RESPONSE OF POTATOES, TOMATOES AND KUMARAS TO FOLIAR APPLICATIONS OF MCPA, MCPB, 2,4-D, CLOPYRALID AND AMITROLE

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SUMMARY

Sublethal doses of MCPA, MCPB, 2,4-D, clopyralid and amitrole were applied to kumara, potato and tomato at the mature vegetative to early flowering stage. On potatoes, clopyralid caused severe foliar symptoms at 0.01 kg ai/ha and yield loss down to 0.001 kg ai/ha. MCPA and MCPB at low rates were damaging to both tomatoes and potatoes. 2,4-D had no effect on potatoes, but at 0.1 kg ai/ha reduced yield of tomatoes. Tuber formation in kumaras was prevented by MCPA and 2,4-D down to 0.01 kg ai/ha. Clopyralid and amitrole down to 0.01 kg ai/ha reduced kumara yield. Foliar damage was not necessarily reflected in yield loss of edible parts.

INTRODUCTION

Accidental drift of pasture and brushweed herbicides can cause damage to broadleaf crops growing in the vicinity with an average of 45 cases reported annually in New Zealand (N.Z. Pesticides Board 1987). The potential hazard to sensitive crops is related to many factors, such as weather condition prevailing at time of application, spray droplet size, application rate, the physical properties of the chemical and formulation. Damage from volatile fumes after application of the herbicide is usually not a factor, as the conditions under which this occurs do not often prevail. In New Zealand climatic conditions tend to prevent the build-up of fumes needed to cause damage.

The susceptibility of a crop to the herbicide being applied is also very important. A number of studies have shown broadleaf crops can vary greatly in their sensitivity to a particular herbicide (Lobb and Woon 1983; Smith and Geronimo 1984). These studies showed the degree of damage that can occur from sub-lethal doses of 2,4-D but there is little data on other herbicides such as MCPA, MCPB, clopyralid and amitrole.

Hazards to non-target crops can be minimized by choosing the "safest" herbicide for a particular nearby crop, but strict drift control is still required.

The purpose of these trials was to determine the effects of sublethal doses of MCPA, MCPB, 2,4-D, clopyralid and amitrole on potatoes (*Solanum tuberosum*), tomatoes (*Lycopersicon esculentum* var. *commune*) and kumaras (*Ipomoea batatas*).

METHOD

All trials were carried out at Waireka Research Station, Ivon Watkins-Dow Ltd, New Plymouth.

Herbicide rates applied were chosen to simulate the quantities of herbicide which may be deposited on a non-target crop if drift of these herbicides on to such crops was to occur (Table 1). The range of rates was extended beyond that which would be expected from herbicide drift so as to investigate the dose response of crops to each chemical.

Herbicides were applied as a broadcast treatment over potatoes and tomatoes through Teejet fan nozzles at 250 litres/ha and over kumaras at 200 litres/ha. Crops were treated at the mature vegetative to early flowering stage. Planting and treatment dates together with crop growth stage at treatment are given in Table 2. Climatic conditions at time of treatment were generally fine and calm.

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TABLE 1: Herbicides evaluated

Chemical	Formulation	g ai/litre	Label use rates kg ai/ha
MCPA K salt	IWD MCPA	375	1.0-2.25
MCPB Na salt	IWD MCPB	400	1.6-2.4
2, 4-D butyl ester	Hi Ester 2, 4-D	720	0.5-2.2
clopyralid amine	Versatill	300	0.15-3.0
amitrole amine	Weedazol 4-L	400	1.0-10.0
clopyralid/MCPB ester	Lontrel Pasture	14/500	0.014/0.5-0.028/1.0

TABLE 2: Trial treatment and application summary.

Crop	Potato	Tomato	Kumara
Planting date	2 Sept 85	8 Nov 85	12 Nov 85
Treatment date	30 Oct 85	27 Jan 86	3 Feb 86
Age at treatment (weeks)	8	11	12
Height at treatment (cm)	30	35	40
Growth stage	Vegetative -Flowering	Flowering -Fruit	Vegetative

Trials were designed as a complete randomized block with three replicates. Each replicate was 5 to 7 metres of one crop row. A polymer drift control agent, Nalcotrol, was added to all treatments to minimize drift onto adjacent plots. Visual assessment of crop damage was made by two independent observers within 2 weeks after treatment and again immediately prior to harvest. Potatoes and kumaras were manually picked after lifting with a potato harvester and tomatoes were harvested over seven picks.

TABLE 3: Potato tolerance to herbicides. Percent foliar damage and percent yield reduction compared to untreated (12.1 t/ha).

	DAT	Application Rate (kg ai/ha)					
		1.0	0.5	0.1	0.01	0.001	0.0001
MCPA	F 15	11	21	4	1	1	1
	F 49	17	5	14	5	15	10
	Y 49	22	20	10	22	0	5
MCPB	F 15	8	18	11	1	1	0
	F 49	18	17	14	5	23	17
	Y 49	20	29	12	0	0	10
2, 4-D	F 15	10	7	3	3	0	1
	F 49	15	8	18	14	4	10
	Y 49	0	10	7	0	5	0
CLOPYRALID	F 15	73	42	13	1	1	1
	F 49	73	65	17	14	14	23
	Y 49	63	61	22	22	24	5
MCPB/CLOPYRALID	F 15	21	10	11	1	1	0
	F 49	23	17	25	4	10	14
	Y 49	7	7	5	0	5	2
		L.S.D.(P=0.05)				C.V.%	
	F 15	5				9	
	F 49	5				12	
	Y 49	25				21	

Key to Tables 3, 4, 5

DAT=Days After treatment

F=Foliage - visual assessment

Y=Yield - fresh weight yield of edible portions

RESULTS AND DISCUSSION

Yield data must be viewed with caution. Small harvest size together with localized areas of drought within each trial reduced the significance of results. Nevertheless, trends can be shown from the data obtained.

