HGCA

PROJECT REPORT No. OS16

# TANK MIXTURES OF 'FOPS' AND 'DIMS' TO REDUCE HERBICIDE COSTS IN AUTUMN-SOWN OILSEED RAPE

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# TANK MIXTURES OF 'FOPS' AND 'DIMS' TO REDUCE HERBICIDE COSTS IN AUTUMN-SOWN OILSEED RAPE

by

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Contents

Summary

Three experiments were done using winter wheat, grown in pots, to simulate volunteer wheat in an oilseed rape crop. Mixtures of a 'fop' (either Pilot (quizalafop-ethyl) or Fusilade (fluazifop-P-butyl)) and a 'dim' (either Laser (cycloxydim) or Checkmate (sethoxydim) were sprayed on to 2-3 leaf or 1-2 tiller wheat plants which were grown under moisture stress. Pilot did not contribute to the performance of mixtures and therefore in the second and third pot experiments, either Fusilade or Laser were mixed with Checkmate.

The most active mixtures were selected from these pot experiments and applied in one field experiement in December 1994 to a winter oilseed rape field crop infested with volunteer wheat.

Mixtures of Fusilade + Laser at 0.25 + 0.125 or 0.125 + 0.25 l/ha (+ Actipron) or Fusilade + Checkmate at 0.25 + 0.09 l/ha ( + Actipron) gave equivalent control of volunteer wheat to that given by Fusilade or Laser at 0.5 l/ha with savings of £3-5 / ha. Oilseed rape yields were not measured.

Introduction

Synergy between low rates of Checkmate (sethoxydim) and Fusilade (fluazifop P-butyl) has been reported by Harker and O'Sullivan (1991) and an initial experiment at Boxworth confirmed this. In the series of experiments reported here four herbicides were included, two 'fops' (quizalafop-ethyl (Pilot) and fluazifop-P-butyl) and two 'dims' (cycloxydim (Laser) and sethoxydim (Checkmate)). Herbicides from these chemical groups are widely used to control grass weeds in oilseed rape.

Both grass weeds and volunteer cereals can be major problems in many of the areas where oilseed rape is grown. This break crop is used by many farmers as the optimum place in the rotation at which to control grass weeds which are difficult to completely control in cereals.

The objective of this project was to test a range of herbicide mixtures at low doses on winter wheat growing in pots, in particular under conditions of moisture stress, and subsequently to compare the more promising mixtures on volunteer wheat in the field.

## POT EXPERIMENTS

### Materials and methods

Seeds of winter wheat were sown in pots filled with John Innes No. 2 potting compost (Table 1). Plants were then raised in a netted tunnel and watered to keep the soil at around field capacity. Approximately 2-3 weeks (depending upon weather) prior to applying the herbicide treatments the plants were moved into a plastic tunnel where the level of watering was controlled in order to stress appropriate plants.

Table 1. Dates of sowing, spraying and harvesting (pot experiments 1-3).

| | Number of plants | Date of sowing | Date of spraying | Growth stage | Date of assessment |
|---|---|---|---|---|---|
| Expt. 1 | 5 | 20/7/94 | 4/8/94 | GS 12/13 | 17/8/94 |
| | | | 11/8/94 | GS 21/22 | 26/8/94 |
| Expt. 2 | 5 | 17/8/94 | 2/9/94 | GS 12/13 | 10/10/94 |
| | | | 21/9/94 | GS 21/22 | 13/10/94 |
| Expt. 3 | 4-7 | 20/9/94 | 28/10/94 | GS 21/22 | 30/11/94 |

Treatments (see Tables 2,3 and 4) were applied at two growth stages (Table 1) in 200 l water/ha using a hand held sprayer fitted with 02F110 nozzles. All treatments in all experiments were made up in 1% Actipron solution.

The herbicides used, and the unit herbicide costs as defined in the Integrated Farming Systems (HGCA reference 0068/1/91) and TALISMAN projects were:

| Product | Active ingredient | Concentration (l/ha) | Full rate (l/ha) | Cost (£/ha) |
|---|---|---|---|---|
| Checkmate | sethoxydim | 125 | 1.5 | 23.70 |
| Laser | cycloxydim | 193 | 1.0 | 34.18 |
| Fusilade | fluazifop-P-butyl | 200 | 1.0 | 30.79 |
| Pilot | quizalafop-ethyl | 500 | 0.25 | 43.75 |
| Actipron | | | 2.0 | 3.0 |

Fresh or dry weights (24h at 102°C) of above soil portions of plants were measured and analysed using analysis of variance.

Results

Experiment 1.

In Experiment 1 the degree of damage was low from all the herbicide treatments applied at GS12/13 (Table 2). No clear benefits resulted from the mixtures although some mixtures severely damaged plants.

Table 2. Herbicide treatments applied at GS 12/13, dry weights (g) and expressed as % control at assessment (pot experiment 1).

| | Herbicide 1 | Dose | Herbicide 2 | Dose | Dry wt | % control |
|---|---|---|---|---|---|---|
| | | (l/ha) | | (l/ha) | (g) | |
| 1 | Fusilade | 1.5 | | | 0.36 | 3.8 |
| 2 | | 1.125 | | | 0.38 | 0.0 |
| 3 | | 0.75 | | | 0.27 | 27.9 |
| 4 | | 0.375 | | | 0.34 | 8.6 |
| 5 | Pilot | 0.25 | | | 0.36 | 3.7 |
| 6 | | 0.188 | | | 0.48 | 0.0 |
| 7 | | 0.125 | | | 0.40 | 0.0 |
| 8 | | 0.063 | | | 0.38 | 0.0 |
| 9 | Laser | 1.00 | | | 0.35 | 6.5 |
| 10 | | 0.75 | | | 0.37 | 1.1 |
| 11 | | 0.50 | | | 0.31 | 17.8 |
| 12 | | 0.25 | | | 0.34 | 8.1 |
| 13 | Checkmate | 1.50 | | | 0.30 | 19.8 |
| 14 | | 1.125 | | | 0.34 | 9.1 |
| 15 | | 0.75 | | | 0.34 | 9.1 |
| 16 | | 0.375 | | | 0.31 | 17.2 |
| 17 | Fusilade | 0.75 | Laser | 0.25 | 0.36 | 3.7 |
| 18 | | 0.375 | | 0.50 | 0.40 | 0.0 |
| 19 | | 0.375 | | 0.25 | 0.36 | 3.7 |
| 20 | | 0.75 | Checkmate | 0.375 | 0.27 | 27.9 |
| 21 | | 0.375 | | 0.75 | 0.38 | 0.0 |
| 22 | | 0.375 | | 0.375 | 0.34 | 8.6 |
| 23 | Pilot | 0.125 | Laser | 0.25 | 0.33 | 11.8 |
| 24 | | 0.0625 | | 0.5 | 0.36 | 3.7 |
| 25 | | 0.0625 | | 0.25 | 0.30 | 19.8 |
| 26 | | 0.125 | Checkmate | 0.375 | 0.31 | 16.2 |
| 27 | | 0.0625 | | 0.75 | 0.33 | 11.8 |
| 28 | | 0.0625 | | 0.375 | 0.31 | 17.2 |
| 29 | Fusilade | 0.75 | Laser | 0.50 | 0.31 | 17.2 |
| 30 | | 0.75 | Checkmate | 0.75 | 0.38 | 0.0 |
| 31 | Pilot | 0.125 | Laser | 0 50 | 0.32 | 14.0 |
| 32 | | 0.125 | Checkmate | 0.75 | 0.28 | 24.7 |
| 33 | Untreated | | | | 0.37 | |
| | SED | | | | 0.052 | |

It was concluded that dry weights did not show up differences between treatments which were apparent by eye; thereafter, fresh weights were measured. Applied at GS 21/22 treatments were much more active (Table 3). There were no benefits in efficacy from mixtures compared to low rates of the herbicides alone. Conditions were cooler following treatment on 11 August (Appendix 1) and plants were under less extreme stress. When it is very hot the plants cannot take up much water even where there is

adequate moisture available in the soil. The target leaf area will also tend to be smaller when the leaves are under stress.

