

# **REPEATED LOW RATE HERBICIDE APPLICATIONS FOR WEED CONTROL IN SCALLIONS**

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# CONTENTS

	<b>Page</b>
<b>Summary.....</b>	<b>1</b>
<b>Introduction.....</b>	<b>2</b>
<b>Methods and materials.....</b>	<b>3</b>
<b>Results.....</b>	<b>4</b>
<b>Discussion.....</b>	<b>11</b>
<b>Conclusions.....</b>	<b>12</b>
<b>Publications.....</b>	<b>13</b>

## SUMMARY

The main objective of this investigation was to determine if satisfactory weed control in vegetable crops (scallions) could be achieved and overall chemical use reduced by very repeated low dose applications of contact and contact residuals herbicides.

The trials showed that scallion crops could tolerate certain post-emergence herbicides better than weed populations earlier in their life cycle provided the first true leaf of the crop had reached 1.5-2cm in length .

Various combinations or cocktails of herbicides of cyanazine, oxyfourfen, ioxynil and gesagard were tested both at Kinsealy and in several commercial locations in Co. Dublin at very low rates varying from 17 to 70g/ha and these were compared with current standard post-emergence recommendation of single rate ioxynil at 0.4-0.7 kg/ha. Each of the cocktail combinations apart from ioxynil and cyanazine produced highly satisfactory weed control when repeated at 7-12day intervals commencing when the first true leaf averaged 2cms long, over a wide range of conditions.

The most effective and satisfactory weed control was achieved from either the oxyflourfen (17-35g/ha) plus cyanazine (35-70g/ha) or the ioxynil(17-35g/ha) plus gesagard (17-35g/ha) combinations. These matched the weed control given by the standard recommended treatment of ioxynil with the advantage of a reduction of up to 50% chemical usage.

## INTRODUCTION

Vegetable production because of scarcity and cost of labour is very dependent on chemicals or herbicides for efficient weed control. Some of the more leafier vegetable crops such as brassicas provide a rapid dense leaf canopy enabling the crop to compete to some extent with weed flushes later in the crop's growing cycle. Onions and scallions however are susceptible to weeds as they offer very little foliage or root competition. A further complication is that these crops are grown on the bed system in relatively close rows making mechanical hoeing difficult. It is known that onion and scallion crops are particularly vulnerable to weed competition earlier on in their cycle from 4-6 weeks after emergence and any competition from then on results in crop loss which will not be made up however good the subsequent weed control is. Weed free crops are also essential for mechanical harvesting of these crops - particularly grass weeds including annual meadow grass (*Poa annua*).

Current recommendations and standard herbicide practice for drilled scallions while depending on weed flora is generally based on two applications of a residual cocktail of propachlor 3 - 4.2 kg/ha + pendimethalin 0.33 - 0.66 kg/ha before and after emergence together with a contact herbicide ioxynil at 0.4 to 0.7 kg/ha depending on severity of weed competition. This offers generally satisfactory weed control except where fumitory (*Fumaria officinalis*) and annual meadow grass (*Poa annua*), fat hen (*Chenopodium album*) and groundsel (*Senecio vulgaris*) predominate.

The main objective of this project was to see if overall herbicide usage could be reduced by very early repeated low dose applications of both contact or contact-residual herbicides including oxyflourfen, ioxynil, cyanazine and gesagard.

Teagasc, Kinsealy wish to thank Mr. J. Rooney, Baldungan, Skerries for his co-operation and assistance in the procurement of trial sites.

## METHODS AND MATERIALS

Trials were carried out at Kinsealy from 1994 to 1997 and also extended to different commercial locations in the country to take account of varying soil and climatic variations. There were four replications in each trial using a randomised design. Herbicides were applied with a Drake & Fletcher sprayer at 40 psi and at 350 l/ha. All treatments received a basic standard pre-emergence application of propachlor at 3.42 kg/ha and pendimethalin at 0.66 kg/ha prior to crop emergence. Ratings of crops and weeds were made continually throughout the season and were compared with both standard recommended chemical treatment controls and also with a post-emergent manual weeding (second control). The standard treatment received a second residual cocktail as above plus ioxynil at 0.4 - 0.7 kg/ha depending on weed pressure. The second control received a single pre-emergence residual cocktail of propachlor plus pendimethalin but no further herbicides, as these plots were subsequently manually weeded.

