SESSION 3B

OILSEED RAPE—WHAT DOES THE FUTURE HOLD?

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INVITED PAPERS 3B-1 to 3B-8

A REVIEW OF AGRICULTURAL DEVELOPMENT AND ADVISORY SERVICE TRIALS FOR RECENTLY INTRODUCED SPECIFIC GRASS WEED HERBICIDES FOR WINTER OILSEED RAPE AND THE EFFECT ON YIELD OF THE TIMING OF REMOVAL OF VOLUNTEER CEREALS. 1983-1985.

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ABSTRACT

Twelve trials were carried out during the harvest years 1983-85 under field conditions to assess the ability of recently introduced specific grass weed herbicides to control volunteer cereals and other grass weeds, and to assess the effect of time of removal of volunteer cereals by various herbicides on the yield of winter oilseed rape. Even densities of winter barley or wheat were broadcast on the trial sites during seedbed prepartion.

There was little indication, from the trials taken to yield of the need to remove cereal competition before the application of propyzamide at the three to four leaf stage of the crop. However, very delayed applications of propyzamide to high levels of volunteer cereals may not allow the optimum yield potential to be achieved. There was little difference in the performance of the herbicides, but TCA was more variable and gave lower responses in yield.

INTRODUCTION

A wide range of herbicides is available to control broad-leaved and grass weeds in oilseed rape, some control both problems and are applied from pre-emergence to after the three to four leaf stage of the crop. A large proportion of the Agricultural Development and Advisory Service (ADAS) and Weed Research Organization (WRO) trials, have shown little or no benefit in the yield of oilseed rape as a result of controlling broad-leaved weeds even where these exceeded 100 per m^2 (Lutman, 1984; Ward, 1982; Ward & Askew 1984). In recent trials by WRO yields were reduced only when the weight of weeds in the spring were at least 50 percent of the total biomass of the sample (Lutman 1984). However, volunteer cereals and grass weeds, particularly _Alopecurus myosuroides_ are more competitive than broad-leaved weeds, except perhaps for _Galium aparine_, especially where populations in the autumn exceed 70 per m^2.

The previously reported trials showed no convincing evidence of the need to remove weed competition earlier than the three to four leaf stage of the crop. With high numbers of cereals and grass weeds the efficacy of the herbicide was more important than the time of application relative to the weed or crop stage of growth in the autumn. However, where the previous combine swaths produced dense growth of cereals or where the rape crop was drilled and lacked vigour, then early removal was necessary.

The level of volunteer cereal control achieved with TCA has been variable, depending on the seedbed conditions and soil moisture. This has resulted in lower yield responses compared with later applied graminicides which gave complete control (Orson, 1984; Lutman 1984). TCA can remove leaf wax and in the absence of weeds, rates of 15.2 kg a.i./ha or higher have reduced yield by more than 6 percent (Lutman, 1985).

Recently, new specific graminicides applied post-emergence have become available as alternatives to TCA and were assessed in ADAS trials in 1983 to 1985. Also, the effect of time of removal of cereal competition was investigated.

MATERIALS AND METHODS

Details of individual sites are shown in Table 1 to 3. On most sites winter barley or occasionally winter wheat seed was broadcast or drilled over the trial area at the rate of 200-300 seed per m^2 when the oilseed rape was being established. At High Mowthorpe Experimental Husbandry Farm (EHF) in the autumn of 1984, 600 seed per m^2 were sown. Volunteer cereals were the principle grass weeds on the sites during the period of the study. In 1983 at Bridgets EHF and 1984 at High Mowthorpe EHF, Poa annua was present as a weed.

TCA was applied pre-drilling or pre-emergence and the specific graminicides as soon as the 'volunteer' cereals reached two to three leaves. To investigate further the time of removal of volunteer cereals, the specific graminicides were also applied approximately two to three weeks after the cereals had reached two to three leaves. The actual time interval varied from site to site in any one year and applications were often later than intended because of very poor spraying weather.

Propyzamide was applied after the 1st October, once the crop had three fully expanded true leaves. Rates of herbicides are shown in Table 4. Broad-leaved weeds were controlled by an application of 0.35 to 0.80 kg a.i./ha benazolin plus clopyralid. At least 14 days elapsed between application of any herbicide and the application of benazolin plus clopyralid.

Plots were at least 50 to 60 m^2 in area and arranged in randomised blocks with at least two or more usually, three replications. Herbicides were sprayed with an Oxford Precision Sprayer or knapsack sprayer at a total volume of 200-225 litre/ha using Tee Jet 8003 or 11003 nozzles. Control of barley volunteers was assessed in early February to early April. Yields were assessed by combine harvester and corrected for moisture and weed seed content. At the Derton site the effect of weed competition was assessed in terms of crop dry weight (g/m^2) on the 18 December. Unfortunately it was not possible to take a second harvest to measure crop dry weight in April 1985.

RESULTS

The results of the trials over the three years are presented in Tables 5, 6 and 7. Generally the crops in the trials showed vigorous growth and the responses in yield were high at Boxworth EHF (1983) and at High Mowthorpe EHF in 1984, compared to Bridgets EHF. However this did not seem to be closely related to the density of volunteer cereals, which was high at Boxworth EHF and low at High Mowthorpe EHF (Tables 5 and 6). Also during 1983 and 1984 there was usually no advantage in yield by controlling volunteer cereals before the application of propyzamide, in late October or early November, or even as late as mid December at High Mowthorpe.

At Denton (1985), volunteer cereal density was high (383 per m^2). The overall yield response to removal of volunteer cereals was large, approximately 2.2 t/ha, with an untreated control yield of 1.7 t/ha. A crop harvest was taken in mid December for a dry weight determination (results not published). For all the early treatments (including pre-emergence TCA), where volunteer cereals were removed at the 2 to 3 leaf stage (mid October), the crop dry weight (g/m^2) was significantly higher than the control. Leaving the removal until the propyzamide timing (mid November) resulted in a greater crop dry weight than the control but less than the weight for the early treatment, but in either case not statistically different. It was not possible to take a further dry weight determination in the spring of 1985. By harvest the relative differences in crop dry weight prior to Christmas, did not seem to be reflected in the seed yield, as the time of removal treatments were not statistically different, (Table 7).

At High Mowthorpe EHF (1985) there was a very high volunteer cereal population (676 per m^2) which established in the autumn. This resulted in severe competition on the untreated controls and removal of volunteer cereals at either timing gave a very large increase in yield, approximately 2.3 t/ha with an untreated control yield of 0.8 t/ha. Due to a late spring and wet summer, the overall level of yield was much lower than in 1984. Although the second application of the specific graminicides and propyzamide was not made until mid-December, this did not result in a significantly different yield compared with early removal.

Overall the new specific graminicides were more reliable than TCA, which resulted in lower responses in yield from TCA at the Boxworth EHF, High Mowthorpe EHF and Denton sites. The responses in yield from the two timings of the specific graminicides were similar, but alloxydim-sodium and sethoxydim were slightly less effective at the later timing on well tillered cereals in the 1983 trials. At Bladon (1985) the early timing of sethoxydim gave poorer levels of control as there was a further germination of barley, which was drilled under very dry conditions.

High levels of Poa annua at Bridgets EHF (1983) and High Mowthorpe EHF (1984) were controlled by TCA or propyzamide alone or in combination. On both sites propyzamide as a single application gave better control than TCA. Interestingly of the specific graminicides tested haloxyfop showed a consistently high level of P. annua control at both Bridgets EHF (1983) and High Mowthorpe EHF (1984). However, at these sites P. annua did not seem to influence the yield of oilseed rape.

DISCUSSION

The level of volunteer cereal control achieved with the specific graminicides over the three years has been consistently higher than TCA, Having contact action, the specific graminicides are not so dependent on seedbed conditions or soil moisture. However, they have little or no residual activity so any grass weeds germinating after application are unlikely to be controlled as happended at the Bladon site. Overall, in 1984 and 1985 there was little difference in the level of performance between specific graminicides.

Most trials comparing the time of removal of competition from volunteer cereals or grass weeds in oilseed rape have shown little advantage from early treatment in the autumn. Early control was advantageous in crops of low vigour or if sown late and under such conditions late post-emergence sprays, applied at low temperatures reduced the speed of action sufficiently to allow a greater loss in yield (Orson 1984; Lutman, 1984). In the trials discussed in this paper the density of volunteer cereals ranged from 112 to 676 plants per m^2. The responses in yield were closely related to the efficiency of the herbicides. In particular, the difference in yield between TCA alone and propyzamide or the specific graminicides was very large on the most responsive sites, i.e. High Mowthorpe EHF in 1984 and 1985, and Denton in 1985.

From this study as in others, there seemed to be little indication that early removal was necessary even with spray applied as late as December. However, seasons differ, and there was a slight suggestion from the High Mowthorpe site (which had a high volunteer cereal population) in 1985, that there may have been a small yield disadvantage by using propyzamide late (mid December) to control cereal volunteers.

The level of volunteer cereals used in the trials were often much higher than those normally found overall in oilseed rape fields. Also they were broadcast evenly over the site, whereas very dense populations are often found in parts of the field, particularly in old combine swaths. These very high populations will often seriously reduce yield, as in the untreated controls at High Mowthorpe EHF 1985, and may sometimes completely prevent crop establishment. Clearly such high populations must be removed as early as possible.

An advantage of the specific graminicides is that a 'wait and see' policy can be adopted, particularly for situations where low levels of volunteer cereals are anticipated as for example after good ploughing. Further information is required on spray thresholds before firmer advice can be given on saving spray costs for low densities. As an alternative to TCA, the specific graminicides offer the prospect of more reliable control of cereal volunteers and other grass weeds, and therefore for very yield responsive sites, the potential for achieving the optimum yield.

Despite the extra cost of the new specific graminicides, relative to the standard TCA treatment, they clearly have a role to play in maintaining the position of oilseed rape as a cleaning crop for all grass weeds, and as a break for cereal soil borne diseases.

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REFERENCES

Lutman, P.J.W. (1985) The effect of dalapon and TCA on the growth and yield of oilseed rape (Brassica napus) Annuals of Applied Biology 107 In press

Lutman, P. J. W. (1984) The effect of weed competition on the growth and yield of winter oilseed rape. Aspects of Applied Biology 6, The agronomy physiology, plant breeding and crop protection of oilseed rape

Orson, J. H. (1984) The control of volunteer cereals in oilseed rape. Aspects of Applied Biology 6, The agronomy, physiology, plant breeding and crop protection of oilseed rape

Ward, J.T. (1982) Weed control in oilseed rape Proceedings British Crop Protection Conference - Weeds 1, 97-102

Ward, J.T. & Askew, M.F. (1984) The control of annual grass and broad-leaved weeds in winter oilseed rape. Aspects of Applied Biology 6, The agronomy physiology, plant breeding and crop protection of oilseed rape.

TABLE 1

Site, crop, weed and spray application data for 1983

	Burmarsh Kent	High Mowthorpe N. Yorks	Bridgets Hants	Boxworth Cambridge
Soil texture	Silty clay loam	Silty clay loam	Silty loam	Silty clay loam
Crop sown	7.9.82	23.8.82	3.9.82	8.9.82
Wheat (w) or Barley (b) plant/m²	211 (w)	160 (b)	172 (b)	345 (w)
Herbicide				
TCA	8.9.82	23.8.82	25.8.82	2.9.82
First application				
Date	15.10.82	13.9.82	22.9.82	25.10.82
Crop	2-4 leaves	1-2 leaves	2-3 leaves	3-4 leaves
Cereal	2-3 leaves	3 leaves	3 leaves	2-3 leaves
Second application				
Date	-	11.10.82	15.10.82	27.11.82
Crop	-	3-4 leaves	4-5 leaves	6-7 leaves
Cereal	-	5 leaves	3-4 leaves	4-5 leaves
Propyzamide	5.11.82	15.11.82	24.11.82	27.11.82

TABLE 2

Site, crop, weed and spray application data for 1984

	Eastern Ashton	High Mowthorpe N. Yorks	Bridgets Hants
Soil texture	Sandy clay loam	Silty clay loam	Silty clay loam
Crop sown	1.9.83	25.8.83	26.8.83
Wheat (w) or Barley (b) plants/m²	500 tillers (w) and (b)	112 (b)	256 (b)
Herbicide			
TCA	-	25.8.83	22.8.83
First application			
Date	23.10.83	20.10.82	20.9.83
Crop	4 leaves	4-5 leaves	2-3 leaves
Cereal	2-3 tillers	2-3 leaves	2-3 leaves
Second application			
Date	9.11.83	22.11.83	5.10.83
Crop	5 leaves	6 leaves	4 leaves
Cereal	4 tillers	4-6 tillers	4-6 tillers
Propyzamide	9.11.83	6.12.83	14.10.83

TABLE 3

Site, crop, weed and spray application data for 1985 trials

	Denton Northants	Bladon Oxon	High Mowthorpe N. Yorks	Bridgets Hants
Soil texture	silty loam	silty loam	silty clay loam	silty clay loam
Crop sown	19.9.84	29.8.84	5.9.84	30.8.84
Wheat (w) or barley (b) plants /m^2	383 (b) and (w)	261 (b)	676 (b)	250 (b)
Herbicide TCA	12.9.84	29.8.84	5.9.84	3.9.84
First application				
Date	15.10.84	18.9.84	3.10.84	16.10.84
Crop	2 leaves	1-2 leaves	2 leaves	2 leaves
Cereal	4 leaves	2-3 leaves	3 leaves	2-3 leaves
Second application				
Date	13.11.84	12.10.84	11.12.84	5.11.84
Crop	4 leaves	4 leaves	5 leaves	4 leaves
Cereal	6 tillers	4-6 tillers	4-6 tillers	5 tillers
Propyzamide	13.11.84	12.10.84	11.12.84	5.11.84

TABLE 4

Rate of herbicides

Herbicide	kg a.i./ha	Year of trial
TCA	10.5	1983-1985
TCA followed by propyzamide	10.5 0.7	1983-1985
propyzamide	0.7	1983-1985
alloxydim-sodium	0.56 + adjuvant oil*	1983-1984
fluazifop-butyl	0.25 + non-ionic wetter* 0.1% vol/vol	1983
fluazifop-P-butyl (1)	0.125 + non-ionic wetter 0.1% vol/vol	1984-1985
sethoxydim	0.29 + adjuvant oil	1983-1984
sethoxydim	0.24 + adjuvant oil	1985
haloxyfop	0.125	1983-1984
haloxyfop	0.094	1985
quizalofop-ethyl	0.125 + adjuvant oil	1984
quizalofop-ethyl (2)	0.075 + adjuvant oil	1985

* The adjuvant oil and wetter were used according to the herbicide manufacturer's recommendation.
Where application was made (1) after mid October and (2) after mid Novemeber the rate was increased as recommended.

