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HDC Project FV 206

Cauliflower and broccoli – Control of Shepherds purse and other persistent weeds by post emergence herbicides

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AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

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Background and Commercial Objective

Shepherd's purse is a common weed of commercial vegetable crops in the UK and is a particular problem in traditional brassica growing areas. It emerges from February to November and can flower throughout the year. The occurrence of Shepherd's purse in brassica crops has increased due to reliance on pre-emergence herbicides which do not control the weed or have limited persistence. In addition, few contact herbicides are approved for use in cauliflower and other brassica crops (Dacthal W-75 (chlorthal-dimethyl) and Comodor 600 (tebutam) are approved pre-emergence). Crops like cauliflower and broccoli are sensitive to herbicides and weed control options are limited.

Three herbicides that are approved (either full or off-label approval) as contact herbicides for use in some vegetable brassicas are sodium monochloroacetate (SMA), pyridate and cyanazine. All control Shepherd's purse as well as a wide range of other weeds. Lentagran WP (pyridate) for example controls Fat-hen and amaranthus but is only approved for use on Brussels sprouts and cabbage. Croptex Steel (sodium monochloroacetate) has off-label approval in cauliflowers and broccoli. Fortrol (cyanazine) controls a wide range of seedlings pre and post emergence and has off-label approval on cauliflower and broccoli. It can be phytotoxic at its off-label application rate and lower doses need to be investigated. Cyanazine has an 11 week harvest interval which may cause some problems for fast maturing crops, but would make an ideal 'herbicide', if successful, for early summer, late autumn and winter cauliflower etc.

The post-emergence herbicides which are approved for brassicas include Semeron 25WP (desmetryne) (off-label) and Dow Shield (clopyralid) but these do not control shepherd's purse. Both have narrow weed control spectra.

The second year of the trial looked at a late Autumn maturing crop of cauliflower using Croptex Steel at various and split rates and concentrating on the higher rates of Lentagran and Fortrol.

Summary of Results

Results from the two year project indicate that:

1. Croptex Steel can be phytotoxic when used at rates as low as 7 kg/ha as a split dose. Quick maturing crops may suffer yield reduction, whilst slower growing varieties may recover in due course. Quick maturing crops suffered yield reduction at higher rates of application whilst slower growing varieties may recover. As scorch was apparent even at low doses, yields may suffer when these applications are used for summer cauliflower and broccoli, and it

is suggested that growers only use Croptex Steel when the situation warrants such action.

2. Fortrol at 1 l/ha was the most effective herbicide in this trial, controlling Shepherds purse and chickweed (albeit weed numbers were low) and having no phytotoxic effects, when used alone, or following pre-emergence propachlor. Fortrol controls a wide spectrum of weeds including redshank, mayweed, groundsel (with fat-hen being moderately susceptible pre-emergence), dependant on due soil type and application rate.

   Lower rate application of Fortrol did not control weeds quite so well and it is suggested that these are not used in brassica weed control programmes.

3. Lentagran application of 2 kg/ha did not cause scorch and appears safe to use, but did not exhibit the same degree of weed control as Fortrol. Lentagran does, however, have a shorter harvest period.

Action Points for Growers

1. Croptex Steel is an effective herbicide, but may not control Shepherds purse as well as Fortrol. It can be phytotoxic at rates as low as 7 + 7 kg/ha split dose. Yields of quick maturing crops may be reduced. Crops with a longer growing period may recover by harvest. It is suggested that Croptex Steel is only used when absolutely necessary on broccoli and cauliflower, even at low rates.

2. Fortrol is a residual and contact action herbicide. Fortrol at 1 l/ha was the most effective product in this trial combining good weed control with no yield reduction. At this rate, it did not cause any phytotoxic effects. Lower rates of Fortrol may be ineffective.

3. Lentagran controls a range of broad leaved weeds by contact action alone, including fat-hen, a fumitory and groundsel. Lentagran at up to 2 kg/ha appears to be safe to use, but may be as effective as Fortrol.

4. Fortrol and Lentagran are both safe to use (at the rates in this trial), following pre-emergence applications of propachlor.

5. It is not suggested that growers eliminate pre-emergence weed control measures from their programmes, but, where they know there will be a problem with weed control, eg for late autumn or spring heading cauliflower, then Fortrol should be considered. Unpublished work in HRI (J Davies pers comm) has indicated that full rate Fortrol is phytotoxic, this work has shown that rates up to 1 l/ha are safe to use, and exhibit a good degree of weed control.

Practical and Financial Benefits from the Study

The range of herbicides currently available to brassica producers is limited, and alternatives are needed.