Table 3. Fresh weights (g) after treatment at GS 21/22 and expressed as % control (pot experiment 1).

| | Herbicide 1 | Dose | Herbicide 2 | Dose | Fresh weight | % control |
|---|---|---|---|---|---|---|
| | | (l/ha) | | (l/ha) | (g) | |
| 1 | Fusilade | 1.5 | | | 1.46 | 81.7 |
| 2 | | 1.125 | | | 1.20 | 85.0 |
| 3 | | 0.75 | | | 1.56 | 80.6 |
| 4 | | 0.375 | | | 2.25 | 72.0 |
| 5 | Pilot | 0.25 | | | 1.76 | 78.1 |
| 6 | | 0.188 | | | 2.32 | 71.1 |
| 7 | | 0.125 | | | * | * |
| 8 | | 0.063 | | | 3.07 | 61.8 |
| 9 | Laser | 1.00 | | | 1.30 | 83.8 |
| 10 | | 0.75 | | | 1.68 | 79.0 |
| 11 | | 0.50 | | | 1.58 | 80.3 |
| 12 | | 0.25 | | | 1.80 | 77.7 |
| 13 | Checkmate | 1.50 | | | 1.98 | 75.4 |
| 14 | | 1.125 | | | 2.45 | 69.5 |
| 15 | | 0.75 | | | 3.60 | 55.2 |
| 16 | | 0.375 | | | 5.81 | 27.7 |
| 17 | Fusilade | 0.75 | Laser | 0.25 | 1.73 | 78.5 |
| 18 | | 0.375 | | 0.50 | 1.33 | 83.5 |
| 19 | | 0.375 | | 0.25 | 1.87 | 76.8 |
| 20 | | 0.75 | Checkmate | 0.375 | 1.53 | 80.9 |
| 21 | | 0.375 | | 0.75 | 1.66 | 79.4 |
| 22 | | 0.375 | | 0.375 | 1.73 | 78.4 |
| 23 | Pilot | 0.125 | Laser | 0.25 | 1.80 | 77.6 |
| 24 | | 0.0625 | | 0.50 | 1.51 | 81.2 |
| 25 | | 0.0625 | | 0.25 | 1.69 | 78.9 |
| 26 | | 0.125 | Checkmate | 0.375 | 2.00 | 75.2 |
| 27 | | 0.0625 | | 0.75 | 2.03 | 74.8 |
| 28 | | 0.0625 | | 0.375 | 2.25 | 72.0 |
| 29 | Fusilade | 0.75 | Laser | 0.50 | 1.60 | 80.1 |
| 30 | | 0.75 | Checkmate | 0.75 | 1.61 | 79.9 |
| 31 | Pilot | 0.125 | Laser | 0.50 | 1.79 | 77.8 |
| 32 | | 0.125 | Checkmate | 0.75 | 1.41 | 82.5 |
| 33 | Untreated | | | | 8.03 | |
| | SED including untreated | | | | 0.799 | |
| | SED excluding untreated | | | | 0.450 | |

* - missing plot.

Experiment 2

In Experiment 2 (Table 4) there was a much steeper dose response for Fusilade at the early growth stage compared to that in Experiment 1. Conditions were also cooler following treatment compared to Experiment 1. Plants from all treatments except Fusilade at 0.063 l/ha and Checkmate at 0.094 l/ha weighed significantly less than untreated (Table 4). At the later application (Table 5) the low rates of both Fusilade and Laser, all rates except the highest rate of Checkmate and the two Checkmate mixtures with 0.063 l Fusilade/ha did not significantly decrease fresh weights compared to the untreated.

Table 4. Herbicide treatments applied at GS 11/12 and fresh weights (g) after treatment and expressed as % control (pot experiment 2).

| | Herbicide 1 | Dose | Herbicide 2 | Dose | Fresh weight | % control |
|---|---|---|---|---|---|---|
| | | (l/ha) | | (l/ha) | (g) | |
| 1 | Fusilade | 0.5 | | | 0.69 | 77.6 |
| 2 | | 0.25 | | | 1.06 | 65.7 |
| 3 | | 0.125 | | | 1.51 | 51.1 |
| 4 | | 0.063 | | | 3.06 | 0.6 |
| 5 | Laser | 0.5 | | | 0.56 | 81.7 |
| 6 | | 0.25 | | | 0.57 | 81.5 |
| 7 | | 0.125 | | | 0.81 | 73.8 |
| 8 | | 0.063 | | | 0.88 | 71.5 |
| 9 | Checkmate | 0.75 | | | 0.57 | 81.6 |
| 10 | | 0.375 | | | 1.17 | 62.1 |
| 11 | | 0.188 | | | 1.49 | 51.5 |
| 12 | | 0.094 | | | 2.71 | 11.9 |
| 13 | Fusilade | 0.125 | Laser | 0.063 | 0.83 | 73.1 |
| 14 | | 0.125 | | 0.125 | 0.60 | 80.6 |
| 15 | | 0.063 | | 0.063 | 1.07 | 65.4 |
| 16 | | 0.063 | | 0.125 | 0.51 | 83.4 |
| 17 | | 0.125 | Checkmate | 0.094 | 0.77 | 75.0 |
| 18 | | 0.125 | | 0.188 | 1.04 | 66.2 |
| 19 | | 0.063 | | 0.094 | 1.94 | 37.0 |
| 20 | | 0.063 | | 0.188 | 0.84 | 72.7 |
| 21 | Pilot | 0.25 | | | 0.60 | 80.4 |
| 22 | | 0.187 | | | 0.54 | 82.4 |
| 23 | | 0.125 | | | 0.52 | 83.2 |
| 24 | | 0.063 | | | 0.68 | 78.0 |
| 25 | Untreated | | | | 3.08 | |
| | SED including untreated | | | | 0.311 | |
| | SED excluding untreated | | | | 0.182 | |

Table 5. Fresh weights (g) at assessment after treatment at GS 21/22 and expressed as % control (pot experiment 2).

