THE DEVELOPMENT OF WEED CONTROL PROGRAMMES IN DRILLED ONIONS

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Summary

The value of residual chemicals for early weed control in onions was assessed in field experiments. On a light soil, propachlor and mixtures of propachlor with chlorpropham or pyrazon and the proprietary mixture of chlorbufam with pyrazon were all effective. Propachlor alone controlled a limited range of weeds but showed some useful activity on organic soil. Although the results of a pot experiment showed that tolerance is limited, field experience suggests that linuron and prometryne can be safely applied post-emergence to onions at 6 oz a.i./acre to follow up earlier residual treatment.

INTRODUCTION

WEEDS present probably the most serious problem in commercial onion growing. The young onion plant is slow in establishing and makes particularly slow growth in the "flag" stage before the emergence of the first true leaf. It is thus a poor competitor at a time when weed emergence is likely to be most rapid. Beyond this period, the crop never attains an abundant foliar canopy and continued protection from weeds is usually necessary for most of the season.

In New Zealand, the onion crop has an important potential export market and the 2,150 acres grown at present (Anon., 1967) is rising steadily. With reliable chemical weed control, the output could expand quickly, especially with modification of row spacing, allowing better land use, which herbicide practices allow.

For a single herbicide treatment to be successful, a chemical, or mixture of chemicals, applied soon after sowing and having season-long residual activity, is required. Neither of the established materials, chlorpropham and allidochlor (CDAA) are sufficiently versatile or persistent to satisfy this requirement.

Alternatively, a herbicide programme can be considered in which continued protection from weeds is achieved by more than one application. To follow contact or short-life residual chemicals, treatments safer than sulphuric acid are needed for use after onion emergence.

Of the several chemicals examined in recent years, propachlor has been reported on favourably (Roberts and Wilson, 1966; Burney, 1966) as also has a commercial mixture of chlorbufam and pyrazon (Cassidy and Doherty, 1964). These are both primarily soil treatments which, although safe to apply after emergence, are generally most effective in the seedbed.

Certain of the substituted ureas and triazines, particularly linuron and prometryne, have shown promise when applied after emergence. Reports of crop damage can usually be attributed to the use of too high doses—1 to 2 lb, especially after heavy rain on light soils (Roberts and Wilson,

1964)—all rates in active ingredient per acre. But effective control of young weeds is possible with these chemicals at doses as low as 6 oz when their soil action under normal spraying practice on all but the lightest soils is unlikely to be important.

The pot experiment reported in this paper examines the effect of linuron, prometryne and metobromuron on young onions. Two field experiments on contrasting soil types compare herbicide programmes making use of this type of treatment after early residual sprays.

ONION POT EXPERIMENT NO. Y458. THE EFFECT OF LINURON, PROMETRYNE AND METOBROMURON ON ONIONS WHEN APPLIED TO EITHER THE FOLIAGE OR THE SOIL

Preliminary tests had shown negligible differences in reaction of two widely grown N.Z. strains, Pukekohe Longkeeper and Yellow Hybrid No. 1, to these herbicides and, to avoid introducing the complication of preventive fungicide spraying, the more disease resistant Yellow Hybrid was used in this experiment. Seed was sown in 4 in. diameter plastic pots in late July, 1967.

In order to provide a soil less chemically absorbent and likely to be more typical of field conditions, the standard J.I.P.2 soil mix was modified to a ratio of 2 parts loam and 1 part sand by volume. Thirty days after sowing, the young plants were thinned to 5 per pot as regular in size and spacing as possible. Herbicide applications were made 12 days later to five replicates when the plants were in the two true-leaf, "post-crook" stage at an average height of 3½ in.

Treatments were applied as follows:

Linuron	....	....	....	6, 12 oz
Prometryne	....	....	....	6, 12 oz.
Metobromuron	....	....	....	12, 18 oz.
Control unsprayed				

Each chemical application was made in two ways

- (1) As a foliar spray (soil protected)
- (2) As a soil drench (without foliar contact)

For applications made to the foliage, the soil in the pot was protected by a ¼ in. layer of sieved and dried peat. This was removed by suction 18 hours later. Chemicals were applied at 30 gal/acre and 25 lb/sq. in., using a modified Chesterford "Mini-log" sprayer, propane powered and fitted with a single "Teejet" flat spray nozzle. Soil treatments were applied by pipette as a drench, 10 ml of solution per pot.