TABLE 5

1983 trials - control of cereals and grasses and yield of seed (tonne/ha at 92% d.m.)

Treatment	% control of cereals (plants or ground cover)				% control *P. annua*	Yield of seed (tonne/ha)	
	Kent	High Mowthorpe	Bridgets	Boxworth	Bridgets	Bridgets	Boxworth
TCA	76	93	65	37	81	2.74	2.11
propyzamide	96	100	100	88	94	2.71	2.46
TCA + propyzamide	99	95	100	89	94	2.85	2.00
Cereals 2 to 3 leaves							
alloxydim-sodium	83	81	94	79	56	2.67	2.10
fluazifop-butyl	100	98	82	95	0	2.71	2.24
sethoxydim	95	85	88	92	19	2.71	2.34
haloxyfop	100	100	100	100	56	2.71	2.30
2 to 3 weeks later							
alloxydim-sodium	-	92	71	63	38	2.52	2.07
fluazifop-butyl	-	94	100	97	6	2.63	2.44
sethoxydim	-	97	59	46	37	2.60	2.42
haloxyfop	-	100	100	97	75	2.80	2.22
unsprayed controls (weed density (m^2) or yield	211	160	172	345		2.24	1.62
S.E.D. between mean of unsprayed control and treatment						± 0.227	± 0.219
S.E.D. between mean of treatments						± 0.262	± 0.268

TABLE 6

1984 Trials - control of cereals and grasses and yield of seed (tonne/ha at 92% d.m.)

Treatments	% control of cereals (plants or ground cover)					% control <u>P.annua</u>	Yield of seed (tonne/ha)	
	Ashton		High Mowthorpe	Bridgets		High Mowthorpe	High Mowthorpe	Bridgets
Assessment date	16.12.83	13.1.84	12.4.84	22.12.83	6.4.84	12.4.84		
TCA	-	-	74	58	51	75	3.65	2.77
propyzamide	13	100	100	93	100	100	4.77	2.69
TCA + propyzamide	-	-	100	100	100	100	4.75	2.61
<u>Cereals 2 to 3 leaves</u>								
alloxydim-sodium	86	100	100	77	51	0	4.83	3.02
fluazifop- butyl	89	100	100	97	98	4	4.96	3.24
sethoxydim	89	100	100	83	80	0	4.71	3.02
haloxyfop	90	100	100	100	100	100	4.87	2.82
quizalofop-ethyl	89	100	100	-	-	0	4.75	-
fluazifop-P-butyl	86	100	100	100	100	4	4.73	2.77
<u>2 to 3 weeks later</u>								
fluazifop- butyl	72	100	100	100	100	0	4.92	2.70
haloxyfop	69	100	100	100	100	100	4.90	2.85
quizalofop-ethyl	63	100	100	100	100	0	4.76	2.87
fluazifop-P-butyl	65	100	100	100	100	0	4.55	2.73
unsprayed controls (weed density/m^2 or yield 500 tillers)			112	256		111	2.81	2.75
S.E.D. between mean of unsprayed control and treatments							± 0.205	± 0.196
S.E.D. between mean of treatments							± 0.251	± 0.240

TABLE 7

1985 Trials - control of cereals and grasses and yield of seed (tonne/ha at 92% d.m.)

Treatments	% control of cereals (plants or ground cover					Yield of seed (tonne/ha)			
	Denton	Bladon 6.11.84	26.4.85	High Mowthorpe 25.4.85	Bridgets	Denton	Bladon	High Mowthorpe	Bridgets
TCA	95	77	83	57	86	3.14	3.87	1.89	2.76
propyzamide	98	87	98	100	99	4.06	3.83	3.00	2.81
TCA + propyzamide	100	82	98	99	100	3.65	3.74	2.99	2.98
<u>Cereals 2 to 3 leaves</u>									
haloxyfop	100	83	88	100	100	3.98	3.69	3.39	3.04
sethoxydim	98	84	65	-	100	4.00	4.18	-	2.95
quizalofop-ethyl	99	91	85	100	100	3.94	4.27	3.09	2.91
fluazifop-P-butyl	99	72	80	100	100	4.29	4.02	3.28	2.95
<u>2 to 3 weeks later</u>									
haloxyfop	99	100	95	100	98	3.93	4.15	3.41	2.88
sethoxydim	89	88	95	-	96	3.88	4.07	-	2.86
quizalofop-ethyl	100	84	95	100	100	3.97	4.03	3.13	2.80
fluazifop-P-butyl	100	89	100	100	100	4.00	3.73	3.07	2.79
Unsprayed controls (weed density/m² or yield)	383	261		676	250	1.67	3.82	0.83	2.45
S.E.D. between mean of unsprayed control and treatments						± 0.231	± 0.275	± 0.218	-
S.E.D. between mean of treatments						± 0.282	± 0.317	± 0.268	± 0.156

3B—1

THE EFFECT OF THE TIMING OF CONTROL OF GRASS WEEDS ON THE YIELD OF OILSEED RAPE

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ABSTRACT

The effects of competition from grass weeds, especially volunteer barley, on the yield of oilseed rape were studied in six trials. Herbicides were applied at intervals between October and March to varying populations of grass weeds. In most trials barley populations of approximately 200 plants/m^2 had no detectable effect on yields of August sown crops even when unsprayed and in one trial more than 300 cereal plants/m^2 appeared to cause no reduction in yields. September sown crops were less tolerant of weed competition and unsprayed barley populations greater than 120 plants/m^2 reduced yields significantly. In all except one trial herbicide applications in January or February prevented loss of yield. Thus early weed control seems not to be necessary to maintain optimum yields in August sown rape. Early applications may be more necessary in less vigorous September sown crops.

INTRODUCTION

It is widely believed in the UK that oilseed rape (Brassica napus) is very sensitive to competition from early emerging weeds and that early control is essential to maintain yields (MAFF, 1983). The most competitive weeds are grass species, especially volunteer cereals and Alopecurus myosuroides (black-grass). In order to achieve early control of grass weeds many growers apply a pre-emergence (e.g. TCA) or an early post-emergence herbicide (e.g. fluazifop-butyl) and then follow this with a broader spectrum product to control surviving grass and broad-leaved weeds (e.g. propyzamide). Earlier experiments in the U.K. (Lutman, 1984) and in France (Regnault, 1984) suggested that double spraying was not necessary and that a single treatment in October-November or even later was often adequate to prevent loss of yield from weed competition. Yields of rape, as well as being affected by weed competition, are also influenced by date of sowing. Research reported by Mendham et al. (1981) showed that the most reliable yields were achieved by rape crops drilled early in September. Later sown crops were less vigorous and were lower yielding in some years. Thus it is probable that there will be an interaction between weed competition and drilling date.

The six experiments described in the paper all studied the effects of time of herbicide application to grass weeds, mainly volunteer cereals, on the yield of oilseed rape. The influence of drilling date on weed competition was studied in three of them.

MATERIALS AND METHODS

General

Between 1982 and 1984 six experiments were drilled with the rape cultivar Jet Neuf late in August and/or early in September. Four (1,2,5,6) were done entirely by the staff of the Weed Research Organization, whilst the other two (3,4) were carried out on farm fields in Oxfordshire and Warwickshire. The agronomy of these two crops was the responsibility of the cooperating farmers. In Experiments 1, 2, 5 and 6, barley seed was broadcast prior to drilling the rape. In all four trials two densities were used; 200 and 400 seed/m^2 in Experiments 2, 5 and 6; 150 and 450 seeds/m^2 in Experiment 1. Natural grass weeds were present on Experiments 3 and 4. All crops received a compound fertilizer in the seed bed and were top dressed with approximately 200 kg/ha N in late February or early March. The experiments were all harvested at the end of July, following desiccation with diquat, using a Claas Compact harvester, with a 2.1 m cut, modified for experimental use and fitted with two vertical knives.

Herbicide Applications

All trials had three or four dates of herbicide application. The first treatments were applied when the rape had 3-6 leaves, generally in October but as early as 28 September (Expt. 1) or as late as 3 November (Expt. 4). The final treatments were applied between 11 January and 3 March. In Experiment 1 two herbicides were used, fluazifop-butyl (25% e.c.) 0.25-0.375 kg a.i./ha (Sept. Oct. Feb.) and propyzamide (50% w.p.) 0.7 kg a.i./ha (Oct. Nov.). Later trials used only one herbicide, fluazifop-butyl (0.125-0.375 kg a.i./ha) with 0.1% Agral wetter (Experiments 2-4) and carbetamide + dimefuron (70% w.p., 2.8 kg a.i./ha) in Experiments 5 and 6. In addition, in the first two experiments, the plots were oversprayed with a mixture of benazolin + clopyralid (35% w.p., 0.35 kg a.i./ha) to control broad-leaved weeds. All herbicide applications were made with a CO_2 pressurised back-pack sprayer and 3-4 m boom fitted with Spraying Systems 8002 TeeJets, at a volume of 250 l/ha and a pressure of 210 kPa.

Assessments

The populations of rape, grass weeds, barley and other weeds were recorded in random quadrats counted on each trial in September or October. The visible effects of the herbicides on the weeds were noted during the winter and on most trials assessments were made of the vigour of the rape (e.g. % ground cover). Yields of rape (t/ha) were corrected to 8% moisture.

Design and Analysis

All experiments were of randomised block design with three or four replicates. Those with two drilling dates were divided into main plots (drilling date) and sub-plots (herbicide treatments/weed density). The plots were 3-3.5 m x 18-20 m. All statistical significance is quoted at the 95% confidence level.

RESULTS

Rape and Weed Populations (autumn)

In the majority of experiments the rape populations were between 70 and 120 plants/m^2 (Tables 1-4). Populations on the plots drilled in August in Experiment 5 were somewhat lower (52 plants/m^2) and in Experiment 4 they were considerably higher (185 plants/m^2). There were no indications that barley density had an appreciable effect on the rape populations. The 'low' barley populations created in the four trials varied from 104 to 162 plants/m^2 (Tables 1,2,4) and the 'high' populations from 172-344 plants/m^2. In Experiment 3 there was a mixed population of 231 grass weeds/m^2 (*Avena fatua*, *Alopecurus myosuroides*, volunteer cereals) and in Experiment 4 the major weed was *A. myosuroides* (438 plants/m^2). Substantial numbers of

Stellaria media, Poa annua, Capsella bursa-pastoris and Lamium purpureum were recorded in Experiment 5, giving total populations of 197 and 305 plants/m^2 at the two drilling dates. A mixed infestation of Veronica persica and V. hederifolia (84 plants/m^2) occurred on Experiment 6.

Grass weed control

All the herbicides gave excellent control of the grass weeds in all trials. Visual assessments showed that treatments applied in September and October had killed the grass weeds by December. Those sprayed in November were senescent and yellow by the December and January assessments and were completely dead before March. The grass weeds sprayed in December or January were only yellow in March but all sprayed grass weeds were dead by harvest.

Broad-leaved weed control

There were few broad-leaved weeds present on the two 'farmer' experiments (3, 4). In Experiment 1 the appreciable amounts of S. media present in the winter on the fluazifop treated plots but not on the propyzamide ones, were controlled with the overall treatment of benazolin + clopyralid. Although the same herbicides were used in Experiment 2 to control S. media, other weeds, particularly Poa annua, Veronica persica and Aphanes arvensis remained on some plots, but were only dense on the control (no barley) plots drilled in September. These weeds were particularly noticeable in March when they achieved up to 33% ground cover. Later in the year they were less evident. In the remaining two experiments (5, 6) the carbetamide + dimefuron controlled both grass and broad-leaved weeds, so the latter were only present in any quantity on the unsprayed control (no barley) plots. Again they were more abundant on the September drilled plots, achieving a maximum of 40% ground cover in March in Experiment 5 and 20% in Experiment 6. In both these two experiments, and in Experiments 1 and 2, the broad-leaved weeds were almost totally suppressed by the barley. It was only after the barley had died that other weeds were sometimes noted.

Rape Growth and Yield

Experiment 1. Barley was present at up to 335 plants/m^2 but it was low in vigour and was dominated by the rape. Thus throughout the autumn, winter and early spring the ground cover by the rape was 70% or higher even on the plots containing the highest density of barley. The yields of rape were not greatly affected by competition from the barley (Table 1). Seed production of plots that had contained barley throughout the growing season was not statistically different from that of plots that had contained no weeds. Hence there were no indications that early weed control was necessary to ensure maximum yields.

Experiment 2. The barley in this experiment was more competitive. In the autumn, it reduced the ground cover by the rape from 95% on the weed-free plots to only 40% on the weedy plots drilled in August, and from 60% to less than 40% on the September drilling. Similar differences remained throughout the winter, although the ground cover of rape on the weed free plots tended to decline a little. At harvest, there were no detectable differences in yield, on the August sown rape, between the plots that had contained no barley and those that had contained barley throughout the life of the crop (Table 2). On the unsprayed plots drilled in September the highest barley density (172 plants/m^2) reduced rape yields by 25-30%, compared with those of the plots sprayed in November or January. There were no indications that the October treatment had resulted in higher yields than

TABLE 1

Effects of competition from volunteer barley on the yield of rape (t/ha) - Experiment 1 (drilled 28 August)

Date sprayed with grass weed herbicides	Barley plants/m^2 8	141	335
28 September	3.24	3.27	3.04
14 October*	3.55	3.40	3.71
5 November	3.47	3.29	3.49
23 February	3.51	3.19	3.34
Unsprayed	3.36	3.55	3.33

S.E. of mean ± 0.215 (all values except 14 Oct.)
0.152 (14 Oct. treatments only)

* 14 Oct. yields are the means of fluazifop and propyzamide treatments
Rape population = 100 plants/m^2

TABLE 2

Effect of competition from barley on the yield of rape drilled in August and September (t/ha) - Experiment 2

Date sprayed with fluazifop-butyl	Date drilled: 25 August (97)*			7 September (78)*		
	Barley plants/m^2 4	121	218	2	115	172
15 October		2.62	2.98		2.63	2.65
17 November		2.96	2.67		2.84	2.75
10 January		2.61	3.10		2.54	2.97
Unsprayed	2.32	2.56	2.68	2.63	2.52	2.06

S.E. of mean (comparisons within drilling dates) ± 0.202
S.E. of mean (" between " ") ± 0.238

* rape population (plants/m^2)

the January one. The differences in yield at the lower weed density between the sprayed and unsprayed were not statistically significant.