| | Herbicide 1 | Dose (l/ha) | Herbicide 2 | Dose (l/ha) | Fresh weight (g) | % control |
|---|---|---|---|---|---|---|
| 1 | Fusilade | 0.5 | | | 3.68 | 37.8 |
| 2 | | 0.25 | | | 3.61 | 39.1 |
| 3 | | 0.125 | | | 4.39 | 25.7 |
| 4 | | 0.063 | | | 5.01 | 15.3 |
| 5 | Laser | 0.5 | | | 2.57 | 56.6 |
| 6 | | 0.25 | | | 2.93 | 50.5 |
| 7 | | 0.125 | | | 3.47 | 41.3 |
| 8 | | 0.063 | | | 4.82 | 18.6 |
| 9 | Checkmate | 0.750 | | | 4.29 | 27.4 |
| 10 | | 0.375 | | | 4.83 | 18.4 |
| 11 | | 0.188 | | | 4.44 | 25.0 |
| 12 | | 0.094 | | | 5.20 | 12.1 |
| 13 | Fusilade | 0.125 | Laser | 0.063 | 2.88 | 51.4 |
| 14 | | 0.125 | | 0.125 | 3.67 | 37.9 |
| 15 | | 0.063 | | 0.063 | 4.53 | 23.5 |
| 16 | | 0.063 | | 0.125 | 2.79 | 52.8 |
| 17 | | 0.125 | Checkmate | 0.094 | 3.71 | 37.3 |
| 18 | | 0.125 | | 0.188 | 3.30 | 44.2 |
| 19 | | 0.063 | | 0.094 | 4.57 | 22.8 |
| 20 | | 0.063 | | 0.188 | 4.91 | 17.1 |
| 21 | Pilot | 0.25 | | | 3.14 | 46.9 |
| 22 | | 0.187 | | | 3.97 | 32.9 |
| 23 | | 0.125 | | | 3.71 | 37.2 |
| 24 | | 0.063 | | | 3.83 | 35.2 |
| 25 | Untreated | | | | 5.52 | |
| 26 | SED including untreated | | | | 0.537 | |
| 27 | SED excluding untreated | | | | 0.508 | |

Experiment 3

Treatments were only sprayed onto plants at GS 21/22 in this experiment and only the lowest rates of Laser at 0.031 and Checkmate at 0.047 failed to reduce plant weight significantly compared to the untreated (Table 6).

Table 6. Herbicide treatments and fresh weights/plant (g) at assessment after treatment at GS 21/22 and expressed as % control (pot experiment 3).

| | Herbicide 1 | Dose | Herbicide 2 | Dose | Fresh weight | % control |
|---|---|---|---|---|---|---|
| | | (l/ha) | | (l/ha) | (g) | |
| 1 | Fusilade | 0.5 | | | 0.36 | 64.7 |
| 2 | | 0.25 | | | 0.39 | 62.5 |
| 3 | | 0.125 | | | 0.47 | 54.6 |
| 4 | | 0.063 | | | 0.71 | 31.2 |
| 5 | | 0.031 | | | 0.82 | 19.8 |
| 6 | Laser | 0.5 | | | 0.37 | 63.8 |
| 7 | | 0.25 | | | 0.34 | 66.6 |
| 8 | | 0.125 | | | 0.45 | 56.6 |
| 9 | | 0.063 | | | 0.57 | 44.9 |
| 10 | | 0.031 | | | 1.20 | 0.0 |
| 11 | Checkmate | 0.75 | | | 0.34 | 67.0 |
| 12 | | 0.375 | | | 0.30 | 70.7 |
| 13 | | 0.188 | | | 0.65 | 36.8 |
| 14 | | 0.094 | | | 0.76 | 26.3 |
| 15 | | 0.047 | | | 1.17 | 0.0 |
| 16 | Fusilade | 0.25 | Laser | 0.031 | 0.44 | 57.3 |
| 17 | | 0.25 | | 0.063 | 0.41 | 60.4 |
| 18 | | 0.25 | | 0.125 | 0.38 | 63.4 |
| 19 | | 0.25 | | 0.25 | 0.30 | 71.3 |
| 20 | | 0.25 | Checkmate | 0.047 | 0.40 | 61.4 |
| 21 | | 0.25 | | 0.094 | 0.43 | 57.9 |
| 22 | | 0.25 | | 0.188 | 0.41 | 60.0 |
| 23 | | 0.25 | | 0.375 | 0.42 | 58.7 |
| 24 | | 0.125 | Laser | 0.031 | 0.53 | 48.6 |
| 25 | | 0.125 | | 0.063 | 0.42 | 59.6 |
| 26 | | 0.125 | | 0.125 | 0.39 | 61.9 |
| 27 | | 0.125 | | 0.25 | 0.44 | 57.1 |
| 28 | | 0.125 | Checkmate | 0.047 | 0.46 | 55.3 |
| 29 | | 0.125 | | 0.094 | 0.52 | 49.6 |
| 30 | | 0.125 | | 0.188 | 0.57 | 44.7 |
| 31 | | 0.125 | | 0.375 | 0.45 | 56.0 |
| 32 | Untreated | | | | 1.03 | |
| | SED including untreated | | | | 0.086 | |
| | SED excluding untreated | | | | 0.063 | |

Conclusions from pot experiments

Due to the extremes of weather experienced during these three pot experiments, it was difficult to draw clear conclusions. Pilot did not to contribute significantly to the mixtures and was not included in subsequent field experiments. Hence the range of treatments for the field experiment was based on mixtures of Fusilade ( a 'fop') with

either Laser or Checkmate ('dims') and doses selected on the basis of the pot experiment results.

## FIELD EXPERIMENT

### Materials and methods

Oilseed rape cv. Bristol was drilled on 25 August 1994 (site details in Appendix 2). Herbicide treatments (Table 7) were applied on 16 and 20 December 1994 using the same hand-held sprayer as used for the pot experiments. Spraying was discontinued on 16 December due to an increase in wind speed. The treatments applied on this date were Fusilade at 0.25 l/ha + either Laser at 0.0625, 0.125, 0.25 or Checkmate at 0.094, 0.188, 0.375 l/ha.

Plots were scored for vigour of volunteer wheat 3, 5, 10, 12 and 15 weeks after treatment, the last date being when it was impossible to distinguish the wheat beneath the oilseed rape canopy. A score of 9 represented no effect and a score of 0 indicated that plants were dead. The scores on 29 March were analysed using analysis of variance (Table 7) and the results of some of the more active mixtures are compared graphically with doses of component herbicides which resulted in good control (Table 8, Figures 3-13).

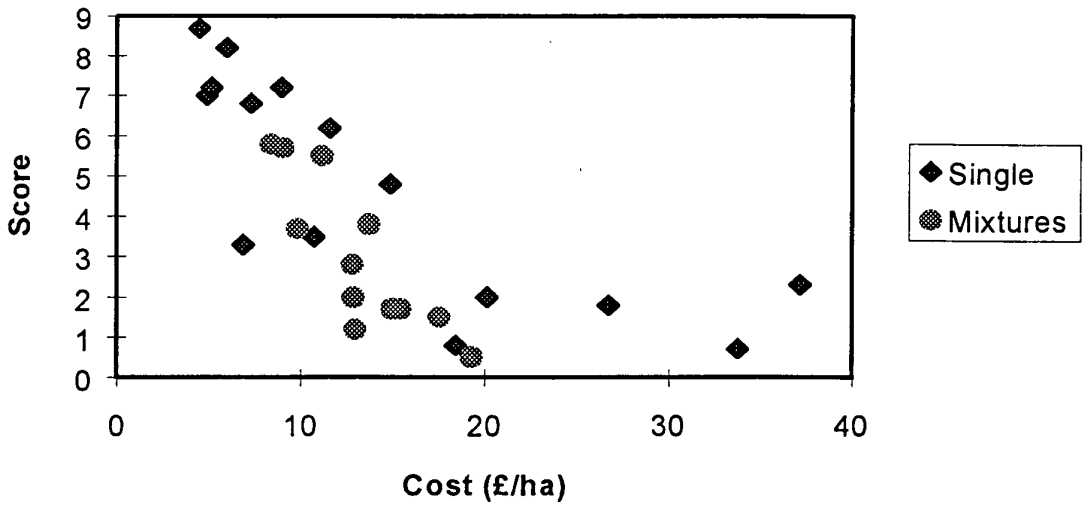
Results

Table 7. Herbicide treatments applied at GS 21/22 and scores for damage to volunteer wheat in the field experiment.