All the low dosage herbicide combinations were applied when the first true leaf of the scallion crop varied from 1.8 to 3 cm long. The herbicides were applied in dry conditions. The low dosage treatments were repeated two or three times at 7-12 day intervals until satisfactory weed control was judged to have taken place. The need for a second standard residual cocktail application was also assessed on each of these treatments.

Plant counts (stands) and assessment of crop damage and weed control achieved were carried out on all treatments at 3-18 day intervals after application and just prior to harvest on a scale of 1-10 for presentation in results as is standard procedure. Finally at harvest each plant was separately weighed and graded and results statistically analysed.

## RESULTS

Preliminary trials in 1994 at Kinsealy indicated that very low rates of ioxynil, oxyflourfen and cyanazine could be tolerated by scallions once the first true leaf was at least 2.0cm long. The main trials thereafter concentrated on application of small dosage rates when the first true leaf of the crop had expanded to between 2 and 3 cm long. Weeds were very small at this stage also - varying from cotyledon to 1-2 leaf stage depending on the weed species present.

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The first trial was carried out on a medium heavy loam at Kinsealy in 1995. Weed pressure was severe - the main weed species being annual meadow grass (*Poa annua*), fumitory (*Fumaria officinalis*) groundsel (*Senecio vulgaris*) redshank (*Polygonum persicaria*) with smaller amounts of fat hen (*Chenopodium album*) and chickweed (*Stellaria media*).

Very satisfactory results were obtained with all the repeated “mini” or low dose rate applications of the herbicides tested, *Table 1* either alone or in combination. Some combinations such as ioxynil and cyanazine-treatments 1 & 2 required 3 applications to achieve satisfactory weed control while only two applications were required for the other low rate herbicide combinations. The addition of a second standard residual herbicide cocktail marginally improved weed control of all the mini treatments. The final weed control achieved at harvest time with each of the low rate herbicide treatments irrespective whether a second residual herbicide cocktail was used (propachlar 3.4 kg plus pendimethalin 0.66 kg) scored superior to the standard treatment (treatment 13) at harvest.

Where the dosage rate were even further reduced by 50% for the first application these early repeated dosage combination still produced excellent results, *Table 2*.

Except for treatment 1 all the other early herbicide treatments matched yields from the standard treatment and were better than the hand weeded control. No significant differences in crop stands or counts occurred.

Weed control achieved (apart from treatment 1) was excellent with all the ‘mini’ treatments, each producing significantly better weed control at harvest time (August) than either the standard treatment (23) or the hand weeded controls. Most of the mini treatment combination which had the addition of a second residual cocktail consisting of propachlor 3.42kg/ha and pendimethalin

0.66 kg/ha. produced marginally better weed control than the same treatments without this second residual cocktail.

These results show that early repeated mini treatments which had rates reduced by 50% for the first application, did not result in loss of weed control and in the case of the oxyflourfen combinations produced less damage to the crop.