TABLE 3

Effect of competition from grass weeds on the yield of rape (t/ha) - Experiments 3, 4

Date sprayed with fluazifop-butyl		Experiment 3 (drilled 29 August) 118x	Experiment 4 (drilled early September) 185x
		Grass weeds (231 plants/m^2)	A. myosuroides + cereals (438 + 21 plants/m^2)
15	October	2.24*	
3/4	November	2.28*	3.16*
14/17	December	2.31	2.92*
25	January		2.87*
21	February	2.24	
3	March		3.30
Unsprayed		2.01	
S.E. of mean ±		0.142	0.147
		*0.100	*0.104

* Mean of two doses of fluazifop-butyl
x Rape population (plants/m^2)

Experiment 3. Although the rape in this trial was not very vigorous, it tended to suppress the mixed grass weed infestation. Thus at the end of February the ground cover by the rape was 60-80% on the sprayed plots and 50-75% on the unsprayed. The poor crop growth is reflected in the poor overall yields, the unsprayed controls producing only 2.0 t/ha (Table 3). The plots sprayed between October and February yielded 2.24-2.31 t/ha. This apparent yield increase was not statistically significant. There were no indications that early weed control resulted in higher yields.

Experiment 4. Even though this crop was very slow to establish and only reached the 1-2 leaf stage in mid-October, the dense black-grass population failed to reduce rape growth appreciably. In January the ground cover of the rape was 70-76% on the sprayed plots and 61-66% on the unsprayed. By early March, the ground cover on the sprayed plots had decreased slightly to 60-70% whilst that on the then unsprayed plots had fallen to 40%. The yields appeared to be unaffected by the time of herbicide application, plots sprayed in November yielding 3.2 t/ha and those sprayed in March 3.3 t/ha (Table 3). There were no unsprayed plots in this trial.

Experiment 5. During the winter the barley had only a small effect on the rape drilled in August. Thus in March the rape on the weed free plots covered 70-78% of the soil surface and on the most weedy plots 58% (Table

TABLE 4

The effect of barley density, date of herbicide application and date of drilling on the % ground cover by rape in March (in brackets) and on seed yield (t/ha) - Experiments 5, 6

Date drilled	Plant numbers/m2 Rape	Vol. cereals	Date of application of carbetamide + dimefuron 14/10	27/10	15/11	6/12	11/1	18/1	Unsprayed
Experiment. 5									
22 Aug.	52	12	(70) 3.38						(78) 3.29
		104	(68) 3.36		(67) 3.14		(65) 3.40		(60) 3.38
		178	(67) 3.24		(63) 3.45		(62) 3.04		(58) 3.32
7 Sept.	94	4	(68) 3.57						(55) 3.31
		162	(72) 3.38		(67) 3.60		(52) 3.58		(30) 2.36
		344	(63) 3.68		(20) 2.94		(18) 3.04		(13) 0.79
Experiment. 6									
26 Aug.	72	26				(55) 3.91			(58) 3.89
		144		(50) 3.99		(55) 4.09		(40) 4.22	(40) 1.97
		232		(20) 3.21		(28) 3.85		(22) 3.69	(23) -
12 Sept.	86	7				(62) 4.44			(63) 3.94
		128		(63) 4.25		(60) 4.65		(57) 4.20	(50) 2.62
		227		(42) 3.76		(40) 4.36		(35) 3.94	(38) -

Yield S.E. of mean (comparisons within drilling dates) ± Expt. 5 0.164
Expt. 6 0.186

Yields significantly different (p = 0.05) from the sprayed 'no barley' controls are underlined

4). The September drilled plots were much more seriously affected. On the unsprayed plots the lower barley density had reduced the rape ground cover to 30% and the higher density had reduced it to only 13%. In contrast the rape cover on the weed free plots was 55-68%. The September sown rape that had been grown in competition with the high barley density treated in November or January was also much less vigorous.

The yield data reflected the differences in crop vigour in March (Table 4). The August drilled crop appeared to be unaffected by the barley competition, nor were there any trends in the data indicating higher yields from early weed control. Conversely, the yields of the September drilled rape were seriously affected by the barley. In the absence of herbicide treatment the lower barley density (NB. this is equivalent to the highest density in the August drilling) severely reduced rape yields. However, yields from the January herbicide treatment were similar to those from the October treated plots and the weed free control. The higher barley density had an even greater effect. Yields on the unsprayed were less than 1.0 t/ha and were also significantly lower on the plots sprayed in November and January, but not on those sprayed in October.

Experiment 6. Dry conditions at drilling delayed the emergence of the August sown rape. Thus the growth on the two drilling dates was similar. In December the rape on the 'no barley' plots covered 72-73% of the soil surface at both drilling dates, but at the highest barley density this cover declined to 16-22%. At the March assessment the effects were more complex (Table 4). On the 'no barley' plots on both drilling dates ground cover by the rape was 55-63%. Most of the sprayed and unsprayed plots containing the low density barley showed similar ground covers. However, in the high barley density plots, especially on the August drilling, there was an appreciable reduction in crop cover, on both the sprayed and unsprayed plots.

The unsprayed plots containing the higher barley density were not harvested because of the vigour of the barley and the very small amount of surviving rape. Yields of the unsprayed lower barley density plots were also considerably reduced (Table 4). The plots from both drilling dates sprayed in October, December and January had similar yields to the 'weed free' plots even when they had been exposed to the higher barley density but overall the rape on the lower barley density plots yielded slightly better than those on the higher density plots. There were indications that the rape on the higher density barley plots sprayed in October did not yield as well as expected. This may have been due to selective grazing by pigeons, but covariance analysis incorporating data expressing the degree of pigeon damage on each plot in April failed to confirm this suggestion.

DISCUSSION

The main conclusion to be drawn from the six trials is that early weed control is not necessary to prevent loss of yield. Post Christmas applications prevented significant loss of yield from grass weeds in all but one trial (Experiment 5) where yields were maintained by an October treatment. Indeed in many experiments the grass weeds had no observed effect on yields even when unsprayed. Thus the majority of August drilled crops appeared to be unaffected by grass weed populations of 178-335 plants/m^2. September sown crops were less robust and unsprayed grass weeds at densities as low as 128 plants/m^2 had an adverse effect on yield. The yield reduction on the unsprayed August drilled plots containing 144 barley plants/m^2 in Experiment 6 seems not to agree with the preceding conclusions.

However, the very dry conditions at drilling which delayed the emergence of the seed sown in August made the early sown crop respond to weeds like a September sown one. The poorer competitive ability of the later sown crops is also well shown in Experiment 5 where 344 barley plants/m^2 were so competitive that only the October herbicide treatment prevented loss of yield. In general, the results support those of earlier trials (Lutman 1984) and agree with the general conclusions of research by ADAS and in France (Orson, 1984; Regnault, 1984) that early weed control was not essential.

The visual assessments of ground cover by the rape during the autumn, winter and spring in the trials, where weeds had little or no effect on yields, indicate that the rape tended to dominate the weeds throughout the growing period. In consequence the ground cover by the rape rarely fell below 50% during the vegetative stages of growth. In contrast where the ground cover by rape was reduced to 40% or less by the weeds during the winter and where weeds were not controlled, rape yields were reduced. This tended to occur only on the September drilled crops. The similar low ground cover by the rape on the late sprayed plots did not always result in yield loss. Thus it would seem that the crop is able to recover from a severe inhibition of early growth provided its growth in spring is not inhibited by the presence of weeds. This ability of rape to recover from severe competition/ damage in the winter is currently being studied in more detail.

The practical advice emanating from this research would be that in many circumstances there is no need to control volunteer cereals and other grass weeds pre-emergence or early post-emergence. A later spray in October-November will normally prevent loss of yield, provided that the weed density is not excessively high. Indeed in many circumstances the use of a herbicide cannot be justified purely in terms of the likely effects of weeds on yields.

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REFERENCES

Lutman, P.J.W. (1984) The effects of weed competition on the growth and yield of oilseed rape. Aspects of Applied Biology 6. Agronomy, physiology, plant breeding and crop protection of oilseed rape 209-220.

MAFF (1983) Oilseed Rape. Ministry of Agriculture, Fisheries and Food, Booklet 2278, pp. 42.

Mendham, N.J.; Shipway, P.A.; Scott, R.K. (1981) The effects of delayed sowing and weather on the growth, development and yield of winter oilseed rape (Brassica napus). Journal of Agricultural Science (Cambridge) 96, 389-416.

Orson, J.H. (1984) The control of volunteer cereals in winter oilseed rape. Agricultural Development and Advisory Service results in harvest years 1982 and 1983. Aspects of Applied Biology 6. Agronomy, physiology, plant breeding and crop protection of oilseed rape 179-184.

Regnault, Y. (1984) The control of grass weeds in oilseed rape in France. Aspects of Applied Biology 6. Agronomy, physiology, plant breeding and crop protection of oilseed rape 185-190.

THE INCLUSION OF OILSEED RAPE HERBICIDES IN AGRONOMY SYSTEMS

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ABSTRACT

On winter oilseed rape sites in Poland where weeds were not properly controlled, yield losses reached 10-30%. The main weed species present were Anthemideae, Galium aparine, Apera spica-venti and volunteer cereals. It has been observed that there were not any positive results achieved from single applications of herbicides. Based on results of field experiments carried out from 1983 to 1985, several systems of chemical weed control in winter oilseed rape have been devised and these are dependent on weed spectrum. Due to the increasing problem of monocots several graminicides were introduced into the above systems.

INTRODUCTION

As in other countries (Eberhard, 1982) the area of winter oilseed rape has recently increased in Poland. In 1984/85 it reached 460 thousand ha. and the trend is expected to continue for the next few years. The optimum sowing date of winter rape is the third week of August, which is frequently during the cereal harvesting period, therefore, the farmers do not always have enough time to prepare the field for the new crop, creating ideal conditions for the development of weeds and volunteer cereals.

Over 70 species of weeds have been identified in crops of winter oilseed rape and the most important ones are listed in Table 1. The common use of trifluralin has influenced the rapid increase of Anthemideae. The range of herbicides has been broadened by the introduction of napropamide, dimethochlor, metazachlor, clopyralid and others. TCA and new graminicides are recommended for monocot control. 70-80% of the winter oilseed rape area in Poland is treated with herbicide for weed control.

Unfortunately the level of weed control is not always satisfactory. This is often due to changeable weather conditions or lack of selection of herbicides necessary to control the weed spectrum present and this is the subject of continuing research work.

MATERIALS AND METHODS

In 1983-85 a number of field trials were carried out on soils containing between 1, 5 and 3% of humus. The crops treated were the oilseed rape varieties Jet Neuf and Quinta, located near Wroclaw, south Poland. In small plot trials 25m² plots were used each replicated 3 times and some commercial trials have been set up on 1 ha large fields. All herbicides were applied at recommended timings and dose rates given in Tables 2 and 3. Herbicides used on small plots were applied with a knapsack sprayer, whilst large experimental fields were sprayed with tractor equipment. The crops were harvested either by a Hege harvester or a combine harvester. The herbicidal efficacy on weeds and the crop was assessed by using standard methods: (a) 3-5 weeks after the treatment, (b) in spring at the beginning of growth, and (c) shortly before harvest.

RESULTS

A typical weed spectrum for winter oilseed rape is presented in Table 1. Other species of weeds appear locally but do not have a significant influence on oilseed rape yield. In such situations applications of common herbicides separately or in addition with TCA have given satisfactory results (Table 2).

The experiments did not show any significant differences between compared herbicides except tebutam which was less effective against Galium aparine. None of the tested chemicals satisfactorily controlled Cruciferae species.

In Table 3 the results from trials carried out on crops infested mainly with Agropyron repens are presented. Almost all the graminicides compared controlled this weed effectively, however, propyzamide, alloxydim-sodium and fluazifop-butyl (0.75 kg a.i./ha) were less effective.

In both series of trials (Tables 2 and 3) no crop phytotoxicity was noted.

Significant yield increase was observed on all treated plots and especially on plots highly infested with Agropyron repens.

In 1985 the usefulness of adjuvant oils like Nippol, 0.5 L/ha, Atplus 411 F, 1.5 L/ha and others were investigated when added to: sethoxydim, quizalofop-ethyl and haloxyfop-ethoxyethyl. It has been stated that they increased the activity of the graminicides which allows a reduction in the dose rate of between 20-30% without any reduction in Agropyron repens control.

The results obtained from these trials, as well as earlier experiments (Rola, Franek, 1983), have established the base for preparing a system of herbicide selection, which can be adjusted by the farmer to suit the weed spectrum in a particular crop. All proposed variants enable proper selection of herbicide required for the application period and dominant weed associations.

DISCUSSION

Chemical weed control has become a necessity in the agronomy of winter oilseed rape. Farmers who do not use proper herbicides in their crops should expect yield losses of between 15 and 30% and sometimes much higher. It is widely known that rape has a long period of vegetative growth, 11 months, which encourages the development of many weeds of both mono and dicotyledonous species. This means that in most crops the weed species appearing, vary as far as their growth patterns are concerned. This, of course, causes difficulties in proper herbicide selection and their application in the right period to enable the control of both dicotyledonous weeds, volunteer cereals and Agropyron repens.

Recently, a number of new rape herbicides have appeared, none of which control all weed species, a fact fairly well known among specialists (Ward 1982, Stormonth and Woodroffe 1982). For this reason a considerable amount of research work is being carried out with herbicide mixtures and their application. For example clopyralid controls Anthemideae whereas trifluralin and propyzamide do not. Tebutam gives inadequate control of Galium aparine and Lamium spp. and in such cases it would be better to apply dimethachlor or metazachlor. Occasionally in unfavourable weather conditions such as drought or high rainfalls, applications of pre-sowing materials would be ineffective. The farmer has a choice of a number of post-emergence herbicides such as carbetamide + dimefuron or benazolin + clopyralid or even metazachlor until the rape has 2 leaves (Luning et al, 1983).

In the case of volunteer cereals and dicotyledonous weeds, the best results were obtained with mixtures of TCA and metazachlor, dimethachlor or, tebutam. Other authors (Stormonth et al, 1982, Spencer 1982), are of similar opinion. Gladders and Musa 1982 point out that TCA may cause increased infestation of diseases on oilseed rape leaves, however, it has not been confirmed in recent experiments carried out by our Institute.

Recently launched graminicides for Agropyron repens control and used at 50-70% lower dose rates for Apera spica venti and volunteer cereal control have been well received by Polish farmers. It is necessary to list graminicides which control the above weeds and these are as follows: fluazifop-butyl, haloxyfop-ethoxyethyl and quizalofop-ethyl which were equally effective. However, they tend to be expensive.

As can be seen in Table 5, the average price of graminicides expressed in terms of oilseed rape seeds is about twice that of the products used for broad-leaved weed control. Nevertheless, chemical weed control in rape is cost effective. In the case of Agropyron repens control, effects can be seen during the next 2-4 years in succeeding crops. In addition dose rates of some graminicides can be reduced provided that adjuvant oils are added.

All above mentioned aspects must be considered by farmers when selecting proper herbicides according to the period of application and weeds spectrum present in their oilseed rape crops.