The use of Croptex Steel causes crop scorch even at reduced doses, and reduces yield in fast maturing crops. Its use is therefore advised only with caution, or “fire brigade” situations. Croptex Steel controls weeds effectively.

It is accepted that pre-emergence weed control is vital to control a wide range of weed species. However, both Fortrol and Lentagran have some potential as contact brassica herbicides. It is hoped that in due course, Fortrol will have its harvest interval reduced and that full approval is also gained for other brassica crops. Fortrol at 1 l/ha is a relatively low cost option.

Science Section

Introduction

Shepherd's purse is a weed common to brassica growing areas. It flowers throughout the year and its frequency has increased due to:

a. a reliance on pre-emergence herbicides which have no control or limited persistence

b. few contact herbicides being approved for use in cauliflower and other brassica crops

Pre-emergence herbicides suitable for use in brassicas are Ramrod (propachlor) and Butisan (metazachlor). Both chemicals are effective against Shepherd's purse and a wide range of other weeds but their persistence is limited and their effectiveness dependent on soil type and state.

Control of such weeds beyond the effectiveness of the pre-emergence herbicides can be difficult with the restrictions that exist in terms of the range of chemicals with approval and the length of the harvest interval.

The herbicides in this trial are Croptex Steel (sodium monochloroacetate), Lentagran (pyridate) and Fortrol (cyanazine), all with various approval and restrictions on use.

Croptex Steel (sodium monochloroacetate) has off-label approval in cauliflower and broccoli with a maximum dose of 22 kg product per hectare, but only one permitted treatment per crop. Shepherd's purse is susceptible to sodium monochloroacetate (MAFF Booklet 2515 'Weed control in brassicas and root vegetables').

Lentagran (pyridate) is only approved for Brussels sprouts and cabbage with a one month harvest interval. Shepherd's purse is moderately susceptible to this herbicide.

Fortrol (cyanazine) controls a wide range of weeds pre and post emergence, but can be phytotoxic at 2 l/ha. Off-label approval exists for broccoli and cauliflower but the 11 week harvest interval restricts use on fast maturing crops. Shepherd's purse is susceptible to cyanazine. (MAFF Booklet 348 'Bulb Onions').

Following trials in 1997, treatments were amended. These included the addition of lower and split rate Croptex Steel treatments, (as high rates caused phytotoxicity and reduced yields). Similar rates of Lentagran and Fortrol were used. Both of these products exhibited potential, particularly Fortrol.

Materials and Methods

Cauliflower transplants cv Belot F_1 were propagated to a commercial standard and treated with Dursban pre-planting at a spacing of 61 x 61 cm and were transplanted on 18 July, full cultural details are given in Appendix I.

Weed counts on both assessment dates were low, except for plots given no herbicide treatments. Plots sprayed with propachlor as a pre-emergence herbicide

always had lower weed cover scores than plots not receiving this treatment. These scores remained low for the second weed assessment date.

Design and Treatments

A. Pre-emergence treatments
   1. No pre-emergence herbicide
   2. Propachlor @ 9 l/ha in 220 l/ha water

B. Post emergence herbicide treatments
   1. Croptex Steel at 22 kg/ha in 220 l/ha water
   2. Croptex Steel at 11 kg/ha in 220l/ha water
   3. Croptex Steel at 11 kg/ha and 11 kg/ha 14 days later in 220 l/ha water
   4. Croptex Steel at 7 kg/ha and 7 kg/ha 14 days later in 220 l/ha water
   5. Lentagran at 2 kg/ha in 200 l/ha water
   6. Lentagran at 1.5 kg/ha in 200 l/ha water
   7. Fortrol at 1 l/ha in 200 l/ha water
   8. Fortrol at 0.5 l/ha water in 200 l/ha water
   9. Untreated control

Pre-emergence treatments were made on 24 July, 11 days after transplanting. At this stage, plants were almost meeting down the row.

The post-emergence sprays were made on 19 August and 4 September (where appropriate).

Applications were made using a hand held Oxford Precision sprayer at 2 bar pressure with a four nozzle boom and Lurmark 02/F110 nozzles. Conditions at spraying were good, dry with a slight breeze and the soil was moist.

A split plot design in four replicates with pre-emergence herbicide treatment applied to main plots, and post-emergence treatments applied to sub-plots.

Harvest Assessments

The recorded area consisted of the middle two rows of each plot, with 20 plants in each row. The plots were assessed 4 times between 9 December 1998 and 15 January 1999.