Results are given in Table 1. All treatments had at least a slight effect on the vigour of the plants, though in most foliar applications and some soil treatments this was insignificant. There was a marked reduction in plant growth from the soil drench as compared with the foliar spray in the case of prometryne and metobromuron but not with linuron. At doses which could be expected to give a good kill of emerging weeds under optimum conditions (6 oz of prometryne or linuron, 12 oz of metobromuron) spray applications caused little damage. Whilst this was also the case with higher doses applied as sprays, the more severe damage caused by soil applications of prometryne and metobromuron suggests that linuron gives the greater margin of safety.

TABLE 1: EXPT. NO.Y458. PLANT VIGOUR

Means of three assessments made 10, 18 and 26 days after treatment.
0=death of plants. 5=full vigour.

Treatment (oz)				Foliar	Spray	Soil Drench
linuron	6	....	....	3.46	abA	3.20 bA
linuron	12	....	....	3.60	abA	3.60 abA
prometryne	6	....	....	3.87	abA	3.27 bA
prometryne	12	....	....	3.66	abA	2.13 cB
metobromuron	12	....	....	3.80	abA	2.07 cB
metobromuron	18	....	....	3.27	bA	1.40 cB
Control				4.07	abA	
Control				4.20	aA	
CV				19.0%		

ONION FIELD EXPERIMENTS, NOS. Y460 AND Y461.
TO INVESTIGATE THE POSSIBILITIES OF HERBICIDE SPRAY
PROGRAMMES IN ONION GROWING ON CONTRASTING
SOIL TYPES

Trial sites were obtained at Opiki and Bulls on properties where onions were being grown on a large scale. The soil type of the first trial, No. Y460, was a peat and the second trial, No. Y461, was situated on a light silt loam. Differences in activity were expected from chemicals working through the soil and appropriate dose ranges were chosen to suit both situations. Experimental details are given in Table 2.

TABLE 2: EXPERIMENTAL DETAILS. EXPT. NOS. Y460. Y461

Experiment No.	....	....	....	....	Y460	Y461
Location	....	....	....	....	Opiki	Bulls
Soil type	....	....	....	....	Peat	Ohakea Silt Loam
Soil analysis (%):						
Fine sand	....	....	....	....	13.0	61.3
Coarse sand	....	....	....	....	12.5	1.0
Silt	....	....	....	....	34.3	19.1
Clay	....	....	....	....	33.8	14.7
Loss on solution	....	....	....	....	6.4	3.9
Loss on ignition	....	....	....	....	28.4	5.2
Soil moisture at pre-emergence						
spraying date (%)	....	....	....	....	24.4	12.8
Plot size:						
Width	....	....	....	....	4 ft (3 rows)	6 ft. 4 in. (6 rows)
Length	....	....	....	....	25 ft	25 ft
Onion variety	....	....	....	....	Pukekohe Long Keeper	Rangitikei Red
Date of drilling	....	....	....	....	Sep. 25, 1967	Sep. 21, 1967
Dates of herbicide application:						
Pre-emergence	....	....	....	....	Oct. 2, 1967	Sep. 29, 1967
Post-emergence	....	....	....	....	Nov. 16, 1967	Nov. 2, 1967
Date of harvest	....	....	....	....		Mar. 12-13, 1968

TABLE 3: TREATMENTS APPLIED TO EXPT. NOS. Y460. Y461

<i>Onion Pre-emergence</i>	<i>Onion Post-emergence</i>
paraquat 4 oz/diquat 4 oz	propachlor 4 lb
paraquat 4 oz/diquat 4 oz	chlorbufam 0.8 lb/pyrazon 1 lb
propachlor 4 lb	linuron 6 oz
propachlor 4 lb. granules	linuron 6 oz
propachlor 6 lb	linuron 6 oz
pyrazon 1.5 lb/propachlor 4 lb	—
chlorpropham 1 lb/propachlor 4 lb	—
chlorbufam 0.8 lb/pyrazon 1 lb	linuron 6 oz
chlorbufam 1.2 lb/pyrazon 1.5 lb	linuron 6 oz
chlorbufam 0.8 lb/pyrazon 1 lb	prometryne 6 oz
chlorbufam 1.2 lb/pyrazon 1.5 lb	prometryne 6 oz
chlorbufam 0.8 lb/pyrazon 1 lb	propachlor 4 lb
Control, handweeded	
Control, unweeded	

Note: Mixtures of paraquat and diquat were applied as "Preeglone" and of chlorbufam and pyrazon as "AliceP"

With one exception, the treatments which are listed in Table 3 were applied at 30 gal/acre and 25 lb/sq in. with a propane powered modified Oxford type sprayer (Cox, 1968) fitted with Teejet flat spray nozzles. Propachlor granules were applied using a small hand-operated blower, covering the area twice to increase uniformity of distribution.