**Table 1:-Effect of thirteen herbicide treatments on yield, stands and weed control of spring sown scallions - 1995**

No.	Treatment	No. apps	Yield t/ha	Stand	Ratings	
	herbicide				July	
					<sup>1</sup> Crop	<sup>2</sup> Weed
1	iox 35g/ha+ cy. 70g/ha	3	18.1	24	9.5	8.5
2	iox 35g/ha+ cy. 70g/ha + *residual cocktail	3	14.3	25	9	9
3	oxy. 33.6g /ha	2	15	21	9.5	8.5
4	oxy. 33.6g/ha + *residual cocktail	2	14.9	21	9.2	8.9
5	oxy. 33.6g/ha + *residual cocktail	2	20.7	22	9.5	8.5
6	oxy. 33.6g/h +iox35g/ha	2	13.6	25	9.4	8.9
7	oxy. 33.6g/ha+iox35g/ha + *residual cocktail	2	17.7	22	9.5	9.1
8	oxy.33.6g/ha+iox 35g/ha + *residual cocktail	2	17.8	22	9.5	8.8
9	oxy. 33.6g/ha+ cy. 70g/ha	2	13.7	25	9.8	8.7
10	oxy. 33.6g/ha+ cy. 70g/ha + *residual cocktail	2	15.7	25	8.9	9.4
11	oxy. 33.6g/ha+ cy. 70g/ha + *residual cocktail	2	20.2	28	9.5	8.9
12	Control hand weeded	-	16.5	23	9.6	9.2
13	Standard treatment iox 500g/ha *residual cocktail	1	11.6	27	9.6	7.8
	<b>f -test</b>		*	NS	**	**
	<b>S.E (df = 57)</b>		<b>1.89</b>	<b>1.86</b>	<b>0.265</b>	<b>0.324</b>

<sup>2</sup>Weed 0 = no control; 10 = 100% control. <sup>1</sup>Crop 0 = 100% damage; 10 = no damage.

\*Residual cocktail: propachlar 3.4kg + pendimethalin 0.66 kg/ha

iox.=ioxylourfen, cy.= cyanazine, oxy.= oxyflourfen

**Table 2:-**Effect of seventeen herbicide treatments on yield, plant counts and weed control of spring sown scallions - Kinsealy 1996.

Treatment		No Apps	Yield t/ha	Plant Counts	Ratings	
No.	herbicide				August	
					<sup>1</sup> Crop	<sup>2</sup> Weed
1	iox. 17.5g + cy. 35g/ha iox. 35g/ha + cy. 70g/ha	1 1	26.4	33.3	9.2	8.6
2	iox. 17.5g/ha + cy. 35g/ha iox. 35g/ha + cy. 70g/ha+ *residual cocktail	1 1	38.6	42	9.8	9.7
3	oxy. 16.8g/ha oxy. 33.6g/ha	1 1	37.6	40	9.7	8.4
4	oxy. 16.8g/ha oxy. 33.6g/ha+ *residual cocktail	1 1	37.0	42.3	9.7	8.7
5	oxy. 16.8g/ha+ iox. 17.5g/ha oxy. 33.5g/ha+ iox. 35g/ha	1 1	37.1	41.7	9.9	9.1
6	oxy. 16.8g/ha+ iox. 17.5g/ha oxy. 33.5g/ha+ iox. 35g/ha + *residual cocktail	1 1	35.9	46.7	9.9	9.9
7	oxy. 16.8g/ha+ cy. 35g/ha oxy. 33.5g/ha+ cy. 70g/ha	1 1	32.3	42.3	9.7	9.3
8	oxy. 16.8g/ha+ cy. 35g/ha oxy. 33.5g/ha+ cy. 70g/ha + *residual cocktail	1 1	31.3	41.3	9.0	9.4
9	iox. 35g/ha+ cy. 70g/ha	2	41.2	38.3	9.9	9.8
10	iox. 35g/ha+ cy. 70g/ha + *residual cocktail	2	30.6	35.7	9.3	9.7
11	oxy. 33.5g/ha	2	36.4	38.7	9.6	9.6
12	oxy. 33.5g/ha+ *residual cocktail	2	31.6	35	9.5	9.8
13	oxy. 33.5g/ha+ iox. 35g/ha	2	36.4	37	9.9	9.9
14	oxy. 33.5g/ha+ iox. 35g/ha + *residual cocktail	2	39.9	37.7	9.7	9.6
15	oxy. 35.5g/ha+ cy. 70g/ha	2	32.2	36.7	9.4	9.3
16	oxy. 35.5g/ha + cy. 70g/ha + *residual cocktail	2	37.9	39.7	9.7	9.8
23	standard treatment iox. 500g/ha + *residual cocktail	1	31.7	38	9.5	8.1
24	hand weeded		27.3	41.5	8.8	9.5
	<b>f - test</b>		NS	NS	*	*
	<b>S.E (df = 50)</b>		3.37	2.25	0.335	0.304

<sup>2</sup>Weed 0 = no control; 10 = 100% control. <sup>1</sup>Crop 0 = 100% damage; 10 = no damage.