Potato:

All chemicals caused some visible foliar damage at rates down to 0.0001 kg ai/ha by 49 days after treatment, with a tendency for damage to become more severe as the rate increased (Table 3). Clopyralid caused severe foliar damage at 0.5 and 1.0 kg ai/ha. 2,4-D and MCPB/clopyralid caused only slight yield suppression at all rates as found by Lobb and Woon (1983). At rates similar to that used here, Hemphill and Montgomery (1981) observed slight increases in yield from 2,4-D. Clopyralid/MCPB up to 1.0 kg ai/ha in the ratio of 1:33 caused less than 10% yield reduction compared to MCPB alone at 0.5-0.10 kg ai/ha which caused 20-30% yield reduction. However, this treatment difference was not statistically significant.

Tomato:

MCPA, 2,4-D and clopyralid at rates down to 0.1 kg ai/ha all immediately caused severe leaf symptoms (Table 4). Symptoms persisted for over 7 days at 0.5 kg ai/ha. MCPB caused only minor leaf symptoms. These treatments all showed some yield loss at rates of 0.01-0.1 kg ai/ha and the loss increased with rate to a 40-50% reduction at 1.0 kg ai/ha. Yield loss would most likely have been much greater if chemicals had been applied prior to fruit initiation.

TABLE 4: Tomato tolerance to herbicides. Percent foliar damage and percent yield reduction compared to untreated (21 t/ha).

		Application Rate (kg ai/ha)				
		1.0	0.5	0.1	0.01	0.001
	DAT					
MCPA	F 2	55	53	42	3	0
	F 8	50	45	8	2	0
	Y 5-37	44	45	28	34	8
MCPB	F 2	2	0	2	0	0
	F 8	8	0	1	0	0
	Y 5-37	37	47	17	36	3
2, 4-D	F 2	61	53	39	1	0
	F 8	50	38	8	0	0
	Y 5-37	49	13	29	2	14
CLOPYRALID	F 2	65	65	53	5	0
	F 8	65	58	47	5	0
	Y 5-37	43	4	11	14	-
AMITROLE	F 2	4	0	3	0	1
	F 8	30	38	27	0	0
	Y 5-37	44	46	37	29	28
		L.S.D.(P=0.05)			C.V. %	
		F 2	3		7	
		F 8	2		8	
		Y 5-37	23		33	

Amitrole caused severe leaf symptoms at rates down to 0.1 kg ai/ha although these took 7 days to develop. Amitrole at 0.001 kg ai/ha reduced yield by 30% with yield loss increasing to 45% at 1.0 kg ai/ha. Smith and Geronimo (1984) observed no yield loss of tomatoes from clopyralid at rates up to 0.01 kg ai/ha and only a slight yield loss from 2,4-D up to 0.11 kg ai/ha. Hemphill and Montgomery (1981) observed a similar response to that reported here for tomatoes to 2, 4-D although they found that the percentage of misshapen and potentially unmarketable fruit was high (40%) at rates above 0.07 kg ai/ha.

TABLE 5: Kumara tolerance to herbicides. Percent foliar damage and percent yield reduction compared to untreated (5.4 t/ha)

		Application Rate (kg ai/ha)			
		1.0	0.5	0.1	0.01
	DAT				
MCPA	F 1	47	45	19	0
	F 9	61	50	30	0
	F 77	82	58	11	0
	Y 77	100	96	91	76
2, 4-D	F 1	58	50	20	0
	F 9	75	55	20	0
	F 77	98	90	7	0
	Y 77	100	100	98	61
CLOPYRALID	F 1	0	0	0	0
	F 9	13	17	4	0
	F 77	2	1	4	0
	Y 77	48	22	35	20
AMITROLE	F 1	0	0	0	0
	F 9	45	30	13	0
	F 77	10	0	0	0
	Y 77	21	15	0	20
		L.S.D.(P = 0.05)			C.V. %
		F 1	2		4
		F 9	2		7
		F 77	2		13
		Y 77	30		42

Kumara:

MCPA and 2, 4-D severely reduced yield at rates down to 0.01 kg ai/ha although at this rate there were no foliar symptoms (Table 5). Clopyralid and amitrole caused leaf symptoms at 0.1 to 1.0 kg ai/ha but these had disappeared by harvest. Clopyralid was more damaging than amitrole at higher rates, causing a 50% yield loss at a rate of 1.0 kg ai/ha, although the extent of foliar damage was similar.

CONCLUSIONS

The “safest” chemicals to use as pasture herbicides when potato crops are grown nearby appear to be 2,4-D or clopyralid/MCPB (ratio 1:33). The use of MCPA, MCPB or clopyralid alone should be avoided. Amitrole also appears to be very damaging to potato (Lobb and Woon 1983). The “safest” herbicides to use when tomato crops are nearby are clopyralid or 2,4-D while MCPA, MCPB or amitrole are considerably less safe. Nevertheless, all these chemicals should be used with extreme caution to prevent drift onto tomatoes. Where kumara is the crop, amitrole, or with less safety clopyralid, should be used in preference to MCPA and 2,4-D. Both MCPA and 2,4-D severely reduced kumara yields even at 1% of the recommended label use rate.

The presence or absence of foliar symptoms alone, is not sufficient evidence to determine whether long term damage has been caused to the non-target crop by herbicide drift. Further research is required to determine the effects of herbicide on the quality as well as quantity of crop yields and how these are affected by crop growth stage at treatment.

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