Pre-emergence chemical applications were carried out 7 days after drilling at Opiki under fine, warm but quite windy conditions. The soil surface appeared dry but on this absorbent peat soil a high moisture content figure was obtained. No weed seedlings were visible; the onion seed was chitting and emergence began about 1 week later. Post-emergence treatments were applied 52 days after drilling after a week's delay caused by high winds. The onions were then 4 to 5 in. in height, with the 2nd true leaf expanding, and the most competitive weeds—*Polygonum persicaria*, *Chenopodium album* and *Echinochloa crus-galli*—were beginning to grow over the rows.

At Bulls, pre-emergence spraying was carried out 8 days after drilling, one week before emergence, under fine, warm conditions. The soil surface was drying with a moist seedbed beneath. A few cotyledon stage weeds, 2 to 3 per sq.ft, were visible. Post-emergence treatments were applied 42 days after drilling when the onions were 3 to 4½ in. tall with 1½ true leaves expanded. Weeds, mainly *Solanum nigrum* and *Chenopodium album*, also volunteer potato, were approximately 2 in. tall.

WEED CONTROL

Counts were made after pre-emergence chemicals had taken effect. Table 4 summarizes the results obtained from those species present in numbers great enough to give reliable information. Symbols indicate the effectiveness of treatments in terms of reduction in weed numbers and a fairly severe standard is set in assuming that a reduction of less than 50% is of no interest. The margin of safety in time required for paraquat and diquat applications before crop emergence meant that this treatment was ineffective on both sites as few weeds had emerged.

TABLE 4: EXPT. NOS. Y460, Y461. SUMMARY OF WEED COUNTS
AFTER PRE-EMERGENCE TREATMENTS

Reduction in numbers:		90% or more								*							
		75-90%								o							
		50-75%								x							
		no useful effect								xx							
										<i>Expt. No. Y460</i>				<i>Expt. No. Y461</i>			
										<i>Assessed 23 days after Spraying</i>				<i>Assessed 20 days after Spraying</i>			
<i>Treatment (lb)</i>		<i>C.album</i>	<i>S.nigrum</i>	<i>E.crus-galli</i>	<i>A.retroflexus</i>	<i>P.persicaria</i>	<i>C.didymus</i>	<i>Cirsium</i> sp.	<i>Trifolium</i> sp.	<i>C.album</i>	<i>S.nigrum</i>	<i>Trifolium</i> sp.	<i>Rumex</i> sp.				
paraquat ¼/ diquat ¼																	
propachlor 4		xx	x	o	o	xx	o	o	o	xx	xx	xx	xx				
propachlor 4, granules		xx	xx	o	x	x	o	xx	xx	o	o	*	x				
propachlor 6		o	o	*	x	x	xx	o	x	*	*	*	x				
pyrazon 1½/ propachlor 4		xx	x	o	xx	xx	x	x	x	*	*	*	*				
chlorpropham 1/ propachlor 4		xx	x	x	x	x	xx	x	x	*	*	*	*				
chlorbufam 0.8/ pyrazon 1		xx	xx	xx	xx	xx	xx	xx	xx	x	x	x	*				
chlorbufam 1.2/ pyrazon 1½		xx	xx	xx	xx	xx	xx	xx	xx	o	o	o	*				
Unweeded control nos./sq. ft		3.5	3.1	2.9	2.5	0.8	0.5	0.5	0.5	2.8	3.1	0.5	0.8				

The activity through the soil of the remaining chemicals varied greatly on the two sites. On the peat, Expt. No. Y460, only propachlor was effective, but on a limited number of weeds; *E. crus-galli* was notably susceptible. Conflicting results were obtained with *C. didymus*, but otherwise a reasonably good general result was obtained at the higher dose, 6 lb propachlor. The addition of pyrazon, or chlorpropham, to propachlor on this site gave no worthwhile improvement. The chlorbufam and pyrazon mixture was ineffective at both rates of application.

On the light soil, Expt. No. Y461, all residual chemicals were effective. A dose of 4 lb of propachlor was adequate and the addition of pyrazon, or chlorpropham, enhanced the effect. The higher rate was necessary for the proprietary mixture of chlorbufam and pyrazon.

The usefulness of treatments made after crop emergence varied. The residual chemicals (propachlor and chlorbufam/pyrazon) would be effective only if the prior treatment had been successful in preventing weed growth so far. Only chlorbufam/pyrazon, on the light soil and at the higher dose, was reasonably successful in such a combination but even a few surviving weeds which were not controlled by the post-emergence application of propachlor were enough to constitute a problem as the season progressed.