Residual cocktail: propachlor 3.4kg + pendimethalin 0.66 kg/ha

iox.= ioxynil, cy.=cyanazine, oxy.=oxyflourfen



Results of autumn sowings in extension trials in Co. Dublin with different weed flora are presented in *Table 3*. As the trial was over wintered and was not harvested until the following April several treatments received a second residual cocktail again in September.

Weed pressure on the scallion crop was severe in this location with particularly high populations of stinging nettle (*Urtica urens*) and chickweed (*Stellaria media*). The first application of the very low rates or 'mini' treatments were applied when the first true leaf was 2 -2.5 cm long in late August. In addition some of these 'minis' (16,18,20) containing oxyflourfen were applied at a slightly later stage to determine if herbicide efficiency could be maintained while further minimising crop injury. These did not perform any better, than the corresponding earlier applied treatments (4,6,8). The high rate main standard treatment of ioxynil (17) at 500g/ha was applied in late September.

The low dosage repeated treatments (2,4,6,8) containing oxyflourfen, cyanazine and ioxynil together with the delayed application treatment (20) and which all received the second residual cocktail of propachlor and pendimethalin produced significantly better weed control than both the hand weeded control (treatment 9) and the standard recommended treatment 17. All treatments significantly controlled stinging nettle with the oxyflourfen proving outstanding when applied early and each gave better control than the later applied main standard treatment (17) - high rate ioxynil. Oxyflourfen alone, however, gave poor control of chickweed but was more effective than ioxynil for groundsel control. Cyanazine gave excellent control as did ioxynil applied as the early low dosages in the combination treatments. Yields from all the low dosage treatments while not significantly better than the hand weeded control, were significantly better than the standard treatment (17).

More severe damage resulted from all treatments receiving oxyflourfen from these autumn applications compared with the earlier summer applications in previous trials. Crops recovered satisfactorily, though more slowly during September/October period.

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The final trial was carried out on an autumn drilled scallion crop on a medium heavy loam in a commercial holding in North Co. Dublin where weed pressure was severe from groundsel (*Senecio vulgaris*), shepherd's purse(*Capsella bursa-pastoris*) and annual meadow grass (*Poa annua*). The various treatments were applied from the end of August to the end of September. In this trial gesagard was added to the range of herbicides, in various low rate combinations.

A very high level of weed control, *Table 4* was achieved right up till harvest time with all the herbicide treatments except for treatment 1, which scored as good as the standard treatment (18). The lowest herbicide dosage treatments (1-7) produced satisfactory weed control though marginally inferior to the main low dosage treatments (8-14) which achieved near 100% weed control at harvest and were superior to the standard treatment (18).

Damage was again most noticeable from the oxyflourfen applications at the 33.6g/ha rate and especially when in combination with the gesagard immediately afterwards. The very low oxyflourfen (17.5g/ha) rates however, were very much less severe on the crops either alone or in combination (treatments 2-5) especially when used with the gesagard. Crop recovery took place slowly during the autumn and was completed by harvest time. Yields from all herbicide treatments were satisfactory but not significantly different from the standard treatment. Herbicide treatments had again no significant effect on plant stand.

**Table 3:-** Effect of thirteen herbicide treatments on yield and weed control of autumn sown scallions 1995-96, Co. Dublin.