TABLE 1

Frequency of the most important weeds in winter oilseed rape in Poland
Observation 2597 fields from 1979 to 1983

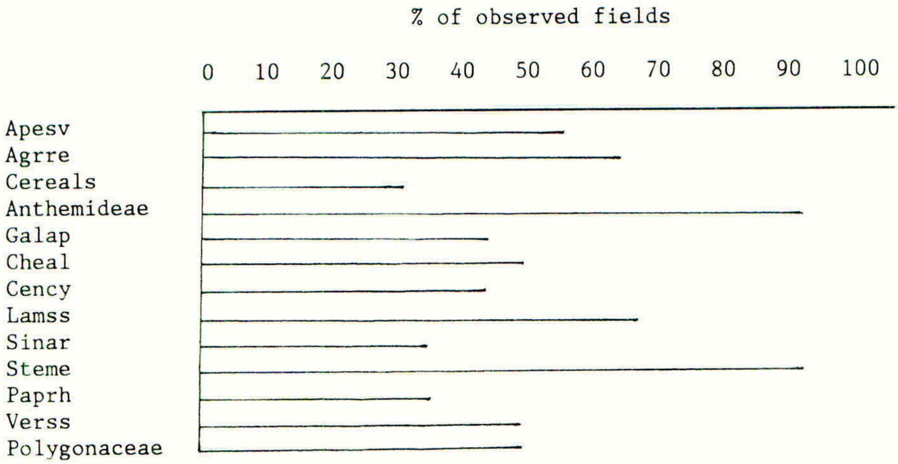

TABLE 2

Weed control in winter oilseed rape and crop yields
Mean of 14 trials, 1983-85

Herbicides	Rate kg a.i/ha	Application time	% Ground Cover at Harvest: Total B/L weeds*	% Ground Cover at Harvest: Vol. cereal	% Ground Cover at Harvest: Apesv	Crop yield t/ha
Untreated	-	-	69	7	13	2.41
Napropamide	1.5	A	8	4	4	2.86
Metazachlor	1.25	B	7	4	6	2.90
Tebutam	3.60	B	25	6	4	2.79
Dimethachlor	1.5-2.0	B	14	7	2	3.00
Metazachlor + TCA	1.0 + 7.6	B	5	2	2	2.68
Tebutam + TCA	1.9 + 7.6	B	14	1	1	2.67
Carbetamide + dimefuron	2.0 + 1.0	C	8	1	3	2.78

Application time:
A - pre-drilling
B - pre-emergence
C - post-emergence, autumn, 4-6 leaf stage oilseed rape.

* Dominant weeds: Steme, Galap, Lamss, Match, Thlar.

TABLE 3

Effect of graminicide treatment on couch and winter oilseed rape yield 1983-85

Treatment	Rate kg a.i/ha	No. of exp.	Vigour 1-9: 3-4 weeks post-spray: Rape	Vigour 1-9: 3-4 weeks post-spray: Agrre	% ground cover at harvest	Yield t/ha
Untreated	-	6	1	9	58	1.83
Fluazifop-butyl	0.75	6	1	2	16	2.23
Fluazifop-butyl	1.00	4	1	1	3	2.54
Haloxyfop-ethoxyethyl	0.25	6	1	3	6	2.41
Haloxyfop-ethoxyethyl	0.375	3	1	1	3	2.66
Quizalofop-ethyl	0.30	2	1	2	8	2.58
Quizolofop-ethyl*	0.30	2	1	2	5	2.79
Sethoxydim	0.60	2	1	3	8	2.55
Alloxydim-sodium	2.25	5	2	3	11	2.43
Propyzamide	1.50	4	2	5	11	2.35

* With adjuvants at plus 411 F at rate 1.5 L/ha.
Graminicides applied in autumn at 4-6 leaf stage of oilseed rape.
Pre-em. broad-leaved weed control: napropamide 1.5 kg a.i. or trifluralin 1.05 kg a.i./ha.

TABLE 4

Systems of herbicides application in winter oilseed rape depending on dominant weeds

Time of herbicide application:**	pre-drilling	Pre-emergence	Post-emergence: Autumn 4-6 leaf stage rape	Post-emergence: Spring After growth starts
Weeds				
Cheal, Steme, Verss	Napropamide Trifluralin	Dimethachlor Metazachlor Propachlor Tebutam	Benazolin Carbetamide + Dimefuron	Benazolin
Galap, Lamss	Trifluralin	Dimethachlor Metazachlor Tebutam	Carbetamide + Dimefuron	Carbetamide
Anthemideae	Napropamide	Dimethachlor Metazachlor	Carbetamide + dimefuron	Benazolin Clopyralid
Apesv Vol. cereals	Napropamide TCA	Alachlor Dimethachlor Metazachlor TCA	Graminicides* Propyzamide	Graminicides*
Agrre	-	-	Graminicides* Propyzamide	Graminicides*

* Graminicides: Alloxydim-sodium, fluazifop-butyl, haloxyfop-ethoxyethyl, quizalofop-ethyl, sethoxydim.
** Selection of herbicides for the control of dominant weeds.

TABLE 5

Economic evaluation of weed control in oilseed rape in Poland

	Chemical Control		
	Broad-leaved weeds	Apesv, volunteer cereals	Agrre
Yield increase on treated fields in kg/ha	477 (19.8%)	300 (12.4%)	670 (36.8%)
Cost of herbicides* in terms of kg seed/ha.	99	135	189
Economical effect in terms of kg seed/ha.	378	165	481

* Yield equivalents at 1985 prices.

REFERENCES

Eberhard, E.D.(1982) Tebutan and Alachlor, a herbicide combination for winter oilseed rape. Proc. 1982 Br. Crop Protection - Weeds, 129-134.

Gladders, P.; Musa, T.M. (1982) Effects of several herbicides on diseases of winter oilseed rape. Proc. 1982 Br. Crop Protection Conference - Weeds. 115-122.

Luning, H.U.; Benoist, M.; Honecker, H. (1983) Nouvelle possibilite d'emploi du Butisan S desherbant de Colza. 6th International Rapeseed Conference. Paris, 1257-1262.

Rola, J.; Franek, M. (1983) Versuchsergebnisse mit herbizidkombinationen zur unkrautbekampfung in winterraps in Polen. 6th International Rapeseed Conference, Paris. 1211-1217.

Spencer, D.H. (1983) Development of Comodor (72% tebutam) in the U.K. for pre-emergence weed control in winter oilseed rape. 6th International Rapeseed Conference, Paris. 1251-1256.

Stormonth, D.A.; Woodroffe, R. (1982) The use of metazachlor for the control of weeds in winter oilseed rape. Proc. 1982 Br. Crop Protection Conference - Weeds. 103-108.

Ward, J.T. (1982) Weed control in winter oilseed rape. Proc. 1982 Br. Crop Protection Conference - Weeds. 97-102.

ANNUAL GRASS AND BROAD-LEAVED WEED CONTROL IN WINTER OILSEED RAPE

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ABSTRACT

In the harvest years 1983 and 1984, ADAS carried out a trial series to compare a range of herbicides applied in tank-mixture or sequence with TCA or fluazifop-butyl, and to assess new herbicides and different timings of existing ones. Significant yield increases from weed removal were achieved at 5 of the 9 harvested sites in 1984, but in 1983 yield increases were small and only occasionally significant. Levels of weed control generally reflected the mode of action and susceptible weed spectra of the herbicide in question.

INTRODUCTION

The results of ADAS experiments in 1979-82 failed to provide consistent evidence that the early elimination of weeds by the use of pre-drilling or pre-emergence herbicides led to higher seed yields than where post-emergence herbicides were applied (Ward, 1982; Ward and Askew, 1984).

Five experiments in harvest year 1983 and 10 in 1984 continued previous work on the assessment of herbicides for the control of both annual grass and broad-leaved weeds in winter oilseed rape. Six herbicides in 1983 and 5 in 1984 were compared either in tank-mixture or sequence with TCA or fluazifop-butyl.

The levels of weed control and the yields obtained from the harvested experiments are presented.

MATERIALS AND METHODS

The experimental treatments included combinations of pre-drilling, pre-emergence and post-emergence herbicides, applied either as tank-mixtures or sequences (Table 1) to crops of winter oilseed rape established by normal farm practice. Sites were located in various areas of England; individual site data are recorded in Table 2. Seed yields were recorded in most cases, crops having been pre-conditioned by swathing or desiccation and then combine harvested.

Plot sizes varied from 36 to 92.5m^2, and 3 or 4 replicates were used.

Whilst the incidence of weeds at the various sites was recorded using different quadrat sizes and methods, details are reported in this paper as percentage weed control. Levels of individual weed infestations are shown as number/m^2 or per cent ground cover; infestations less than 7 weeds/m^2 are not reported. Cereals were established at Sites 1, 2 and 6-11 to simulate heavy infestations of volunteer plants.

RESULTS

Seed yields are presented in Tables 3 and 5, percentage reduction of grass weeds and volunteer cereals in Tables 4 and 6, and percentage reduction of broad-leaved weeds in Tables 4 and 7.

TABLE 1 Herbicides : timings and application rates

	Dose kg ai/ha 1983*	1984
Pre-drilling		
TCA + trifluralin	10.5 + 1.1	10.5 + 1.1
TCA + triflualin + napropamide	10.5 + 0.98 + 0.98	10.5 + 1.1 + 0.94
Pre-emergence		
TCA + tebutam	10.5 + 3.6	10.5 + 3.6
TCA + metazachlor	10.5 + 1.25	10.5 + 1.25
Sequential applications		
TCA/propyzamide + clopyralid	10.5/0.775	10.5/0.775
TCA/benazolin + clopyralid	10.5/0.35	-
TCA/carbetamide + dimefuron	-	10.5/2.8
trifluralin/fluazifop-butyl	1.1/0.25	
trifluralin + napropamide/fluazifop-butyl	0.98 + 0.98/0.25	1.1 + 0.94/0.25
tebutam/fluazifop-butyl	3.6/0.25	3.6/0.25
metazachlor/fluazifop-butyl	1.25/0.25	1.25/0.25
metazachlor/metazachlor + fluazifop-butyl	-	0.75/0.5 + 0.25
fluazifop-butyl/propyzamide + clopyralid	0.25/0.775	0.25/0.775
fluazifop-butyl/benazolin + clopyralid	0.25/0.35	-
fluazifop-butyl/carbetamide + dimefuron	-	0.25/2.8
fluazifop-butyl/propyzamide + cyanazine	-	0.25/0.7 + 0.375
fluazifop-butyl/pyridate	-	0.25/1.5

*at sites 1 and 2, doses of TCA reduced to 8.0 kg ai/ha and fluazifop-butyl increased to 0.3 kg ai/ha.

TABLE 2 Site data for experiments in 1983 and 1984 harvest years

Site ref	Location	Soil texture	cv	Application details: Sprayer	Nozzle	Water (l/ha)	Pressure (bars)
1983 harvest							
1	Essex	ZyL	Lingot	) Van	) Allman)	225*	2.2*
2	Northants	FSL	Jet Neuf	) der	) '00')		
3	Notts	LS	Rafal	) Weij	) Teejet	200	2.0
4	Hants	ZyL	Jet Neuf	CP3	) 8002	225	2.4
5	Yorks	ZyCL	Rafal	OPS	Teejet 11003	255*	2.0*
1984 harvest							
6	Norfolk	SCL	Jet Neuf	)			
7	Northants	ZyCL	Bienvenu	) Van	Teejet		
8	Cambs	ZyCL	Jet Neuf	) der	11002	225*	2.1*
9	Suffolk	SCL	Rafal	) Weij			
10	Lincs	SCL	Jet Neuf	)			
11	Essex	ZyCL	Rafal				
12	Hants	ZyL	Jet Neuf	OPS	) Teejet	225	2.4
13	Warwicks	FSL	Bienvenu	) Van	) 8002		
14	Notts	ZyCL	Bienvenu	) der) Weij	))	200	2.0
15	Yorks	ZyCL	Rafal	OPS	Teejet 11003	273*	2.0*

*propyzamide + clopyralid applied in 300-325 l/ha water at 3.1-3.2 bar depending on site.

TABLE 3 Crop yields (tonnes/ha @ 92% DM) 1983 harvest

Site	1	2	3	4	5	Mean
sed ±	0.151	0.267	0.114	0.242	0.219	-
TCA + trifl	3.04	2.82	2.93	2.03	2.82	2.73
trifl/fluaz	2.94	2.52	2.85	2.16	3.06	2.71
TCA + trifl + naprop	3.04	2.50	2.88	2.04	2.49	2.59
trifl + naprop/fluaz	2.94	2.67	2.94	2.21	3.01	2.75
TCA + tebutam	2.69	2.60	2.87	2.00	2.71	2.57
tebutam/fluaz	3.12	2.76	3.03	1.98	2.97	2.77
TCA + metaz	2.84	2.51	2.98	1.98	2.74	2.61
metaz/fluaz	2.87	2.74	2.86	2.40	2.74	2.72
TCA/propyz + clopyr	2.82	2.43	2.84	1.96	2.83	2.58
fluaz/propz + clopyr	2.81	2.76	3.07	2.30	2.47	2.68
TCA/benaz + clopyr	2.74	2.53	2.84	1.92	2.88	2.58
fluaz/benaz + clopyr	2.97	2.52	2.76	1.82	3.00	2.61
untreated	2.74	2.59	2.94	2.34	2.91	2.70

TABLE 4 Per cent grass and broad-leaved weed control 1983 harvest

Species:	Vol barley		Vol wheat and barley	*Stellaria media*			*Veronica* spp		*Matricaria* spp	
Site:	1	5	2	2	3	4	3	5	1	3
TCA + trifl	11	60	34	65	47	70	87	95	0	3
trifl/fluaz	100	100	100	78	53	67	100	98	0	13
TCA + trifl + naprop	50	76	75	93	87	82	97	100	81	43
trifl + naprop/fluaz	100	100	98	93	97	70	100	100	38	67
TCA + tebutam	70	92	88	91	93	68	100	100	5	70
tebutam/fluaz	100	100	98	98	97	70	100	98	0	70
TCA + metaz	85	59	73	87	100	98	100	100	76	93
metaz/fluaz	100	100	100	87	100	95	100	100	57	100
TCA/propyz + clopyr	8	100	96	69	97	32	97	100	29	77
fluaz/propyz + clopyr	100	100	100	71	63	0	73	100	29	60
TCA/benaz + clopyr	100	95	20	78	80	40	50	100	57	80
fluaz/benaz + clopyr	100	98	94	78	57	60	40	92	76	77
untreated:										
weeds/m²	317	-	331	12	-	25	-	-	15	-
per cent ground cover	-	9.9	-	-	32	-	7	9	-	10