| | Herbicide 1 | Dose | Herbicide 2 | Dose | Final score | Cost |
|---|---|---|---|---|---|---|
| | | (l/ha) | | (l/ha) | | (£/ha) |
| 1 | Fusilade | 1.0 | | | 0.7 | 33.79 |
| 2 | | 0.5 | | | 0.8 | 18.39 |
| 3 | | 0.25 | | | 3.5 | 10.69 |
| 4 | | 0.125 | | | 3.3 | 6.80 |
| 5 | | 0.063 | | | 7.0 | 4.92 |
| 6 | Laser | 1.0 | | | 2.3 | 37.18 |
| 7 | | 0.5 | | | 2.0 | 20.09 |
| 8 | | 0.25 | | | 6.2 | 11.55 |
| 9 | | 0.125 | | | 6.8 | 7.27 |
| 10 | | 0.063 | | | 7.2 | 5.14 |
| 11 | Checkmate | 1.5 | | | 1.8 | 26.70 |
| 12 | | 0.75 | | | 4.8 | 14.85 |
| 13 | | 0.375 | | | 7.2 | 8.93 |
| 14 | | 0.188 | | | 8.2 | 5.96 |
| 15 | | 0.094 | | | 8.7 | 4.48 |
| 16 | Fusilade | 0.25 | Laser | 0.063 | 2.0 | 12.83 |
| 17 | | 0.25 | | 0.125 | 1.7 | 14.97 |
| 18 | | 0.25 | | 0.25 | 0.5 | 19.25 |
| 19 | | 0.25 | Checkmate | 0.09 | 1.2 | 12.93 |
| 20 | | 0.25 | | 0.19 | 3.8 | 13.65 |
| 21 | | 0.25 | | 0.375 | 1.5 | 17.48 |
| 22 | | 0.125 | Laser | 0.063 | 5.7 | 8.99 |
| 23 | | 0.125 | | 0.125 | 5.5 | 11.12 |
| 24 | | 0.125 | | 0.25 | 1.7 | 15.39 |
| 25 | | 0.125 | Checkmate | 0.09 | 5.8 | 8.33 |
| 26 | | 0.125 | | 0.19 | 3.7 | 9.81 |
| 27 | | 0.125 | | 0.378 | 2.8 | 12.78 |
| | SED | | | | 1.28 | |

The graphical comparison between final score and cost/ha (Figure 1) shows a good correlation between final score and mixture cost but a levelling off of the response at the higher costs of the herbicides alone.

Figure 1. Cost versus final score of data in Table 7.

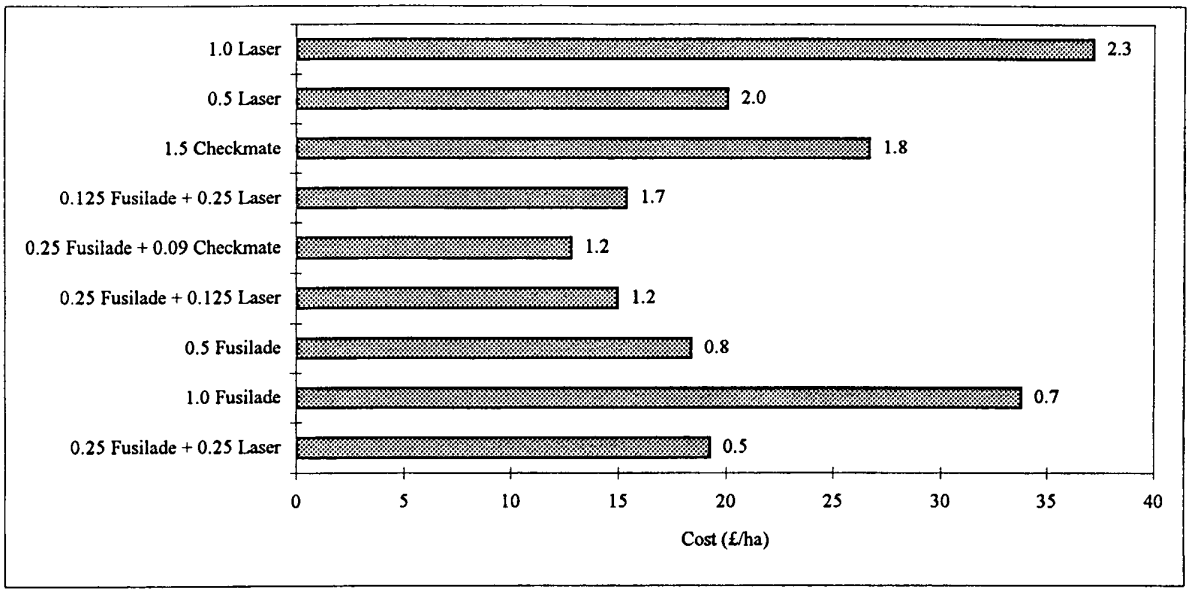



None of the final scores (Table 8) were significantly different from each other and the graphical presentation (Figure 2) shows clearly the large differences in cost/ha of treatments which gave comparable levels of control.

Table 8. Costs of treatments (£/ha) and final scores for effects on 29 March 1995.

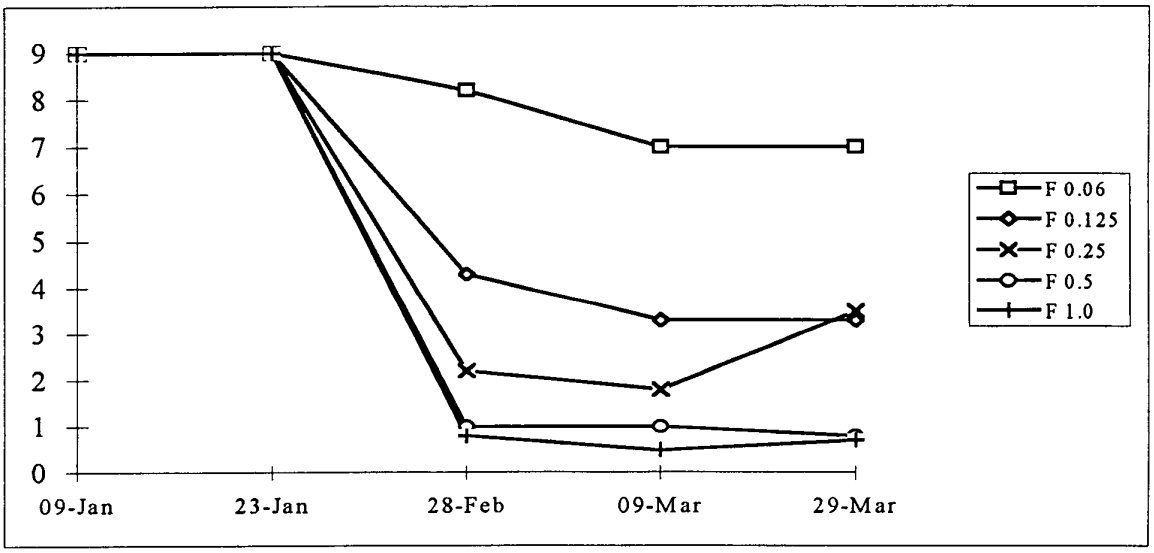
| Treatment | Dose | Cost including Actipron | Final score |
|---|---|---|---|
| Fusilade | 0.5 | 18.39 | 0.8 |
| Fusilade | 1.0 | 33.79 | 0.7 |
| Laser | 0.5 | 20.10 | 2.0 |
| Laser | 1.0 | 37.18 | 2.3 |
| Checkmate | 1.5 | 26.70 | 1.8 |
| Fusilade+Laser | 0.25+0.25 | 19.25 | 0.5 |
| Fusilade+Laser | 0.25+0.125 | 14.97 | 1.2 |
| Fusilade+Laser | 0.125+0.25 | 15.39 | 1.7 |
| Fusilade+Checkmate | 0.25+0.09 | 12.83 | 1.2 |