Treatment		No apps	Yield t/ha	Ratings		Weed Counts			
No.	herbicide			August		<sup>3</sup> Ch	<sup>4</sup> Gr	<sup>5</sup> Amg	<sup>6</sup> Stg Net
		<sup>1</sup> Crop	<sup>2</sup> Weed						
1	iox. 35g/ha+ cy. 70g /ha.	2	15.3	9.5	9.2	0	2.2	6.5	0
2	iox. 35g/ha cy.70g/ha +*residual cocktail	2	15.0	9.7	9.3	0.5	1.5	6.5	0
3	oxy. 33.6g/ha	2	11.5	9	6.7	9.5	2.5	2.0	0
4	oxy. 33.6g/ha + *residual cocktail	2	17.6	8.9	7.9	8.7	0.7	1.7	0
5	oxy. 33.6g/ha + iox. 35g /ha	2	9.5	9	7.5	5.2	1.0	5	0
6	oxy. 33.6g/ha +iox. 35g/ha *residual cocktail	2	16.9	9.7	9.2	2.7	1.2	6	0
7	oxy. 33.6g/ha + cy. 70g /ha.	2	17	9.5	9.2	0.7	1.5	7	0
8	oxy. 33.6g/ha + cy. 70g /ha.*residual cocktail	2	14.1	9.6	9.7	0.2	0.5	3	0
9	Control hand weeded	-	14.6	9.3	8.1	16.7	5.2	3.5	25.7
16	oxy. 33.6g/ha +*residual cocktail	2	14.2	8.5	7.5	6.2	0.7	2.7	4.2
17	standard treatment iox. 500g /ha + *residual cocktail	-	10.9	9.1	7.8	10.7	2.7	2.7	6.7
18	oxy. 33.6g/ha iox. 35g /ha + *residual cocktail	2	14.9	8.2	8.4	3.7	0	2.2	0
20	cy. 70g/ha + oxy. 33.6g/ha *residual cocktail	2	13.4	9.7	9.5	1	0	0.5	0
<b>f - test</b>			**	*	***	***	*	NS	***
<b>S.E (df = 56)</b>			1.7	0.4	0.451	1.662	1.216	1.842	3.022

<sup>1</sup>Weed 0 = no control: 10 = 100% control. <sup>2</sup>Crop 0 = 100% damage: 10 = no damage.

3 =chickweed 4 = groundsel 5 = annual meadow grass 6 = stinging nettle

- Residual cocktail: propachlor 3.4 kg/ha + pendimethalin 0.66kg/ha

iox.= ioxynil, cy.= cyanazine, oxy. =oxyflourfen

**Table 4:-Effect of fifteen herbicidal treatments on yield, plant counts and weed control of autumn sown scallions - Co Dublin 1996/1997.**

Treatment		No apps	Yield t/ha	Plant Counts	Ratings	
No.	herbicide				October	
					<sup>1</sup> Crop	<sup>2</sup> Weed
1	iox. 17.5g/ha+ cy 35g/ha	2	55.6	26	10	8.7
2	oxy. 16.8g/ha	2	52.4	22.2	10	9.7
3	oxy. 16.8g/ha + iox. 17.5g/ha	2	67.3	21.7	9.8	10
4	oxy. 16.8g/ha+ cy 35g/ha	2	54.5	25.2	9.8	8.9
5	oxy. 16.8g/ha + ges. 17.5g/ha	2	64.5	22.2	9.9	9.4
6	cy 35g/ha+ ges. 17.5g	2	53.1	23.7	10	9.4
7	iox. 17.5g+ ges. 17.5g /ha	2	61.9	25.7	10	9.4
8	iox. 35g/ha+ cy 70g/ha	2	65.4	22.5	10	9.7
9	oxy. 33.6g/ha	2	62	22.0	9.7	9.9
10	oxy. 33.6g/ha + iox. 35g/ha	2	68.4	22.2	9.8	10
11	oxy. 33.6g/ha + cy 70g/ha	2	61.8	22.7	9.9	9.8
12	oxy. 33.6g/ha + ges. 35g/ha	2	51.6	23.0	9.7	9.9
13	cy 70g/ha+ ges. 35g/ha	2	51.5	23.0	10	9.8
14	iox. 35g/ha+ ges. 35g	2	57.6	27.0	9.8	9.6
18	Standard treatment iox. 500g/ha	1	60.8	23.0	10	9.2
19	oxy. 240g/ha	1	66.3	25.7	9.8	8.7
20	Control hand weeded		54.4	23.5	9.7	7.5
	<b>f - test</b>		NS	NS	NS	***
	<b>S.E (df = 60)</b>		7.3	1.54	0.25	0.233