TABLE 5 Crop yields (tonnes/ha @ 92% DM) 1984 harvest

Site:	6	8	9	10	11	12	13	14	15	Mean
sed ±	0.110	0.163	0.146	0.212	0.187	0.139	0.177	0.167	0.134	0.054
TCA + trifl	2.93	3.90	4.16	3.39	3.36	-	-	-	-	-
TCA + trifl + naprop	3.00	3.86	4.09	3.58	3.41	3.15	4.44	3.74	4.46	3.75
trifl + naprop/fluaz	3.47	4.09	4.19	3.54	3.42	3.32	4.26	3.91	4.79	3.89
TCA + tebutam	3.10	3.85	4.17	3.95	3.46	3.21	4.48	3.65	4.61	3.83
tebutam/fluaz	3.36	4.03	4.12	3.96	3.46	3.12	4.40	3.58	4.61	3.85
TCA + metaz	3.10	4.03	4.29	3.24	3.61	3.21	4.38	3.78	4.33	3.77
metaz (pre-em)/fluaz	3.51	4.21	4.22	3.85	3.48	3.20	4.30	3.58	4.60	3.88
metaz (post-em)/fluaz	3.23	3.83	4.11	3.78	3.61	3.22	4.32	3.76	4.65	3.84
metaz/metaz + fluaz	3.28	4.16	4.20	3.44	3.51	3.14	4.21	3.98	4.77	3.85
TCA/carbet + dimef	3.16	3.99	4.25	3.43	3.43	3.25	4.28	3.70	4.52	3.78
fluaz/carbet + dimef	3.12	3.93	4.06	3.70	3.37	3.15	4.46	3.56	4.70	3.78
TCA/propyz + clopyr	3.05	4.05	4.13	3.33	3.43	3.15	4.31	3.73	4.46	3.74
fluaz/propyz + clopyr	3.13	3.94	4.18	3.51	3.57	3.17	4.28	3.88	4.72	3.82
fluaz/propyz + cyan	3.29	3.95	4.14	3.72	3.63	3.18	4.18	3.36	4.84	3.81
fluaz/pyridate	3.30	3.86	3.65	3.54	3.60	3.20	4.43	3.62	4.52	3.75
untreated	2.93	3.46	3.64	1.12	2.70	3.21	4.36	3.63	4.67	3.37

TABLE 6 Per cent grass weed control 1984 harvest

Weed species:	Volunteer wheat							Volunteer barley		*Poa annua*
	6	7	9	10	11	13	14	8	15	15
TCA + trifl	94	68	86	38	98	-	-	86	-	-
TCA + trifl + naprop	97	70	95	82	93	67	77	90	21	100
trifl + naprop/fluaz	100	98	100	100	100	93	100	100	100	97
TCA + tebutam	99	87	100	93	100	93	99	99	93	98
tebutam/fluaz	99	98	100	100	100	100	100	100	100	97
TCA + metaz	98	88	100	98	100	95	98	89	100	100
metaz (pre-em)/fluaz	100	98	100	100	100	96	100	100	100	100
metaz (post-em)/fluaz	100	98	100	100	100	97	100	100	100	100
metaz/metaz + fluaz	99	94	100	100	100	98	100	100	100	100
TCA/carbet + dimef	99	95	100	100	100	98	99	99	100	92
fluaz/carbet + dimef	94	98	100	100	100	100	99	100	82	70
TCA/propyz + clopyr	100	97	100	100	100	98	98	100	100	100
fluaz/propyz + clopyr	100	100	99	98	100	98	100	100	96	96
fluaz/propyz + cyan	100	99	100	100	100	100	93	100	100	98
fluaz/pyridate	93	93	100	97	100	32	99	100	96	58
untreated : weeds/m^2	108	773	500	225	567	23	10	754	9	39

TABLE 7 Per cent broad-leaved weed control 1984 harvest

Weed species:	Stellaria media				Veronica spp				Matricaria spp		Sinapis arvensis			Galium aparine	Lamium hybridum
Site:	6	10	13	15	6	9	10	15	8	9	8	10	11	7	14
TCA + trifl	94	100	-	-	100	100	75	-	59	7	14	63	0	71	-
TCA + trifl + naprop	100	100	77	97	100	100	92	100	86	91	20	16	0	53	77
trifl + naprop/fluaz	100	84	36	94	100	90	83	98	63	44	40	30	3	76	97
TCA + tebutam	100	100	100	77	93	100	100	70	77	100	27	63	0	41	100
tebutam/fluaz	88	92	98	88	86	90	100	63	69	81	0	35	0	23	51
TCA + metaz	100	100	100	100	97	100	100	98	100	100	87	81	49	71	100
metaz (pre-em)/fluaz	100	100	100	94	100	100	100	93	100	100	39	53	59	56	52
metaz (post-em)/fluaz	82	100	90	39	100	100	92	86	100	81	53	0	3	65	84
metaz/metaz + fluaz	94	100	100	94	97	81	100	98	94	91	20	35	38	16	93
TCA/carbet + dimef	82	100	93	68	97	100	100	95	75	91	93	91	90	0	98
fluaz/carbet + dimef	69	100	96	4	90	81	100	93	49	35	93	95	54	23	97
TCA/propyz + clopyr	82	100	93	59	59	29	17	61	63	35	100	58	33	0	62
fluaz/propyz + clopyr	82	84	89	45	59	32	0	0	26	53	80	67	0	29	38
fluaz/propyz + cyan	82	100	100	27	63	90	0	89	24	91	100	77	95	41	87
fluaz/pyridate	0	76	0	0	80	81	92	0	89	100	66	95	100	76	99
untreated : weeds/m^2	11	8	15	11	20	7	8	15	24	7	17	14	13	11	22

DISCUSSION

In 1983 harvest year, the effects of weed control on yield were few, possibly due to late drought limiting yields (Table 3). In 1984, however, 5 of the 9 harvested sites gave yield increases from weed removal, but these were where high populations of volunteer cereals ($>100/m^2$) had been established (Table 5). The comparison of TCA and fluazifop-butyl when used in tank-mixture or sequence with a range of other herbicides indicated a slight trend towards higher yields following the use of the latter, but differences rarely achieved significance. There was no consistent advantage from early weed removal due to the use of the other pre-drilling or pre-emergence herbicides.

At several sites in 1984, the use of carbetamide + dimefuron, propyzamide + cyanazine and pyridate following fluazifop-butyl, and carbetamide + dimefuron following TCA caused various degrees of scorch to the foliage of the oilseed rape. This was mainly outgrown by the onset of flowering and did not affect yields. Metazachlor applied at full dose pre-emergence of the crop caused a check to early growth at some sites, but applied either post-emergence or split between pre and post-emergence it appeared much less phytotoxic. In most cases, yields were not affected.

In 1983, (Table 4) treatments involving the use of herbicides in sequence with fluazifop-butyl produced high levels of volunteer cereal control. In tank-mixture or sequence with TCA, however, control was not always so good. Levels of volunteer cereal control were generally better in 1984 (Table 6).

Stellaria media and *Veronica* spp are competitive weeds in oilseed rape, but were well controlled by many of the herbicide combinations (Tables 4 & 7). *Matricaria* spp., which can be particularly troublesome at harvest, were not well controlled by most herbicides at Sites 1 and 3 in 1983, but were fully controlled by several in 1984. *Galium aparine*, frequently only poorly controlled in commercial crops, was only present at Site 7 where 4 treatments gave better than 70 per cent control of it. Autumn germinating *Sinapis arvensis* may fail to survive the winter but can be a serious contaminant of rapeseed. At Sites 8, 10 and 11 it was adequately controlled by several herbicide sequences.

CONCLUSION

This series of trials suggested that where crops of winter oilseed rape were established well, their yields were not significantly reduced by the presence of uncontrolled low populations of either grass or broad-leaved weeds. Where higher populations ($>$ 100 plants/m^2) of volunteer cereals were not controlled, however, yields were usually reduced. The timing of weed control did not have significant effects on yield; neither did the herbicide sequence used, provided it was capable of controlling the particular weeds present.

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REFERENCES

Ward, J.T. (1982). Weed control in winter oilseed rape. Proceedings British Crop Protection Conference - Weeds. 1, 97-102

Ward, J.T. & Askew, M.F. (1984). The control of annual grass and broad-leaved weeds in winter oilseed rape. Aspects of Applied Biology 6. 239-250.

GRASS WEED CONTROL IN WINTER OILSEED RAPE WITH ISOMERS OF FLUAZIFOP-BUTYL

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ABSTRACT

Fluazifop-butyl (PP009) is a racemic mixture of two isomers. Only one isomer (fluazifop-P-butyl or PP005) is active as a post-emergence graminicide. A formulation containing only this resolved form has been successfully evaluated for the control of annual grass weeds in oilseed rape. This formulation now has Ministry Approval.

PP009 and PP005 were compared with TCA in spray programmes with other standard herbicides for combined grass and broad-leaved weed control, the PP009 and PP005 treatments giving consistently better control of volunteer cereals and *Alopecurus myosuroides*. These treatments also outyielded the TCA treatments.

Early autumn sprays of PP005 offer the farmer a substantial yield benefit as well as flexibility of spray timing and consistently good grass weed control. Post-emergence treatment with PP009 avoids the need for pre-drilling incorporation of TCA and this can save time at drilling.

PP005 can be used in tankmix with cypermethrin for combined grass weed and pest control in oilseed rape. PP005 can also be used in tankmix with the following herbicides, clopyralid, benazolin/clopyralid and metazachlor.

INTRODUCTION

The use of fluazifop-butyl (PP009) in oilseed rape was first reported at this conference in 1980 (Plowman *et al* 1980, Finney and Sutton 1980). Since then PP009 has been widely used for grass weed control in oilseed rape and has become established as a standard graminicide. It has been included in many ADAS and WRO trials (Orson 1984, Lutman 1984, Ward and Askew 1984). These trials have confirmed the yield benefits and good grass weed control resulting from well timed sprays of PP009 either alone or in sequence with other standard herbicides.

Volunteer cereals and other annual grass weeds such as *Alopecurus myosuroides*, *Avena fatua* and *Bromus sterilis* are all controlled by PP009. These weeds are highly competitive with the young oilseed rape plants which can be smothered and killed, particularly by volunteer barley in the combine swath. The removal of grass weeds is also important because the crop is grown as a break crop in a cereal rotation. Grass weeds can carryover pests and diseases into following or adjacent crops.

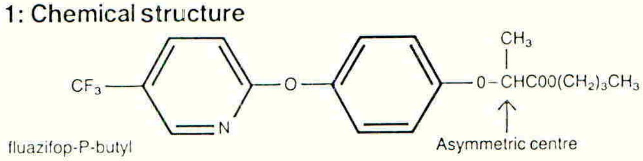
PP009, which has been sold as 'Fusilade', is in fact a racemic mixture of two isomers (enantiomers). This paper presents the results of trials evaluating PP009 and its R-enantiomer PP005 for use in oilseed rape.

The objectives of the trials were:
1. To compare fluazifop-P-butyl (PP005) and fluazifop-butyl (PP009).
2. To compare spray programmes based on PP005 or PP009 with TCA in spray programmes with other standard herbicides.
3. To evaluate PP005 and PP009 in tankmix with other herbicides and with cypermethrin.

CHEMICAL STRUCTURE

The two isomers of fluazifop-butyl result from the existence of an asymmetric centre in the molecule (Figure 1). These isomers differ in the arrangement of the groups around the asymmetric centre. ICI's scientists at Jealott's Hill Research Station have synthesised relatively pure forms of the two isomers and tested them in the herbicide screens. Only one form (PP005) is active as a post-emergence graminicide; the other form is practically inactive (Dicks et al 1985).

Fig 1: Chemical structure



PP005 is the active ingredient in 'Fusilade' 5, which is now Approved for use in winter oilseed rape, as well as in sugar and fodder beet.

MATERIALS AND METHODS

The two formulations are compared in Table 1. They contain the same quantity of fluazifop-P-butyl (125g/l).

TABLE 1

Formulation details	PP005 12.5% e.c.	PP009 25% e.c.
Fluazifop-P-butyl (active isomer)	125g/l	125g/l
S-fluazifop-butyl (inactive isomer)	-	125g/l

The results in this paper have been selected from three types of trial.

Field Screening.
The treatments were applied to a 1 m strip of crops and weeds drilled in rows.

Field Trials
These 11 experiments consisted of 3-4 randomised blocks of 10-14 treatments. The plot size was 2.5-3.0m x 10-25m.

Compatibility Screens
In these experiments the treatments were applied at standard and double rates across six varieties of oilseed rape.

Spraying

All treatments were applied in 200-250 l water/ha using hand-held CO_2 powered spray booms fitted with TeeJets and operated at 2.1 bar. 'Agral', an Approved wetting and spreading agent, was always added with PP005 or PP009 to give a concentration of 0.1% in the diluted spray.

Assessments

Crop damage (Chlorosis, Necrosis or Vigour) was assessed visually. Weed control was either assessed visually or by a weed count using five $0.16m^2$ quadrats per plot. Yields were taken using a small plot combine. In all tables figures within each trial with the same letters in common are not significantly different (P=0.05), using Duncan's multiple range test.

Details of trial sites and trial spraying dates are given in Table 2.

TABLE 2

Trial No.	Site	Spray dates Pre-drill & pre-em products	PP009/ PP005	Post-em products	Grass weed GS for PP009/PP005	Assess-ment dates
001	Jealotts Hill Berks.	-	10.05.82	-	1-3 leaves	21.6.82
NE10	Sleaford Lincs	-	5.10.82	-	3 lvs-2 tillers	1.12.82
WM12	Kineton Warwickshire	-	4.11.82	-	3 lvs-tillered	5.01.83
021	Bury St Edmunds Suffolk	-	27.10.82	-	2-3 leaves	15.12.82
022	Bury St Edmunds Suffolk	-	27.10.82	-	2-3 leaves	15.12.82
023	Kineton Warwickshire	-	18.10.82	-	1-2 leaves 2-3 tillers	26.11.82
024	Kineton Warwickshire	-	25.10.82	-	1-2 leaves 2-3 tillers	7.12.82
NE6	Sleaford Lincs	6.08.82 6.08.82	5.10.82	27.10.82	3 lvs-2 tillers	1.12.82 14.03.83
NE7	Corby Lincs	26.08.82 26.08.82	4.10.82	27.10.82	3 lvs-2 tillers	29.11.82 10.03.83
SAI8	Kilrenny Fife	16.08.82 16.08.82	22.09.82	12.10.82	3-4 leaves	15.12.82 24.03.83
SAI10	Balbeggie Perthshire	21.08.82 25.08.82	21.09.82	14.10.82	1-2 leaves	15.12.82 28.03.83
EM5	Meldreth Cambs.	20.08.82 26.08.82	25.10.82	26.11.82	3 leaves	19.11.82 5.04.83

RESULTS

Field Screening

Results from early field screening give a good indication of the relative efficacy on a range of annual grasses (Table 3). In all tables rates of chemicals are in terms of active ingredient per hectare.