Figure 2. Histogram of cost (£/ha) versus activity (score for efficacy) as in Table 8.



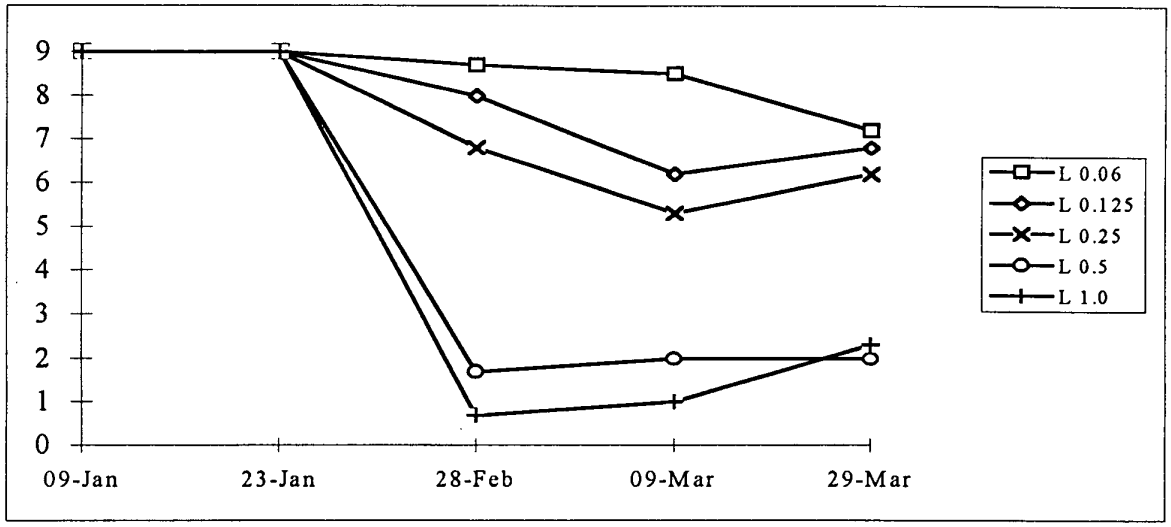

Fusilade at 0.5 l/ha (half recommended rate) gave good control of volunteer wheat whereas there was some recovery from 0.25 l/ha (Figure 3).

Figure 3. The effect of Fusilade applied at a range of rates (l/ha) to winter oilseed rape.



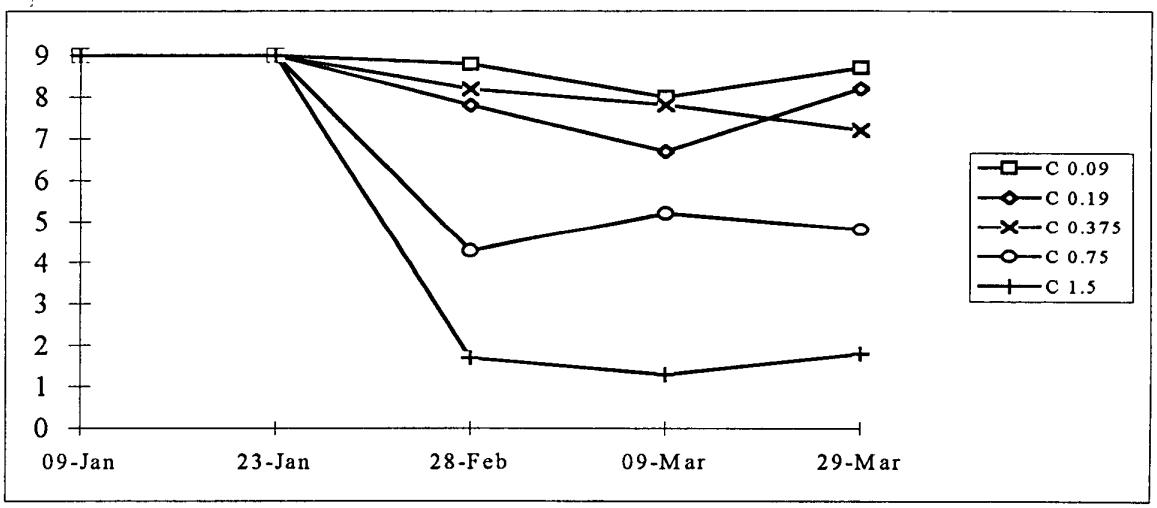
Laser at 0.5 l/ha (half recommended rate) gave good control of volunteer wheat (Figure 4).

Figure 4. The effect of Laser applied at a range of rates (l/ha) to winter oilseed rape.



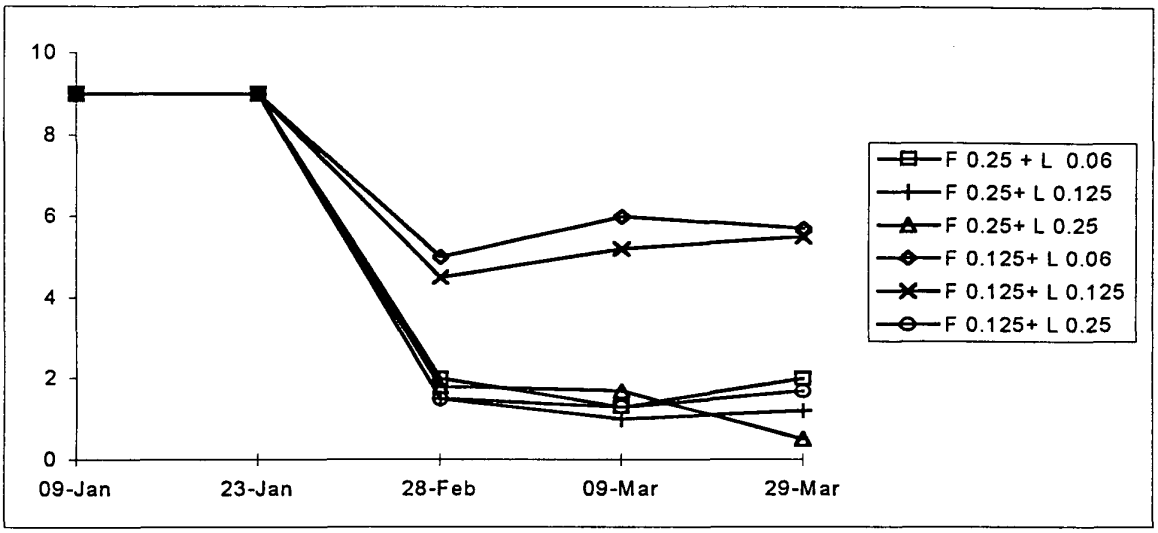

The full rate of Checkmate (1.5 l/ha) was required to give adequate control of the volunteer wheat (Figure 5).