Statistical Analysis

Data from the trial were subjected to analysis of variance using Genstat 5. This included information from the harvest assessments and the weed counts. Weed counts were subjected to analysis of variance after log transformation.

Results and Discussion

The crop established well and grew extremely quickly in the early autumn. Cooler than average conditions in November, however, delayed maturity, consequently the crop was harvested into January.

By the second assessment date, the crop had made a very good canopy, and it is likely that this may have suppressed further weed emergence.

Weed Assessments

Percentage weed cover

The percent ground cover was low on both assessment dates, except for plots receiving no herbicide treatments.

However, Fortrol at 1 l/ha had significantly lower cover scores control compared with Croptex Steel at 11 kg/ha and Fortrol at 0.5 l/ha, when no propachlor was used, on the first assessment.

There was no significant difference between contact treatments following pre-emergence propachlor.

On the second assessment, Fortrol at 1 l/ha was particularly effective, as was Croptex Steel applied as at 11 kg/ha, as a repeat application.

Weed counts

Plant numbers of Shepherd's purse, nettle and chickweed were monitored.

There were relatively low numbers of Shepherd's purse seen in the trial, and results should be treated with some caution. However, on the first assessment date, the highest numbers were seen in plots treated with Croptex Steel at 11 kg/ha, Lentagran at 2 kg/ha and the untreated control. This suggests that Fortrol may have better control of Shepherd's purse than both Lentagran and Croptex Steel.

Chickweed was controlled most effectively by Fortrol at 1 l/ha. No other herbicide treatments gave any significant control of this weed.

Most post-emergence herbicides provided significant control of nettle relative to the untreated control by the second assessment, Fortrol at 1 l/ha providing the best control.

Table 1 Percent weed cover on 7 and 28 September

Post-emergence treatment	7 September		28 September	
	No Pre-emergence herbicide	With Pre-emergence herbicide	No Pre-emergence herbicide	With Pre-emergence herbicide
Croptex Steel 22 kg/ha	4.19	1.25	10.19	1.75
Croptex Steel 11 kg/ha	6.94	1.12	8.13	1.44
Croptex Steel 11 + 11 kg/ha	4.44	1.19	3.69	1.06
Croptex Steel 7 + 7 kg/ha	4.31	1.00	5.87	0.88
Lentagran 2 kg/ha	4.44	1.25	5.19	1.00
Lentagran 1.5 kg/ha	4.62	1.50	5.06	1.19
Fortrol 1 l/ha	1.13	0.81	0.87	0.19
Fortrol 0.5 l/ha	5.13	1.06	4.56	0.63
Untreated	18.75	2.81	20.06	2.25
LSD comparing same pre-emergence treatment (48 df) 5%	3.455		0.458	
LSD comparing different pre-emergence treatment (48 df) 5%	4.886		0.648	

Table 2 Number of Shepherd's purse, Chickweed and Annual nettle according to post-emergence treatment (log transform)

Post-emergence treatment	Number of Weeds (log transform)					
	Shepherd's Purse		Chickweed		Annual nettle	
	1st assessment	2nd assessment	1st assessment	2nd assessment	1st assessment	2nd assessment
Croptex Steel 22 kg/ha	(0.818)	(0.494)	2.648	2.315	1.000	0.923
Croptex Steel 11 kg/ha	(0.151)	(0.432)	2.597	2.434	1.060	1.032
Croptex Steel 11 + 11 kg/ha	(0.750)	(0.981)	2.153	1.883	0.930	0.821
Croptex Steel 7 + 7 kg/ha	(0.981)	(0.588)	2.425	2.027	0.700	0.699
Lentagran 2 kg/ha	(0.494)	(0.706)	2.871	2.484	0.960	0.066
Lentagran 1.5 kg/ha	(0.494)	(0.511)	2.804	2.185	1.210	0.811
Fortrol 1 l/ha	(0.818)	(0.750)	0.993	0.207	1.030	(0.425)
Fortrol 0.5 l/ha	(0.656)	(0.656)	2.234	1.632	1.520	0.218
Untreated	(0.357)	(0.323)	2.773	1.784	1.910	1.856
LSD (48 df) 5%	0.458	0.692	0.496	0.589	0.870	0.851

Note: Negative values in parenthesis

Harvest assessments

Harvest assessments indicated no real differences between treatments in yield or quality, although Lentagran at 1.5 l/ha had a low yield, without pre-emergence propachlor. (Table 3) It should be noted that the crop was slow to mature being cut in late December/January, allowing plants to recover from any phytotoxic herbicide treatments.