TABLE 3

Comparison of PP005/PP009, Jealott's Hill Research Station, Trial 001,1982

Treatment	Rate g/ha	Rate l/ha	% Weed Control (6 weeks post spray) Avena fatua	Alopecurus myosuroides	Bromus sterilis	Lolium perenne	Barley	Mean
PP005	62.5	0.5	90	95	80	35	90	78
12.5% e.c.	125	1.0	100	100	100	60	100	92
PP009	125	0.5	80	90	70	40	80	72
25% e.c.	250	1.0	100	100	100	65	100	93

In this experiment the products gave similar levels of control at 0.5 and 1.0 l/ha. This suggests that PP005 is twice as active as the racemic mixture on a weight for weight basis. This hypothesis was tested in the following series of field trials.

Comparison of PP005 and PP009

In these six replicated trials PP005 at rates of 125, 187.5 and 375g/ha was compared to 250, 375 and 750g/ha of PP009.

The weed control data for the lower rates is summarised in Table 4. Both PP005 at 125g/ha and PP009 at 250g/ha have given good control of volunteer cereals and *Alopecurus myosuroides*. The rate response was significant in one trial on *Alopecurus myosuroides*.

TABLE 4

Control of Grass Weeds in Oilseed Rape 1982/83
% Reduction in weed population (6-9 weeks post-spray)

Trial	Fluazifop-P-butyl (PP005) 125 g/ha	Fluazifop-P-butyl (PP005) 187.5 g/ha	Fluazifop-butyl (PP009) 250 g/ha	Fluazifop-butyl (PP009) 375 g/ha	Untreated (No/m^2)
		Volunteer Barley			
NE10	100 b	100 b	100 b	100 b	(175) a
021	82 b	79 b	92 b	89 b	(30) a
023	96 b	99 b	95 b	98 b	- a
024	90 b	94 b	89 b	93 b	- a
Mean	92	93	94	95	
		Alopecurus myosuroides			
WM12	99 b	100 b	98 b	98 b	(106) a
021	92 b	95 b	89 b	94 b	(516) a
022	96 b	95 b	90 b	95 b	(221) a
024	90 b	96 c	87 b	97 c	- a
Mean	94	97	91	96	
		Volunteer Wheat			
WM12	100 b	92 b	98 b	95 b	(9) a

These results confirm that the PP005 is twice as active as the racemic mixture. In fact these results confirm that fluazifop-P-butyl is the herbicidally active isomer, the two formulations contain 125g/l of this isomer and are equally active litre for litre.

The highest rates tested were overlap rates and proved safe to the crop as no crop damage was reported in these trials.

Occasionally PP009 has been reported to have a transient effect on the leaf surface; this is not de-waxing. At Jealott's Hill electron microscopy showed that the oils and surfactants from the formulation can be deposited on the wax and thereby reduce the light scattered by the surface, which in turn makes the leaf more translucent.

This reduction of light scatter by the leaf surface must not be confused with de-waxing such as that caused by TCA, which physiologically prevents the formation of epicuticular wax on plants such as Brassicae. Gladders and Musa in 1982 reported that the usage of TCA on oilseed rape increased the incidence of leaf and stem infections of Leptosphaeria maculans and Alternaria brassicae and that this was associated with a decrease in leaf wax and/or increasing leaf wettability.

Sequential Use in Weed Control Programmes

Winter oilseed rape crops are now being drilled in the second half of August when soil temperatures are high (c.16°C) and if moist are ideal for weed germination and growth. Consequently most farmers use two sprays for combined grass and broad-leaved weed control and aim to complete their spraying before December.

In this series of five trials comparing PP009 with TCA spray programmes, the results show how favourably the PP009 based programmes compare with those using TCA (Table 5).

TABLE 5

Weed Control Programmes in Oilseed Rape 1982/83
% Reduction in volunteer barley (Nov/Dec assessment following autumn treatment)

1st Spray (Rate kg/ha)	2nd Spray (Rate kg/ha)	Trial NE6	NE7	SAI10	EM5	Mean
TCA (11)	tebutam (3.6)	95 d	99 d	93 bc	96 b	94
TCA (11)	naprop/triflur (2)	82 c	-	77 b	81 b	80
TCA (11)	metazachlor (1.25)	-	95 c	-	-	-
TCA (11)	propyzamide (0.7)	55 b	85 b	82 bc	82 b	76
TCA (11)	benaz/clopyr (0.8)	65 b	82 b	69 b	82 bc	75
Tebutam(3.6)	PP009 (0.25)	100 e	100 d	100 c	100 e	100
Napro/trifl(2)	PP009 (0.25)	100 e	-	100 c	91 bd	97
Metaz (1.25)	PP009 (0.25)	-	100 d	-	-	-
PP009 (0.25)	propyzamide (0.7)	100 de	100 d	100 c	94 cd	99
PP009 (0.25)	benaz/clopyr (0.8)	100 e	100 d	100 c	96 de	99
PP005 (0.125)	benaz/clopyr (0.8)	100 e	100 d	100 c	94 cd	
Untreated (No/m^2)		(79) a	(208) a	(21) a	(42) a	

At the 250g/ha rate PP009 gave 91-100% control of volunteer barley in the autumn. PP005 at 125g/ha also gave very good control. This is significantly better than that from the TCA based programmes. Results of a spring assessment were similar except that the level of control from the slower acting propyzamide/TCA programme had increased to 99%.

Results for other grass weeds are summarised in Table 6. At the 250g/ha rate PP009 followed by benazolin/clopyralid gave significantly better control of Alopecurus myosuroides than the programme of TCA followed by benazolin/clopyralid. The PP009 treatment also gave useful suppression of Elymus repens at one site. Again PP005 at 125g/ha has given a similar level of control. Poa annua control was generally good from treatments including tebutam, napropamide/trifluralin and propyzamide.

TABLE 6

Weed Control Programmes in Oilseed Rape 1982/83
% Reduction in weed population (Spring assessment following autumn treatment)

1st Spray (Rate kg/ha)	2nd Spray (Rate kg/ha)	Weed / Trial	Alopecurus myosuroides NE6	Elymus repens NE7	Poa annua NE6	Poa annua SAI8
TCA (11)	tebutam (3.6)		93 bc	63 ab	95 bc	100 c
TCA (11)	naprop/triflur (2)		95 bc	-	89 cd	100
TCA (11)	metazachlor (1.25)		-	75 bc	-	-
TCA (11)	propyzamide (0.7)		100 c	96 bd	100 e	100 c
TCA (11)	benaz/clopyr (0.8)		73 b	78 bd	71 bc	100 c
Tebutam(3.6)	PP009 (0.25)		100 c	99 cd	99 de	99 c
Napro/trifl(2)	PP009 (0.25)		100 c	-	99 de	99 c
Metaz (1.25)	PP009 (0.25)		-	96 bd	-	-
PP009 (0.25)	propyzamide (0.7)		100 c	100 d	100 e	96 c
PP009 (0.25)	benaz/clopyr (0.8)		100 c	85 bd	60 b	0 a
PP005 (0.125)	benaz/clopyr (0.8)		100 c	96 cd	51 b	8 b
Untreated	(No/m^2)		(33) a	(48) a	(47) a	(28) a

The most frequently occurring broad-leaved weed in these trials was Stellaria media. This was assessed at four sites and all of the broad-leaved weed herbicides gave good control (Table 7). Veronica persica was assessed at two sites, where tebutam and napropamide/trifluralin gave the best control. Data for the other weeds which occurred at one site only are summarised in Table 7.

TABLE 7

Weed Control Programmes in Oilseed Rape, 1982/83
% Reduction in weed population (Spring assessment)

Weed / Trial no.	Stellaria media (4 trials)	Veronica persica SAI8/EM5	Viola arvensis SAI10	Lamium purpureum SAI8	Myosotis arvensis SAI8
Treatment (Rate kg/ha)					
tebutam (3.6)	92	91	70	59	27
naprop/triflur (2)	93	99	66	100	90
propyzamide (0.7)	81	70	37	24	33
benaz/clopyr (0.8)	86	57	30	48	100
Untreated (No./m^2)	(17)	(20)	(10)	(6)	(4)

Two trials in this series were taken to yield and the PP009 programmes outyielded the TCA based programmes by 0.13 t/ha (SAI8) and 0.07 t/ha (EM5). Similar differences were seen in earlier trials (Gibbard *et al*, 1982). Trial SAI8 was in Scotland and in the two Scottish trials dewaxing was seen with the TCA treatments. This effect persisted into the spring.

Use in tank mixtures for pest and broad-leaved weed control

The inclusion of suitable tank mixing recommendations is frequently requested by farmers and enables them to simplify their spray programmes.

As with PP009, the most important PP005 mixture used on the UK oilseed rape crop is the tank mix with cypermethrin ('Ambush' C). It is Approved for combined grass weed control and control of *Psylliodes chrysocephala* (Cabbage stem flea beetle). This pest is spreading rapidly and frequently requires treatment in the autumn. The mixture will also control *Ceutorhynchus picitarsis* (Rape winter stem weevil), another pest that is believed to be on the increase.

In addition to this our trials have confirmed that PP005, like PP009, can be used safely and effectively with clopyralid, benazolin/clopyralid and with metazachlor.

With all tankmixes it is important to consult and comply with the recommendations for both products.

DISCUSSION

In these trials and in many other trials around the world the comparision of the racemic mixture fluazifop-butyl with the fluazifop-P-butyl isomer has confirmed that fluazifop-P-butyl is the herbicidally active component.

In the UK we have transferred all usage from PP009 to the resolved form, PP005. We believe that in principle it must be beneficial to reduce the quantity of chemical applied for the same herbicidal activity.

The trials reported here, and independent trials from ADAS and WRO (Orson 1984, Lutman 1984, Ward and Askew, 1984) have confirmed the substantial benefits of post-emergence grass weed control in oilseed rape.

Yield data in these papers show large yield increases from grass weed control in oilseed rape. In the 15 ADAS and WRO trials the PP009 programmes have averaged a 0.52 g/ha yield increase (20%) compared to 0.26 g/ha (10%) from programmes based on TCA. The data also confirm the importance of an early post-emergence release from the weed competition; volunteer barley in the combine swath can completely smother the crop.

Use of PP005 in the early autumn (September/October) offers the farmer flexibility of spray timing without extra cultivations to incorporate pre-drilling treatments. Early drilling is seen to be essential for maximising oilseed rape yields. August and September are now two of the busiest months on large arable farms and so farmers are likely to continue to use minimal cultivations for oilseed rape establishment. This is quicker and helps to conserve moisture.

Our experience over the last five years confirms that farmers are indeed moving towards post-emergence treatments in oilseed rape and we believe that this trend is likely to continue in the future.

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NOTE: 'Agral', 'Ambush' and 'Fusilade' are trademarks of Imperial Chemical Industries PLC.

REFERENCES

Dicks, J.W.; Slater, J.W.; Beswick, D.W. (1985) PP005 - The R-enantiomer of fluazifop-butyl. Proceedings 1985 British Crop Protection Conference - Weeds.

Finney, J.R.; Sutton, P.B. (1980) Planned grass weed control with fluazifop-butyl in broad-leaved crops. Proceedings 1980 British Crop Protection Conference - Weeds 2 429-436.

Gibbard, M.; Smith, M.R.; Stoddart, G.B. (1982) Annual and perennial grass weed control with fluazifop-butyl in oilseed rape and other broad-leaved crops. Proceedings 1982 British Crop Protection Conference - Weeds 2 819-825.

Gladders, P.; Musa, T.M. (1982) Effects of several herbicides on diseases of Winter Oilseed Rape. Proceedings 1982 British Crop Protection Conference - Weeds 1 115-121.

Lutman, P.J.W. (1984) The effects of weed competition on the growth and yield of oilseed rape. Aspects of Applied Biology 6 209-220.

Orson, J.H. (1984) The effects of volunteer cereals in winter oilseed rape. ADAS results. Aspects of Applied Biology 6 179-184.

Plowman, R.E.; Stonebridge, W.C.; Hawtree, J.N. (1980) Fluazifop-butyl: a new selective herbicide for the control of annual and perennial grass weeds. Proceedings 1980 British Crop Protection Conference - Weeds 1 29-37.

Ward, J.T.; Askew, M.F. (1984) The control of annual grass and broad-leaved weeds in winter oilseed rape. Aspects of Applied Biology 6 239-250.

THE USE OF CYANAZINE ALONE, IN MIXTURE AND IN SEQUENCE FOR WEED CONTROL IN OILSEED RAPE

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ABSTRACT

Cyanazine alone, in mixture and in sequence was applied post-emergence to a total of 47 trials distributed throughout the UK.

Results from these series show that the addition of cyanazine resulted in a more rapid knockdown of weeds especially Stellaria media plus increased control of Lamium purpureum, Veronica persica, Sinapis arvensis and Urtica urens than that obtained from the application of the commercial standards alone. Trials indicate that applications should be made to crops that are well waxed and winter hardy or some crop damage may occur.

Where cyanazine + propyzamide was applied sequentially following a graminicide the only treatment where there were unacceptable crop effects was following alloxydim-sodium + oil. There were no adverse effects from tank mixing specified insecticides with cyanazine + propyzamide, cyanazine alone or the lower rate of cyanazine + benazolin/clopyralid.

INTRODUCTION

At the Ninth British weed control conference in 1968 Chapman et al introduced cyanazine as a herbicide which showed promise on a range of crops and subsequent work by Haddow et al in 1972 showed the selectivity of cyanazine post-emergence in some Brassica species.

With the increased growth in the area of oilseed rape grown there has been an increasing awareness of the limitations in the spectrum of broad leaf weed control and the slowness of action from the leading post-emergence herbicides; especially in the control of Lamium purpureum, Veronica persica, Sinapis arvensis and Urtica urens.

Initial work had shown that cyanazine at 0.375 kg a.i./ha was the optimum rate for mixture with some of these slower acting herbicides. Work commenced in 1981 with propyzamide at 0.7 kg a.i./ha as the tank mix partner.

With the advent of newer post-emergence graminicides weed pressures have changed in the crop creating a greater demand for a broad spectrum broad leaf weed herbicide. Trial work was started to examine the use of cyanazine alone at 0.5 kg a.i./ha and in mixture with clopyralid at various rates. Because cyanazine is used commercially in Denmark as a tank mix with benazolin/clopyralid on spring rape this mixture was included in the trials. The cyanazine rate was increased from 0.2 to 0.375 and 0.4 to 0.75 kg a.i./ ha to improve weed control under UK conditions in winter rape in the 1984-85 season.