Figure 5. The effect of Checkmate applied at a range of rates (l/ha) to winter oilseed rape.



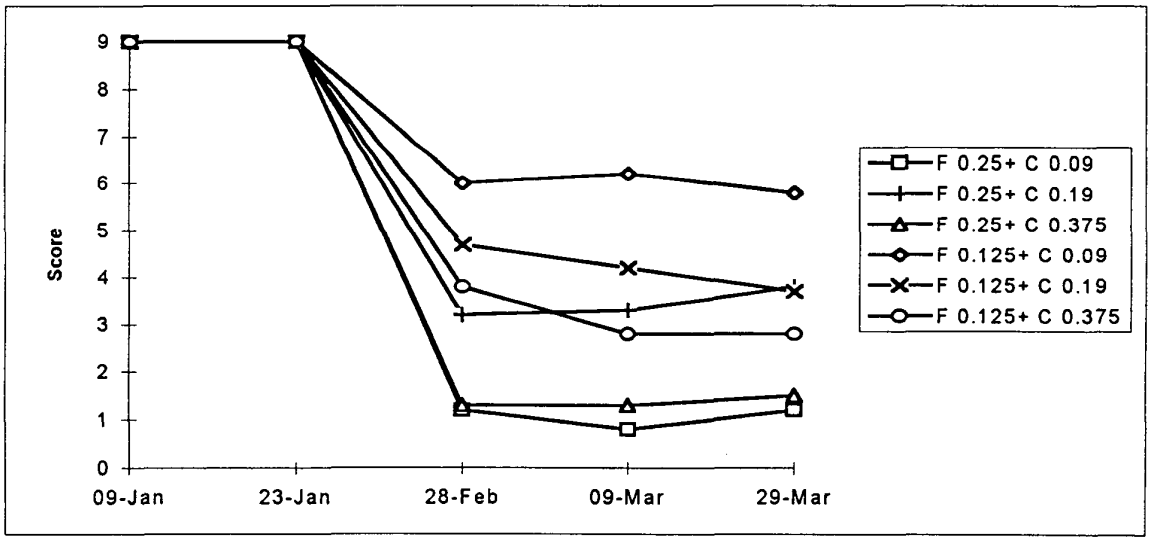
In order to give good control of volunteer wheat with the mixtures, it was necessary to include 0.25 l/ha of either Fusilade or Laser (Figure 6).

Figure 6. The effect of Fusilade + Laser applied at a range of rates (l/ha) to winter oilseed rape.



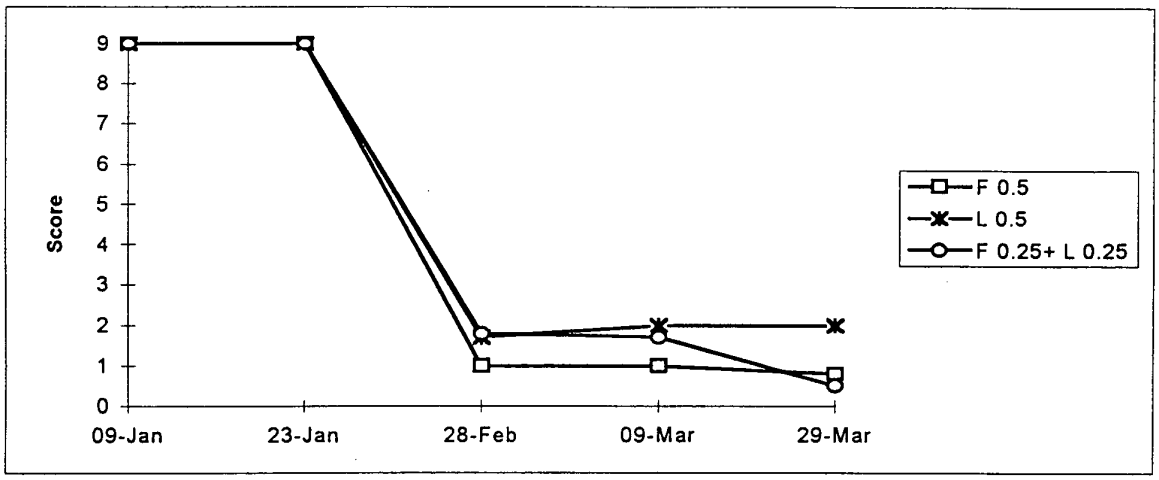

It was necessary to include 0.25 l Fusilade/ha in the mixtures with Checkmate to achieve good control (Figure 7).

Figure 7. The effect of Fusilade + Checkmate applied at a range of rates (l/ha) to winter oilseed rape.



The mixture of Fusilade + Laser, each at 0.25 l/ha, gave comparable control of wheat compared with 0.5 l/ha of either Laser or Fusilade (Figure 8).

Figure 8. The effect of Fusilade, Laser and a mixture of the two applied to winter oilseed rape.




The mixture of 0.25 l Fusilade + either 0.125 l (Figure 9) or 0.06 l Laser/ha (Figure 10) gave comparable control to that from 0.5 l/ha of either component alone.

Figure 9. The effect of Fusilade, Laser and a mixture of the two applied to winter oilseed rape.