TABLE 5: ONION COUNTS AND YIELDS

(Counts made 5 weeks after pre-emergence treatment and before post-emergence treatment applications)

Treatments		Onion Counts (plants/ft of row)		Yields (tons/ac.)
Pre-emergence	Post-emergence	Expt.No. Y460	Expt.No. Y461	Expt.No. Y461
paraquat 4 oz/diquat 4 oz	propachlor 4 lb	13.1 a	9.6 abABC	*26.3 aAB
paraquat 4 oz/diquat 4 oz	chlorbufam 0.8 lb/pyrazon 1 lb	14.3 a	9.8 abAB	*26.3 aAB
propachlor 4 lb	linuron 6 oz	14.9 a	10.3 aA	27.3 aAB
propachlor 4 lb, granules	linuron 6 oz	14.6 a	8.7 abcABC	27.3 aAB
propachlor 6 lb	linuron 6 oz	15.1 a	8.1 cBC	26.3 aAB
pyrazon 1½ lb/propachlor 4 lb	—	15.5 a	8.2 bcABS	25.7 abABC
chlorpropham 1 lb/propachlor 4 lb	—	14.9 a	9.5 abABC	25.7 abABC
chlorbufam 0.8 lb/pyrazon 1 lb	linuron 6 oz	13.5 a	8.3 bcABC	25.3 abABC
chlorbufam 1.2 lb/pyrazon 1½ lb	linuron 6 oz	13.5 a	7.5 cC	24.7 abcABC
chlorbufam 0.8 lb/pyrazon 1 lb	prometryne 6 oz	15.6 a	8.9 abcABC	26.2 abAB
chlorbufam 1.2 lb/pyrazon 1½ lb	prometryne 6 oz	13.6 a	7.6 cBC	24.8 abABC
chlorbufam 0.8 lb/pyrazon 1 lb	propachlor 4 lb	14.0 a	8.5 bcABC	*23.3 bcBC
Control, hand-weeded		13.3 a	9.4 abABC	26.9 aAB
Control, unweeded		15.1 a	8.8 abcABC	*22.1 cC
CV		13.2%	14.3%	8.5%

*These treatments hand-weeded after weed assessment

Linuron and prometryne, applied as foliar sprays at low doses, are limited in being capable of killing only young weeds. Whilst application at the optimum time was possible at the light soil site, an extended period of bad weather seriously delayed spraying on the peat soil experiment. This trial became weedy and was terminated before harvest.

Treatment combinations which maintained adequate weed control until onion harvest on the light soil, Expt. No. Y461, are listed below; higher rates of residual chemicals did not significantly improve results:

Propachlor 4 lb followed by linuron 6 oz
 Pyrazon 1½ lb, propachlor 4 lb mixture
 Chlorpropham 1 lb, propachlor 4 lb mixture
 Chlorbufam 0.8 lb, pyrazon 1 lb mixture, followed by linuron 6 oz
 Chlorbufam 0.8 lb, pyrazon 1 lb mixture, followed by prometryne 6 oz

CROP TOLERANCE

Plant counts made on the organic soil site showed that no pre-emergence chemical applications caused onion mortality. However, on the light soil some treatment differences occurred and in particular the chlorbufam/pyrazon mixture at the higher dose caused a reduction in plant population. This is shown in Table 5 which also summarizes the final yields obtained on the light soil. Observations of the crop indicated that none of the post-emergence treatments on either site caused plant mortality. Excluding those treatments marked with an asterisk, it can be assumed that any reduction in yield is caused by chemical toxicity. The combination of propachlor 4 lb (either granular or spray) followed by linuron 6 oz gave the best overall result.

CONCLUSIONS

The two contrasting soil types chosen for the field experiments demonstrate well the possibilities and limitations of residual chemicals. On a soil high in organic matter, only propachlor showed any useful residual activity and on a limited range of weeds. Weed control was more easily obtained on the light soil and in this situation propachlor and the mixtures of propachlor with either pyrazon or chlorpropham and the proprietary mixture of chlorbufam with pyrazon all gave good weed control.

The dangers of chemical uptake through the roots of young onions has been shown in the pot experiment. The plant develops a very limited root system and new roots arise, not from branching of older roots, but shallowly from the stem base (Jones and Mann, 1963). It may be that root uptake is as much a hazard as the plant grows older, although work in progress suggests that doses of 6 oz of linuron and probably of prometryne are safe in practice after the first true leaf has attained a length of 3 in. Other chemicals, in particular benzthiazuron, cypromid, carbetamide and GS. 14260, show promise as foliar treatments and these may be particularly useful in further developing spray programmes for onions on organic soils.

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