METHOD AND MATERIALS

TABLE 1

Site details

Trial Ref.	Location	Soil type	Variety	Sequence	Spray Date	Crop growth stage
1981-2						
1	Herts	CL	Rafal	TCA	5.11.81	1,04
2	Cambs	Organic	Jet Neuf	TCA	4.11.81	1,06
3	Cambs	CL	Jet Neuf	TCA	6.11.81	1,04
4	Cambs	SZL	Jet Neuf	TCA	5.11.81	1,03
1982-3						
5	Cambs	Organic	Jet Neuf	-	27.10.82	1,06
6	Cambs	SCL	Jet Neuf	TCA	27.10.82	1,05
7	Cambs	SCL	Jet Neuf	TCA	22.01.83	2,00
8	Cambs	C	Jet Neuf	TCA	20.01.83	2,00
9	Cambs	SCL	Jet Neuf	-	29.11.82	1,06
10	Cambs	ZCL	Jet Neuf	TCA, Graminicide	23.01.83	2,00
11	Notts	ZL	Jet Neuf	TCA	25.11.82	1,05
12	N. Yorks	S	Jet Neuf	TCA	24.11.82	1,05
13	Cambs	Organic	Jet Neuf	Graminicide	27.10.82	1,06
14	Cambs	ZCL	Jet Neuf	TCA, Graminicide	23.01.83	3,1
15	Cambs	ZCL	Jet Neuf	TCA, Graminicide	31.03.83	3,1
1983-4						
16	Cambs	SCL	Jet Neuf	TCA	6.10.83	1,05
17	Herts	Calc SZL	Jet Neuf	TCA	21.10.83	1,05
18	Cambs	C	Jet Neuf	TCA	29.10.83	1,05
19	Glos	Cotswold Brash	Jet Neuf	Graminicide	31.10.83	1,05
20	Norfolk	LCS	Bienvenu	-	22.10.83	1,05
21	N. Yorks	ZCL	Jet Neuf	TCA	21.10.83	1,05
22	Tayside	SL	Rafal	-	21.10.83	1,06
23	Herts	Calc SZL	Jet Neuf	TCA	28.10.83	1,05
24	Herts	ZCL	Jet Neuf	TCA	29.10.83	1,05
25	Lincs	SL	Jet Neuf	TCA	25.10.83	1,04/05
26	Cambs	CL	Jet Neuf	-	4.11.83	1,04
27	N. Yorks	ZC	Jet Neuf	-	21.10.83	1,05
28	Cambs	SCL	Jet Neuf	Graminicides	3.11.83	1,04
29	N. Yorks	LS/SL	Jet Neuf	Graminicides	31.10.83	1,06
30	Tayside	SL	Rafal	Graminicides	1.11.83	1,07
31	Norfolk	LCS	Korina	-	22.10.83	1,05
32	Cambs	SCL	Jet Neuf	-	29.10.83	1,05
33	Glos	Cotswold Brash	Jet Neuf	Graminicide	31.10.83	1,04/05
34	Northants	CL	Bienvenu	-	20.10.83	1,03/04
35	Northants	CL	Bienvenu	-	4.11.83	1,04/05
36	Cambs	SCL	Jet Neuf	-	4.11.83	1,05/06
1984-5						
37	Cambs	C	Jet Neuf	Graminicides	13.12.84	1,06
38	N. Yorks	ZL	Bienvenu	Graminicides	7.12.84	2,00
39	Fife	SCL	Rafal	Graminicides	12.12.84	1,07
40	Cambs	C	Jet Neuf	-	13.12.84	1,06
41	Cambs	CL	Bienvenu	-	Timing	
42	Cambs	CL	Bienvenu	TCA	Timing	
43	Cambs	SCL	Bienvenu	-	5.02.85	2,03
44	Cambs	SCL	Bienvenu	-	27.12.84	2,00
45	Fife	SL	Bienvenu	-	15.12.84	1,06
46	N. Yorks	SL	Bienvenu	-	16.04.85	3,7
47	Cambs	ZCL	Bienvenu	-	2.04.85	3,1

Trials in oilseed rape were started in 1981 to evaluate the use of cyanazine as the 50% s.c. 'Fortrol'. Between 1981 and 1985 47 trials were laid down the site details were as shown in Table 1 with crop growth stages recorded by means of the Sylvester-Bradley key. At all sites crop effect was assessed on the 1 - 9 scale where 1 = no effect and 9 = crop removal. Weed control was assessed as % ground cover.

Forty trials were of randomised block design with 4 replicates and all applications were made with modified van der Weij sprayers with 80° fan jets at a volume of 280 litre/ha and a pressure of 2.8 bar. All plots were 12 x 3.2 metres with the exception of two timing trials (41 and 42) where plots were 6 x 3.2 m.

There were also 4 logarithmic trials (34, 35, 36 and 47) where cyanazine was applied at a peak dose of 2 kg a.i./ha in a volume of 222 l/ha, a modified van der Weij log sprayer was adapted to provide a half dose distance of 5 metres.

Due to problems associated with taking small rape plots to yield three unreplicated yield trials (23 - 25) were laid down in autumn 1983. These took the form of 1 hectare blocks treated with cyanazine at 0.375 kg a.i./ha + propyzamide at 0.7 kg a.i./ha and propyzamide alone at 0.7 kg a.i./ha. Application was by the farmer's sprayer at similar volumes and pressures to those in the replicated trials. Yields were obtained at sites 23 and 25 by bagging off from the farmer's combine, at site 24 the yield was obtained from an electronic weigher on the farmer's combine.

RESULTS

Cyanazine + propyzamide

Of the 19 replicated trials evaluating cyanazine + propyzamide little crop effect was recorded at any of the rates tested in the first two seasons except for site 5 where some leaf loss and crop check were recorded. (This site also had a heavy infestation of *Psylliodes chrysocephala*) and site 12 where there was crop shortening at the double rate.

In the third season (1983-84) crop scorch was recorded on sites where treatments were applied between 20 and 25 October 1983 these were unacceptable at all rates at site 17 and were scored 5. These subsequently recovered and only cyanazine 0.75 kg a.i./ha + propyzamide 1.4 kg a.i./ha could later be identified by a slight shortening of the crop; % total weed control from this series (trials 1 - 12 and 16 - 22) showed consistently better weed control and more rapid knockdown from treatments where cyanazine was included and this is reflected in the breakdown for the control of individual species in Table 2. Table 3 shows % weed control both total and individual species from 2 timing trials carried out in 1984-85 with cyanazine 0.375 kg a.i./ha + propyzamide 0.7 kg a.i./ha.

When cyanazine 0.375 kg a.i./ha + propyzamide 0.7 kg a.i./ha and propyzamide 0.7 kg a.i./ha were compared in yield trials little crop effect was recorded on sites 23 and 24; at site 25, 17 days after application, the crop was given a score of 4 for scorch, this was transient. Weed control at all three sites was good with both treatments controlling *Stellaria media* but only the cyanazine + propyzamide controlled *Lamium purpureum* and *Veronica persica*; these latter two weeds remained in the propyzamide treated plots at all three sites. Yields are shown in Table 4.

TABLE 2

% Broad leaf weed control

Trial No.		DAT	Cy+Prop 0.375+0.7	Cy+Prop 0.5+0.7	Cy+Prop 0.75+1.4	Prop 0.7	Prop+Clop 0.7+0.07	Prop+Ben+Clop 0.7+0.3+0.05	Assess. % weed cover
5	SM	75	100	100	100	63*	59*		76
		162	99	100	100	68	71		69
6		162	100	100	100	100	95		9
9		129	99	97	100	87	77		29
10		75	96	90	99	88	85		30
11		174	96	100	100	99	100		82
12		168	97	100	100	98	93		54
16		131	94	99	100	91	83	100	42
17		206	99	99	100	81	84	99	78
19		114	82	99	98	96	100	88	60
20		209	100	100	100	95	100	100	54
21		89	100	100	100	96**	96**	100	94
7	CS	75	91	79	82	61	70		8
10		75	43	62	81	0	40		25
12		168	38	64	76	7	88		54
5	LP	75	100	100	100	0(9)	0(14)		5
		162	97	100	100	0(16)	0(14)		11
19		114	72	94	96	97	45	65	25
21		89	100	100	100	0(8)	0	0	2
5	SA	75	100	100	100	100	29	49	4
10		75	100	100	100	25	50		5
9	VP	129	70	68	92	38	32		16
10		75	62	71	100	52	50		7
11		174	97	99	100	99	99		52
17		206	100	100	100	88	82	85	19
19		114	79	88	79	81	68	81	40
21	UU	89	100	100	100	0	45	47	10
20	PR	209	0	0	64	0(85)	0(82)	0(83)	63

SM = Stellaria media; CS = Chamomilla suaveolens; LP = Lamium purpureum; SA = Sinapis arvensis; VP = Veronica persica; UU =Urtica urens; PR = Papaver rhoeas *Stellaria still dying; ** 80% ground cover of dead Stellaria; figures in parenthesis indicate % weed cover where this exceeds the control.

TABLE 3

% Weed control from cyanazine/propyzamide at 5 timings (1984/5)

Trial No			41 (NO TCA)				42 (AFTER TCA)			
	Date	CGS	Total	Monocots*	Stel	Veron	Total	Monocots*	Stel	Veron
1	24.10.84	1,04	72	37	85	78	86	75	89	82
2	27.10.84	1,04	84	72	91	75	83	61	89	84
3	30.10.84	1,05	91	74	98	85	94	79	98	84
4	7.11.84	1,05	85	80	95	61	87	100	90	73
5	6.12.84	2,00	89	89	92	80	93	100	94	88
% weed cover			91	15	49	20	102	9	67	18

*as Avena fatua Alopecurus myosuroides and vol cereals.
Stel = Stellaria media; Veron = Veronica persica

In two further trials (26 and 40) Fenvalerate at 0.025 kg a.i./ha and alfamethrin (proposed common name) at 0.01 kg a.i./ha were added to cyanazine 0.375 kg a.i./ha + propyzamide 0.7 kg a.i./ha and there was no crop effect, the weed control was comparable to cyanazine + propyzamide alone.

TABLE 4

Yield of Rape Seed (tonnes/ha)

Trial No.	23	24	25
cyanazine 0.375 kg a.i./ha + propyzamide 0.7 kg a.i./ha	3.18	4.45	4.31
propyzamide 0.7 kg a.i./ha	3.15	4.39	3.51

Where cyanazine 0.375 kg a.i./ha + propyzamide 0.7 kg a.i./ha followed a graminicide (trials 28 - 30 and 37 - 39) the only sequence where unacceptable crop check occurred (at 3 sites) was following alloxydim - sodium + oil. Little difference was recorded between treatments for weed control - these were following fluazifop-butyl + wetter 0.375 + 0.252 kg a.i./ha; alloxydim-sodium 0.934 kg a.i./ha; alloxydim-sodium + oil 0.5624 + 2.425 kg a.i./ha; fenthiaprop ethyl 0.223 kg a.i./ha; sethoxydim + oil 0.29 + 2.425 kg a.i./ha; haloxyfop (ethoxyethyl ester) 0.125 kg a.i./ha; and quizalfop-ethyl + oil 0.125 + 1.98 kg a.i./ha.

Cyanazine alone and with benazolin or clopyralid for broad leaf weed control

TABLE 5

% Broad leaf weed control

Trial No.	DAT	Cy 0.5	Cy+Cl 0.5+ 0.05	Cy+Cl 0.35+ 0.06	Cy+Cl 0.525+ 0.09	ben/Cl 0.30+ 0.05	Cy+ben/Cl 0.2+ 0.21/0.035	Cy+ben/Cl 0.4+ 0.42/0.07	Assess. % weed cover
13 SM	75	98	93						89
	162	96	86						79
14	73	70	46			85	83		30
15	36	63	65	61	72	44*			54
31	209				100	100	100	100	48
32	192				92	100	100	100	7
33	114				94	100	100	100	83
43	77	91			95	97	99	100	64
44	123	89			89	100	100	100	45
46	100	100		99	100	100	100	100	52
14 VP	73	61	57						7
15	36	40	60	52	20	0			6
31	209				100	15	52	48	12
32	108				97	25	80	88	15
33	114				58	5	47	47	48
44	123	97			100	9	91	93	9
14 CS	73	47	66			59	60		25
15	36	36	30	50	50	20			13
31	209				100	100	95	100	10
44	123	76			97	55	64	97	8
13 LP	75	94	79						5
	162	100	71						11
32	108				100	14	91	100	9
13 SA	75	100	93						4
14	73	100	100			11	100		5
33 PR	234				74	17	41	89	23

*Stellaria still dying off. Cy = cyanazine; Cl = clopyralid; ben = benazolin. SM = Stellaria media; VP = Veronica persica; CS = Chamomilla suaveolens; LP = Lamium purpureum; SA = Sinapis arvensis; PR = Papaver rhoeas.

Total weed control from this series (trials 13 - 15, 31 - 33 and 43 - 46) show consistent improvement and more rapid knockdown by the addition of cyanazine over benazolin + clopyralid alone and the breakdown of species can be seen in Table 5. Crop effects in this series were minimal except at site 31 where crop scorch (3.5) was recorded in every cyanazine treatment 16 days after application on 22.10.83, this effect was transient. At site 43 application date was 5.2.85. damage to the older leaves of the crop was recorded 45 days after application; this also occurred to a lesser degree on the control plot, but all plots completely recovered. Within this series alfamethrin at 0.01 kg a.i./ha was tank mixed with both cyanazine 0.5 kg a.i./ha and the lower rate of cyanazine + benazolin/clopyralid. The addition of alfamethrin made no difference either to efficacy or crop safety of the mixtures.

TABLE 6

Timing trial cyanazine 0.5 kg a.i./ha in 1984/5 % dicot weed control 33 days after last application

Trial no.			41 (NO TCA)			42 (AFTER TCA)		
	Date	CGS	Total dicots	Stellaria media	Veronica persica	Total dicots	Stellaria media	Veronica persica
1	24.10.84	1,04	66	69	61	69	66	90
2	27.10.84	1,04	67	84	43	79	87	61
3	30.10.84	1,05	75	84	51	88	91	74
4	7.11.84	1,05	67	91	18	65	80	38
5	6.12.84	2,00	82	90	65	85	89	78
6	27.12.84	2,00	65	81	73	80	75	82
7	8.03.84	2,02	88	86	90	89	86	94
8*	21.03.84	3,1	58	62	44	32	37	10
benazolin 0.3/ clopyralid 0.05 at T6			46	75	0(29)**	42	92	0(41)**
% weed cover			76	49	23	92	67	18

*rain 1 hour after application; ** % ground cover of *Veronica persica*

Table 6 shows the dicot weed control in timing trials where cyanazine at 0.5 kgs a.i./ha was compared with the commercial standard benazolin/clopyralid. All crop effects were acceptable but were higher at T3, T5 and T7 timings and scored a maximum of 3.5. The % *Veronica persica* ground cover for the benazolin/clopyralid treatment was greater than the untreated control, the figure for each trial is shown in parenthesis.