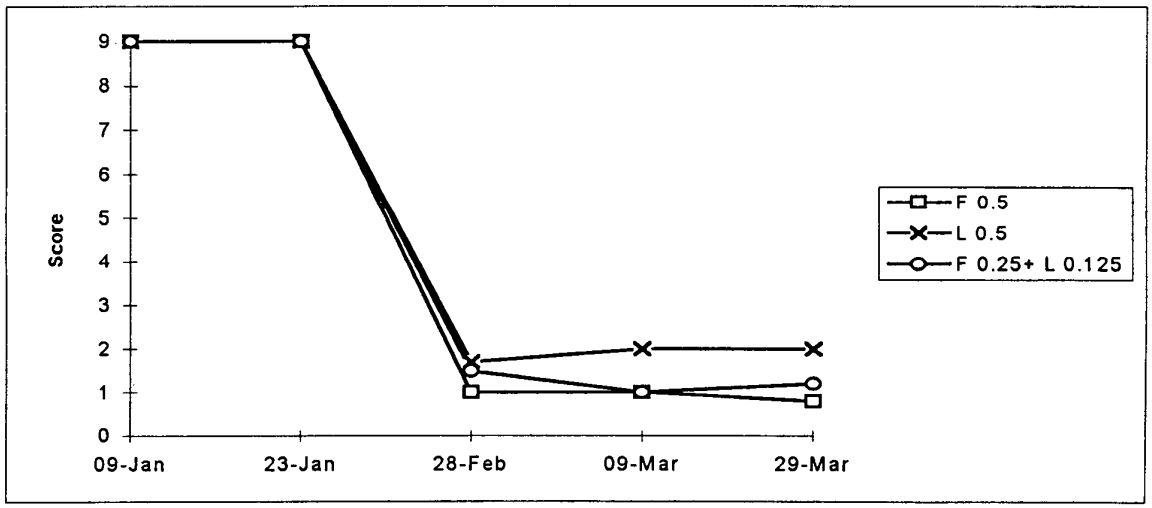
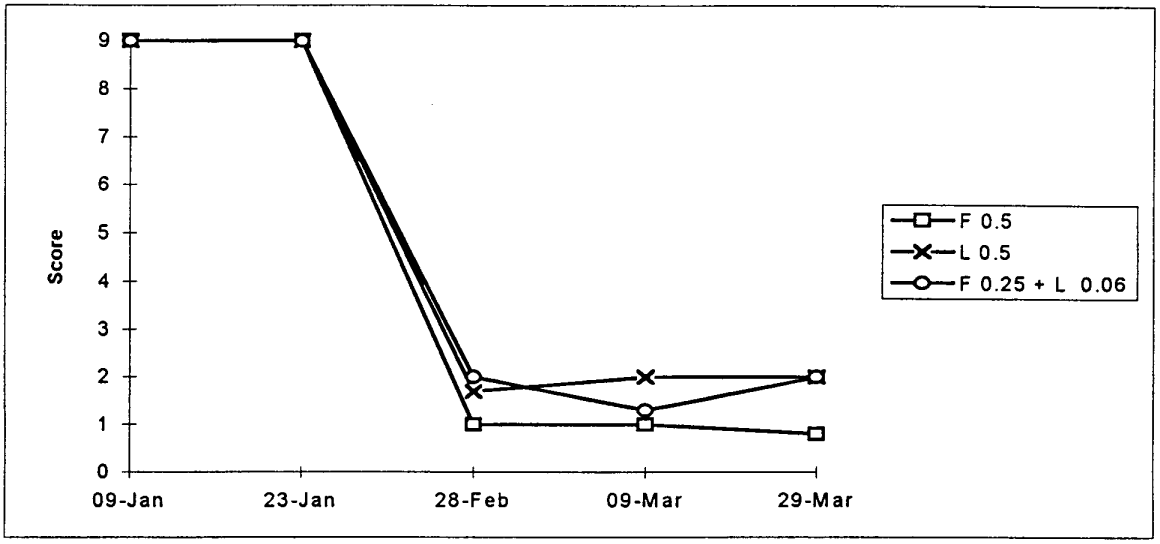
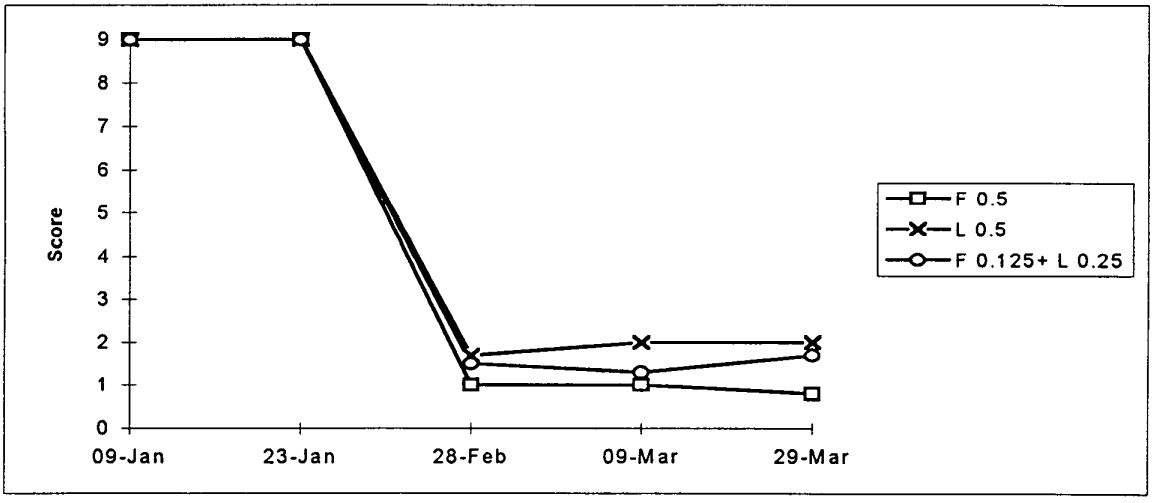


Figure 10. The effect of Fusilade, Laser and a mixture of the two applied to winter oilseed rape.




The mixtures of 0.1251 Fusilade/ha + Laser at 0.25 l/ha gave comparable control to either Fusilade or Laser at 0.5 l/ha (Figure 11).

Figure 11. The effect of Fusilade, Laser and a mixture of the two applied to winter oilseed rape.



The low rates of Checkmate added to Fusilade at 0.25 l/ha (Figure 12) or 0.125 l/ha (Figure 13) gave comparable control of wheat to that from Fusilade at 0.5 l/ha or the full rate of Checkmate alone.

Figure 12. The effect of Fusilade, Checkmate and a mixture of the two applied to winter oilseed rape.

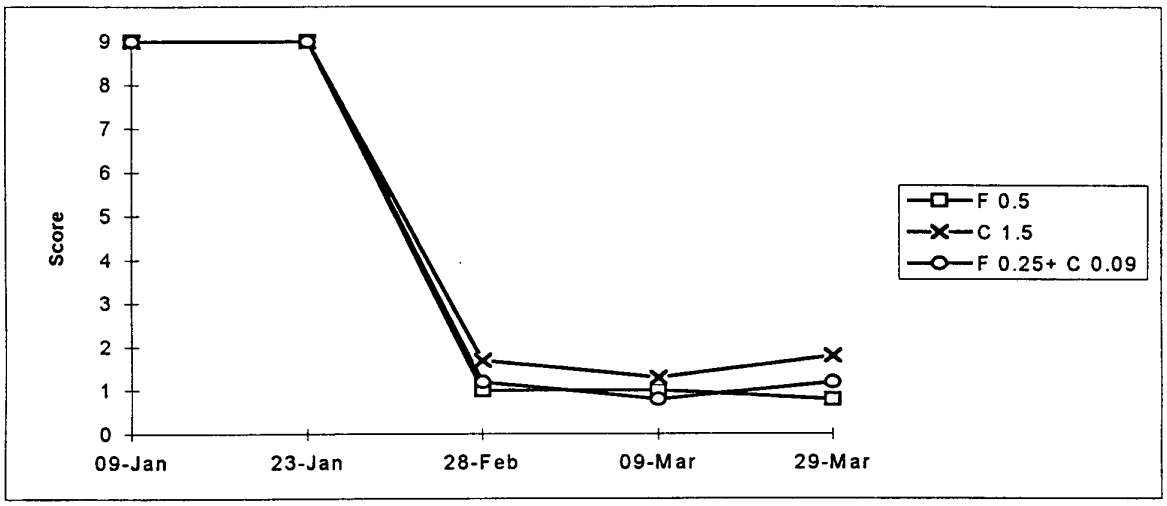
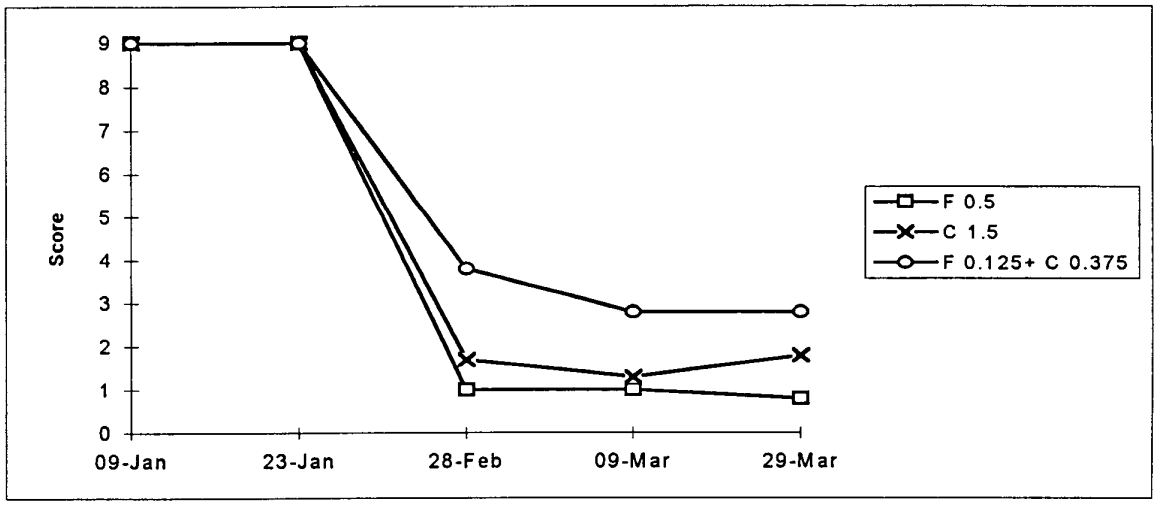