<sup>2</sup>Weed 0 = no control; 10 = 100% control. <sup>1</sup>Crop 0 = 100% damage; 10 = no damage.

iox. = ioxynil, cy. =cyanazine, oxy.= oxyflourfen, ges.= gesagard

## DISCUSSION

Trials using early repeated very low dosage rates of several contact and residual herbicides on scallions which are used universally at relatively higher rates usually in one application were conducted at the Teagasc Research Centre at Kinsealy and in growers commercial holdings in Co. Dublin from 1995-1997. Results over this period showed that for the weed flora occurring in agricultural holdings in Ireland these very early applications proved highly effective in producing a high degree of weed control relatively early in the crops cycle which has been found to be the most critical period for the crop to be weed free.

Oxyflourfen proved to be one of the outstanding herbicides for post-emergence herbicidal activity in all trials. Application rates as low as 17 g/ha of this chemical were very effective applied when the first true leaf of the crop was 2 - 3 cm long. This rate produced less damage to the crop compared with 35 g/ha rates which had been used for the earlier trial applications and had resulted in crop damage which was more severe with autumn applications. These very low rates (17-33g/ha) produced very effective weed control when used in combinations with cyanazine (35 - 70 g/ha), ioxynil (17-35g/ha) or in later trials with gesagard (35-70g/ha) and repeated 7-12 days later with a higher rate oxyflourfen (35 g/ha). Oxyflourfen always produced yellow or chlorotic speckling combined with trophism but crops always recovered provided the first true leaf was at least 2 cm and preferably 2.5 cm.

Where weed pressure was low, these early repeated low dosages provided adequate weed control without the need for a second residual cocktail of propachlor + pendimethalin. This especially applied to the oxyflourfen/cyanazine combination. In some cases where weed pressure was high and where crops sown were over-wintered till the next April a second residual cocktail produced beneficial results. Most of the combinations achieved satisfactory weed control with just two applications but the ioxynil/cyanazine combinations required 2 - 3 applications. For the main range of weed flora found in Ireland the oxyflourfen plus cyanazine combination produced best results over the entire trial period. However where specific weeds were in abundance such as chickweed the ioxynil in combination with the oxyflourfen was effective. There was no significant effect on plant stands in any of the years trials associated with any of the low dosage rate herbicide treatments compared with the standard herbicide treatment. Final yields and quality matched those of the standard treatment also.

## CONCLUSIONS

The main objective of this project was to determine if repeated low dosage applications of herbicides applied early in the crops growing cycle could provide efficient weed control without yield loss and reduce overall quantity of herbicides used. The project assessed several post emergent (mainly contact) herbicides at very low rates either alone or in combination, and determined if these would provide season long efficient weed control to match existing current recommendations. The trials showed the following:-

- The herbicides ioxynil, gesagard, oxyflourfen and cyanazine at very low rates varying from 17 to 70 g/ha could be applied very early in the crops growing cycle when the first true leaf had expanded and grown to 2-3 cm long.
- Highly efficient weed control was obtained with ioxynil, gesagard, oxyflourfen and cyanazine at very low rates (17 to 70 g/ha) when used in combination and repeated twice or three times at 7-12 day intervals.
- The best combinations were two applications of oxyflourfen plus cyanazine and ioxynil plus gesagard. These matched the current standard recommendations of ioxynil at 0.4 - 0.7 kg/ha.
- The above combinations eliminated the need for a normal second residual cocktail application of propachlor at 3.42 kg + pendimethalin at 0.66 kg/ha.
- Overall herbicidal usage was significantly reduced with drilled scallions, with 50% reduction in chemical usage being achieved with the low dosage rates.
- The above results held with both spring and late summer/early autumn sowings.
- Crop selectivity was generally satisfactory, but in the case of oxyflourfen, some damage always resulted though crops recovered and grew satisfactorily. With this product, however, the timing or rates were easily adjusted to offer better crop selectivity.

Results presented in this paper should not be taken as recommendations.

## PUBLICATIONS

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