Table 3 Effect of contact herbicide treatment on total marketable yield (crates/ha) and % Class I heads

Herbicide treatment		No pre-emergence	With pre-emergence	No pre-emergence	With pre-emergence
Croptex Steel	22 kg/ha	2283	2376	64.9	74.7
Croptex Steel	11 kg/ha	2394	2302	68.2	63.5
Croptex Steel	11+11 kg/ha	2153	2135	66.7	69.6
Croptex Steel	7+7 kg/ha	2227	2172	62.7	61.7
Lentagran	2 kg/ha	2320	2246	59.7	65.8
Lentagran	1.5 kg/ha	1986	2246	64.0	70.3
Fortrol	1 l/ha	2227	2190	69.6	73.1
Fortrol	0.5 l/ha	2172	2153	62.9	60.8
Untreated		2153	2227	70.4	68.6
LSD (48 df) 5%		366		13.4	

Data in Table 4, number of days from harvest to planting indicates no difference in time to harvest and length of cutting period between herbicide treatments. The untreated plots however, had the shortest cutting period.

Table 4 Number of days from planting to harvest and length of cut

Post emergence treatment	No. of days to harvest	Length of cutting period
Croptex Steel 22 kg/ha	258.85	29.58
Croptex Steel 11 kg/ha	256.04	30.03
Croptex Steel 11 + 11 kg/ha	258.32	29.89
Croptex Steel 7 + 7 kg/ha	256.44	27.79
Lentagran 2 kg/ha	256.14	29.38
Lentagran 1.5 kg/ha	255.85	28.83
Fortrol 1 l/ha	255.41	27.17
Fortrol 0.5 l/ha	254.90	29.49
Untreated	252.22	23.51
LSD (48 df) 5%	1.62	3.27

Discussion

Although weed numbers, particularly those of Shepherd's purse were low in this trial, extremely useful information has been gained from the second year of the project. Unlike the first year, when relatively quick maturing cauliflower and broccoli crops were grown, a late season cauliflower cv Belot, was used. Following transplanting in a wet year, the crop established extremely well, and before too long had formed a good canopy which in itself would have contributed to weed control.

Phytotoxic effects were seen following all Croptex Steel applications. However, it is likely that the cool, wet autumn which delayed crop maturity, prevented any yield differences becoming evident at harvest. Reductions in yield of cauliflower and broccoli were evident following Croptex Steel application in the previous year's work when quick maturing varieties were grown, as the crop does not have time to recover. As all applications of Croptex Steel in the second year of the project produced scorch, it is suggested that this product is used only when absolutely necessary for these two crops.

Fortrol appears a promising contact herbicide. Evidence suggests it has useful contact action, ie there were low weed counts in the trial, and, it appears to control Shepherd's purse (albeit numbers were low). Data from the project suggest that Fortrol may be more valuable than Lentagran, ie better control, although it is recognised that it has a longer harvest period. The broader spectrum of weeds controlled by Fortrol, and the fact that it acts as a residual and contact herbicide adds to the benefit of this product, compared with Lentagran. Data also shows that Fortrol (and Lentagran) are safe to use either alone, or following a pre-emergence application of propachlor.

Acknowledgements

Thanks are due to Jane Bowtell, and to Andrew Mead for statistical analysis.

APPENDIX

Trial Crop Diary

CROP :		Cauliflower
FIELD/SOIL TYPE :		10 Acres V / Coarse silty marine alluvial
PREVIOUS CROPPING :		1996 – ES Cauliflower, Seed company demo's 1997 – grass
SOIL ANALYSIS :		29/01/98 pH 7.85, P=3, K=2, Mg=3
CULTIVATIONS :		09/02/98 Ploughed
FERTILIZER :	BASE :	13/07/98 100 kg/ha Triple super phosphate 13/07/98 250 kg/ha Sulphate of potash 13/07/98 100 kg/ha Nitram
PLANT :		13/07/98 var Belot
INSECTICIDES :		07/08/98 Aphox @ 420 kg/ha + Toppel 10 @ 250 ml/ha in 600 l/ha water 19/08/98 Aphox @ 420 kg/ha + Toppel 10 @ 250 ml/ha in 450 l/ha water 04/09/98 Aphox @ 420 kg/ha + Toppel 10 @ 250 ml/ha in 600 l/ha water 24/09/98 Aphox @ 420 kg/ha + Toppel 10 @ 250 ml/ha in 600 l/ha water
NOTES :		24/07/98 Brasson @ 9 l/ha in 450 l/ha water 19/08/98 Post-emergence treatments 04/09/98 Post-emergence treatments 07/09/98 Weed count 28/09/98 Weed count 09/12/98 – 15/01/99 Harvest assessments