Figure 13. The effect of Fusilade, Checkmate and a mixture of the two applied to winter oilseed rape.



## Conclusion

The three pot experiments followed by the one field experiment demonstrate the potential to reduce herbicide costs for grass weed control in oilseed rape through the use of 'fops' and 'dims'. Mixtures of Fusilade + Laser at 0.25 + 0.125 or 0.125 + 0.25 l/ha (+ Actipron) or Fusilade + checkmate at 0.25 + 0.09 l/ha ( + Actipron) gave equivalent control of volunteer wheat to that given by Fusilade or Laser at 0.5 l/ha with savings of £3-5 / ha. However, oilseed rape yields were not measured and it must be emphasised that this report covers only one field experiment at one site in one year. The robustness of such treatments would require much wider testing.

Herbicides of the 'fop' and 'dim' groups have been implicated in the development of resistance in black-grass and wild-oats. If, therefore, there are grass weeds present in the rape crop in addition to volunteer wheat there may be implications, as yet unspecified, in terms of the development of resistance from the use of low rate mixtures of these chemical groupings.

## References

Harker, K.N. and O'Sullivan, P.A. (1991). Synergistic mixtures of sethoxydim and fluazifop on annual grass weeds. Weed Technology, **5**, 310-316.

Appendix 1. Temperatures recorded at Boxworth meteorological station for the 7 day period post treatment.

Experiment 1.

| Date | | Maximum | Minimum | Range |
|---|---|---|---|---|
| 4/8/94 | Spray date | 24.9 | 18.7 | 6.2 |
| 5 | | 25.9 | 16.8 | 9.1 |
| 6 | | 23.8 | 13.6 | 10.2 |
| 7 | | 22.3 | 13.7 | 8.6 |
| 8 | | 20.8 | 12.4 | 8.4 |
| 9 | | 22.4 | 10.2 | 12.2 |
| 10 | | 18.6 | 12.1 | 6.5 |
| 11 | Spray date | 17.8 | 15.2 | 2.6 |
| 12 | | 19.0 | 12.2 | 6.8 |
| 13 | | 19.2 | 10.7 | 8.5 |
| 14 | | 19.8 | 5.7 | 14.1 |
| 15 | | 22.6 | 5.3 | 17.3 |
| 16 | | 23.3 | 9.8 | 13.5 |
| 17 | | 17.2 | 11.2 | 6.0 |
| 18 | | 20.1 | 9.8 | 10.6 |

Experiment 2.

| Date | | Maximum | Minimum | Range |
|---|---|---|---|---|
| 2/9/94 | Spray date | 20.1 | 8.4 | 11.7 |
| 3 | | 21.2 | 7.7 | 13.5 |
| 4 | | 21.1 | 13.9 | 7.2 |
| 5 | | 17.6 | 11.4 | 6.2 |
| 6 | | 17.0 | 8.9 | 8.1 |
| 7 | | 20.1 | 7.5 | 12.6 |
| 8 | | 18.7 | 9.7 | 9.0 |
| 9 | | 17.8 | 7.4 | 10.4 |
| 21 | Spray date | 19.0 | 8.9 | 10.1 |
| 22 | | 18.7 | 9.5 | 9.2 |
| 23 | | 18.4 | 9.9 | 8.5 |
| 24 | | 17.7 | 12.2 | 5.5 |
| 25 | | 16.5 | 13.0 | 3.5 |
| 26 | | 16.2 | 11.5 | 4.7 |
| 27 | | 15.8 | 8.1 | 7.7 |
| 28 | | 17.1 | 8.8 | 8.3 |

Experiment 3.

| Date | | Maximum | Minimum | Range |
|---|---|---|---|---|
| 20/9/94 | Spray date | 13.6 | 9.9 | 3.7 |
| 21 | | 19.0 | 8.9 | 10.1 |
| 22 | | 18.7 | 9.5 | 9.2 |
| 23 | | 18.4 | 9.9 | 8.5 |
| 24 | | 17.7 | 12.2 | 5.5 |
| 25 | | 16.5 | 13.0 | 3.5 |
| 26 | | 16.2 | 11.5 | 4.7 |
| 27 | | 15.8 | 8.1 | 7.7 |

**Appendix 2**

| | | | |
|---|---|---|---|
| Site: | ADAS Boxworth | | |
| Field name: | Backside | | |
| Soil texture: | Clay | | |
| Drainage: | Good | | |
| Soil analysis: | pH | : | 7.9 |
| (Jan 1994) | P mg/l (index) | : | 20 (2) |
| | K mg/l (index) | : | 178 (2) |
| | Mg mg/l (index) | : | 73 (2) |
| | OM% | : | 2.8 |
| Previous cropping: | 1994 Winter wheat | | |
| | 1993 Winter wheat | | |
| | 1992 Winter wheat | | |
| Previous cultivation: | Plough, Maschio x 2, drill, roll | | |
| Crop: | Cultivar | : | Bristol |
| | Sowing date | : | 25.8.94 |
| | Seedrate (kg/ha) | : | 7.9 |
| | Fertiliser (kg/ha) | : | 196 (3-way split, spring) |

| | |
|---|---|
| Herbicides : | 16 & 20.12.94 (see experimental treatments) |
| Fungicides: | 31.3.95 Sportak 45 1.0 l/ha |
| Insecticides: | 23.9.94 Draza 5.5 kg/ha |
| Desiccant: | 10.7.95 Reglone 3.0 l/ha |
| | 10.7.95 Agral 0.4 l/ha |
| Harvest date: | 17.7.95 |