadl.	10,900 abA
5			atrazine 1	cyanazine 2	19	21 abcAB	29	Grass	10,200 bA
6			atrazine 1	cyanazine 1	17	25 abcAB	29	Grass & Broadl.	10,300 bA
7			atrazine 1	Inter-row cultivation	31	43 abAB	38	Grass	11,200 aA
8			atrazine 1+1		29	33 abcAB	43	Grass	11,100 abA
9		cyanazine 4	atrazine 1		0	15 cAB	4	Broadl.	10,800 abA
10			atrazine 1+1 + alachlor 2		0	15 cAB	6	Grass & Broadl.	11,100 abA
11			atrazine 1		27	46 aA Ang. trans	64	Grass	10,400 abA

TABLE 5: TRIAL 3, ARDMORE SILTY PEAT

Treatment No.	Treatment (lb) 5/11/70	12/11/70	23/11/70	Weed Cover* 16/12/70	22/12/70	28/4/71	Grain Yield (lb/ac)
1	butylate 3			3	7	8 aA	9200 bcdAB
2	butylate 3		cyanazine 2	0	2	7 abcABC	9300 abcdAB
3	butylate 3		atrazine 1	1	5	5 cdBC	9200 bcdAB
4	butylate 3	cyanazine 4		1	1	5 dC	10100 abcAB
5			cyanazine 2	1	4	6 bcdABC	9200 bcdAB
6			cyanazine 1.5 + Oil	0	2	6 bcdABC	8700 dB
7			alachlor 4	2	6	8 abAB	9300 abcdAB
8			atrazine 1	2	6	5 cdBC	10400 aA
9		cyanazine 4		0	2	5 dC	10300 abA
10			atrazine 2/alachlor 1	1	2	5 dC	9500 abcdAB
11				4	8	8 abAB	9100 cdAB
						CV 20.2%	CV 8.2%

*0-10 scale, 0 = no weeds, 10 = weeds

and Weiss, 1963; Sumich, 1966; Cumberland *et al.*, 1970; Woon, 1970). However, the trial results presented ohere indicate that, whatever weed control measures are used, it is important to time weed-free conditions in maize crops, so that the crop does not face serious competition at a certain stage in its development.

Research into agronomic aspects of maize tend to indicate the existence of a "critical stage" in the life of a maize plant. This is a time between four and six weeks after emergence when the plants' environment has a major effect on the potential yield of grain from the plant. It may occur at different times in different years, at different sites and possibly exists for only a few hours or, at the most, a few days. It could coincide with cob initiation.

The results of Trial 1 shown in Table 3 are worth examining in light of this theory. It is possible that the "critical stage" occurred about mid-December, in 1969. This was just after the weed infestation observations made on December 12, 1969.

At this time Treatments 8 and 9 were both relatively free of grass weeds but only Treatment 9 was free of flat weeds. Grain yields were consequently higher on Treatment 9.

Along with Treatment 8, Treatments 1, 3 and 7 were less effective and at the critical stage weed competition was severe, and subsequent grain yields low. Treatments 4, 5 and 6 were relatively weed-free at mid-December and high grain yields resulted.

CONCLUSION

(1) The timing of weed-free conditions in maize crops may be as important as the timing of chemical applications to maximize effectiveness of the chemicals and grain yields.

(2) Broadleaf weeds affect grain yields to a greater extent than grass weeds.

(3) Where grass weeds are present in maize, the use of either butylate, alachlor or propachlor in combination with cyanazine or atrazine is indicated (atrazine and butylate appear to be particularly complementary).

(4) Cyanazine gives good control of grass weeds in particular and broadleaf weeds. As a pre-emergence application it also produces high grain yields but as a post-emergence application (probably as a result of phytotoxic burning of the crop) grain yields are adversely affected.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of Field Research staff, for assistance in the field; Chris Dyson (NZDA Biometrics Section) for statistical analyses; farmers for making trial sites available; and L. J. Matthews, for advice and guidance.

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