TABLE 7

Crop effects from logarithmic trials with cyanazine (1-9 scale)

Site no	34*					35*				36			47		
Date applied	20.10.83					4.11.83				4.11.83			2.4.85		
Days from application	15	20	25	41	111	5	10	26	96	11	25	97	7	14	22
cyanazine kg a.i./ha															
2.0	8	8	7.5	7	7	1	2.5	3.5	1	1	4	4.5	2.3	4	3
1.0	8	8	7	6	7	1	1	3	1	1	3	2	1	1	1
0.5	8	7.5	6	6	6	1	1	2	1	1	3	2	1	1	1
0.25	6.5	6.5	3.5	3.5	5	1	1	2	1	1	2	2	1	1	1
0.125	6	6	2.5	3	5	1	1	2	1	1	1	1	1	1	1

* same field

Table 7 shows crop effects (1 - 9 scale) from 4 logarithmic trials with cyanazine at a peak dose of 2 kgs a.i./ha.

DISCUSSION

Crop and climatic conditions varied between the four trial seasons and influenced results.

In 1981-2 crops established well but in 1982-3 though the crop established well applications were dependant on very variable weather conditions and few crop effects were recorded in either season except on a very light soil. In 1983-4 crops were drilled at the peak of soil moisture deficit and had limited moisture for the first six weeks especially in the south east where rape plants were still germinating on 1 October. The weather then changed to moist warm conditions resulting in lush growth which was followed by strong winds. These winds then abated and the temperature fell with frost at night. It was during this last period that the applications 20 - 25 October were made onto lush crops with little wax, which had been battered by the winds. This resulted in crop effects as crop scorch which was most severe and unacceptable in the south east at site 17, while in Scotland at site 22 applied on the same day there were few crop effects. This variation in crop effect can be directly attributed to the climatic conditions at establishment as few crops drilled in the south east had access to moisture. Where a crop was drilled early in the south east and maintained access to moisture as at site 16 an application on 6 October resulted in no crop effects. Later applications were applied without difficulty and there were few crop effects from these.

In 1984-5 there was a period of mild weather at the end of January 1985, followed by a period with ground frosts and temperatures as low as -15^{o}C which would account for the crop effect recorded at site 43.

In the cyanazine + propyzamide series weed control was good at all sites with more rapid kill where cyanazine was included in the treatment. This is shown in table 2 where at trials 5 and 6 the Stellaria media in propyzamide and propyzamide/clopyralid plots was still dying off 75 days after application while control of Stellaria media where cyanazine was tank mixed with propyzamide was markedly faster and superior, particularly in heavy infestation. The inclusion of cyanazine (Table 2) also substantially improved control of Lamium purpureum, Sinapis arvensis, Veronica persica and Urtica urens. Some control of Chamomilla suaveolens and Papaver rhoeas is also shown. The narrow spectrum of weed control provided by the standards used alone, compared with propyzamide + cyanazine can be seen by the percentage weed cover remaining, particularly Papaver rhoeas and Lamium purpureum, in the standards at sites 5, 20 and 21.

The yield trial data on Table 4 shows that at sites 23 and 24 where little crop effect was recorded yields were very similar while at site 25 even though crop effect as scorch was recorded on the cyanazine + propyzamide block this treatment still substantially outyielded the propyzamide alone treatment.

Where cyanazine + propyzamide follow a graminicide the only sequence where unacceptable crop check occurred was following alloxydim sodium + oil. The compatibility trials with insecticides showed that both alfamethrin and fenvalerate can be tank mixed with cyanazine + propyzamide.

The use of cyanazine alone and in mixture showed increased spread of activity over the commercial standard benazolin/clopyralid (Table 5) especially at site 15 where at 36 days after application Stellaria media was still dying. When compared to benazolin/clopyralid weed control was improved by all treatments reflecting a broader spectrum of weeds controlled. Table 5 shows that while all treatments controlled Stellaria media the benazolin/ clopyralid treatment did not adequately control Veronica persica, Lamium purpureum, Sinapis arvensis or Papaver rhoeas. Control of Chamomilla suaveolens varied according to the level of dose rate of clopyralid though in both late applications (site 15 and 44) benazolin/ cloyralid treatments were inferior to the other treatments. Increasing the rate of cyanazine in the cyanazine + benazolin/clopyralid in 1984/5 improved the level of weed control compared to previous seasons.

Results from the timing trial with cyanazine at 0.5 kg a.i./ha in Table 6 show that weed control was better at T3, T5 and T7. After application it was noted that there was slightly more effect of the chemical on these three timings than the rest though all were acceptable. This indicates a relationship between crop and weed sensitivity. Control of Stellaria media was similar between timings in both trials but control of Veronica persica was better at each timing after TCA. Total weed control from benazolin/ clopyralid was very similar between the two trials. Within species there were differences, as Stellaria media control was much improved after TCA but this increased removal resulted in a greater percentage of uncontrolled Veronica persica taking over the space created highlighting the inability of this mixture to control Veronica.

The logarithmic trials in Table 7 highlighted the difference in crop effect where cyanazine was sprayed on a lush unwaxed rape crop at site 34 on 20 October 1983 and 15 days later onto a well waxed winter hardy crop at site 35. The poorly waxed crop was highly sensitive to cyanazine and was affected by doses as low as 0.125 kg a.i./ha but when the plant was waxed and winter hardy as in sites 35, 35 and 47 then it was tolerant to doses up to 2.0 kg a.i./ha.

The overall results discussed above show that cyanazine applied alone or in mixture to well waxed winter hardy crops can increase rapidity of weed kill especially for Stellaria media and substantially improve control of Lamium purpureum, Veronica persica, Sinapis arvensis and Urtica urens.

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REFERENCES

Chapman, T.; Jordan, D.; Payne, D.A.; Hughes, W.O. and Schieferstein, R.H. (1968) WL 19805 - A New Triazine Herbicide. Proceedings 9th British Weed Control Conference

Christensen, V.A. (Dansk Shell) (1982) Private communication

Haddow, B.C.; Jones, R.G. and Gillespie, A.W. (1972) Field Trials with Cyanazine for Weed Control in Brassicas. Proceedings 10th British Weed Control Conference

Sylvester-Bradley, R.; Makepeace, R.J. and Broad, H. (1984) A code for stages of development in oilseed rape. Aspects of Applied Biology 6, 1984

THE DEVELOPMENT OF POST AND SPLIT (PRE PLUS POST-EMERGENCE) RECOMMENDATIONS FOR THE USE OF METAZACHLOR IN WINTER SOWN OILSEED RAPE.

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ABSTRACT

Metazachlor was initially introduced into the United Kingdom in 1982 as a pre-emergence herbicide for use in winter rape. Trials carried out since 1979/80 confirmed that it could also be used as a post-emergence herbicide but that susceptible weed species were only controlled at early growth stages. As the period of weed growth, during which post-emergence applications can be applied with optimal effect is short, the use of a split treatment of metazachlor, applying it as a sequence pre and post emergence was tested. This treatment combined good weed control with a flexibility in the post-emergence timing that allowed the pyrethroid, cypermethrin and the specific grass weed herbicide, fluazifop-p-butyl, which are extensively used in winter rape,to be sprayed in combination with it.

INTRODUCTION

Metazachlor, marketed under the trade name of 'Butisan S', was originally introduced into the United Kingdom as a pre-emergence herbicide for use in oilseed rape (Stormonth and Woodroffe, 1982). Its potential for use as a post-emergence treatment was examined in trials from 1979/80 onwards when it became known that the introduction of a new group of post-emergence graminicides was likely. When metazachlor was applied to established broad-leaved weeds (when the crop was in the 2-4 true leaf stage) the levels of weed control were unacceptable.

Later trials examined the use of earlier post-emergence applications of metazachlor and subsequently the use of a split treatment involving the sequential application of reduced rates of metazachlor pre and post emergence of the crop.

MATERIAL AND METHODS

Trials in plans other than H/801/84 and H/801/85 (the year quoted is the year of harvest) were laid down on farm crops using a randomised block design with either 3 or 4 replicates. The plot size was commonly $48m^2$. The treatments, propelled by carbon dioxide, were applied using a Van der Weij Knapsack sprayer, through Birchmeir Hellico Sapphire 6673a hollow cone nozzles, in a water volume of 250 litres/ha. All treatments were applied with a nozzle pressure of 2.5 bar.

Metazachlor as a 500 g/litre s.c. was used. Fluazifop-p-butyl as a 125 g/litre e.c. was used in combination with the non-ionic wetter 'Agral'. Cypermethrin was used as a 50 g/litre e.c.

Weed control assessments were made by visual inspection of the whole plot. Percentage ground cover in the untreated plots and percentage control relative to the untreated plots, of individual weed species, were recorded in the autumn, at the cessation of growth, and in the following spring, when crop growth recommenced.

Crop vigour was recorded as a percentage relative to the untreated plots.

Assessments of yield were made with a specially modified Claas Compact 25 small plot combine harvester. Approximately $36m^2$ per plot was combined and the weights of seed obtained converted to t/ha at 9% moisture content.

H/801/84 and H/801/85: A selection of weed species (see results) were sown in parallel rows with an Oyjord drill. Each species of weed was sown as a group of 3 rows at 0.25m spacing between each row. The triple rows of each species were sown on approximately 0.8m centres.

The different herbicide treatments were applied, using a specially constructed tricycle push sprayer, at right angles to the rows of weeds. Each treatment was replicated twice. The herbicides were applied in 200 l/ha water at 2 bar through Spraying System 8002 nozzles. The plot width was 1.25m. An untreated area of 0.25m was left between each plot.

The spraying equipment was fitted with a screen on all sides in order to eliminate drift into adjacent plots.

Trial H/801/84 was drilled on the 10th September on a medium soil. Trial H/801/85 was drilled on the 10th October on two sites, on medium and light soils, according to the ADAS textural grouping.

RESULTS

Trials carried out in 1979/80 showed that poor control of Stellaria media resulted from applications of metazachlor made at the 5-10 true leaf stage of the weed (Table 1).

Table 1
H/301/80: % control of S. media given by pre and post-emergence applications of metazachlor at 1.4kg a.i./ha: (4 sites)

Assessment time	Untreated	Pre emergence	Post emergence
Autumn	17	89	48
Spring	24	93	59

Post-emergence timing: crop 2-5 true leaf stage (Mid October - early November)

In 1982/83 a series of trials was carried out to discover if weeds could be controlled by any post-emergence application of metazachlor and, if so, whether there would be any adverse effect on the crop, since the application would have to be made at an early stage of crop development. The results (Table 2) show that the weed species present in the trials viz Stellaria media, Lamium amplexicaule, Lamium purpureum and Myosotis arvensis, which were sensitive to the pre-emergence application of metazachlor, were also susceptible to the early post-emergence applications. However, as the applications were made to weeds at stages of development later than the cotyledon to early true leaf stages, the level of weed control declined.

Table 2: H/802/83: The effect of application timing of metazachlor (1.25kg a.i./ha**) on broad leaf weed control, crop vigour and yield of oilseed rape.

Timing by crop stage		Untreated	Immediately post drilling	Within 48 hours of drilling	Crop seedlings visible	50% of plants with cotyledons spread	50% of plants with 2 true leaves	50% of plants with 4 true leaves
S.media	% control	27	99	99	99	96	80	63
(5 sites)	weed size					C	C-4*	6-8*
L.amplexicaule	% control	3	99	100	98	100	53	46
(1 site)	weed size						C	4-6
M.arvensis	% control	1	99	99	99	100	99	21
(1 site)	weed size					C	2*	2-4*
L.purpureum	% control	12	100	100	100	100	87	100
(1 site)	weed size					C	4-6*	4-6*
% crop vigour:	Autumn	100	92	90	84	94	92	98
	Spring	100	94	98	97	96	98	102
(5 sites)								
Yield t/ha (4 sites)		2.45	2.78	2.77	2.83	2.90	2.75	2.77
% relative yield		100	113	113	116	118	112	113

** except application made at 50% of plants with 4 true leaves, which was at 1.5kg a.i./ha
* Refers to number of true leaves, pairs of true leaves or whorls. C = weed cotyledon stage.
Weed control assessment timing: Spring

There was a tendency for the crop to show increased sensitivity to applications made during early crop emergence. However initial adverse vigour effects were not reflected in reductions in crop yield. This finding is in agreement with other work (Ward and Askew, 1984)

Having established that weed species were susceptible to early post-emergence applications of metazachlor but that sensitivity varied between species, the aspect of weed susceptibility in relation to application timing was studied in more detail in trial series H/801/84, where a range of common weed species were treated at different growth stages.

The results (Table 3) showed that there was some slight variation in the stage at which control could be obtained between species but that optimum weed control could only really be obtained at early weed growth stages. These stages generally coincided with the 1-1½ leaf stage of the rape.

Table 3: H/801/84: % weed control from post-emergence applications of metazachlor at 1.25kg a.i./ha applied to weeds at a range of growth stages (1 site)

Application date: Crop growth stage*		28 Sept 1 lf	3 Oct 1½ lf	9 Oct 2-3 lf	17 Oct 3-4 lf	24 Oct 4 lf
V.persica	(A)	100	100	100	100	100
	(B)	C	C	1	2	2
M.inodora	(A)	97	80	73	30	58
	(B)	1	1	2	4-6	5-8
L.purpureum	(A)	97	99	100	45	30
	(B)	C	C-1	2	2	2-3
M.arvensis	(A)	93	90	75	55	48
	(B)	C	C-1	1	2-3	3-4
S.media	(A)	83	88	92	45	48
	(B)	C	1	2	3-4	4-5
G.aparine	(A)	50	50	53	63	48
	(B)	C	C-1	1	1-2	2
P.annua	(A)	92	90	93	98	90
	(B)	11	12	12-13	13-14	13-14
A.myosuroides	(A)	83	78	78	50	65
	(B)	11	11-12	12-13	12-14	13-14

*Crop and broad leaf weed abbreviations refer to:
C = Cotyledon stage
1 = 1st true leaf, pair of leaves or whorl present
2 = 2nd true leaf, 2 pairs of leaves or whorls present, etc
Grass weed growth stages are according to Zadoks.
A = % weed control: B = weed growth stage at application
Assessment timing: late February.

Because optimum weed control was only to be obtained from pre or early post-emergence applications of metazachlor, i.e. over a very short period of crop and weed growth stages, splitting the application was examined as a means both of extending the metazachlor recommendation on to very light soils and of introducing more flexibility into the timing of the post-emergence component of the treatment.

A summary of the results from trials carried out in 1983/84 and 1984/85 (Table 4) shows that overall weed control from the split treatment was similar to that given by the pre-emergence application of metazachlor but that the post-emergence treatment generally gave, initially, poorer weed control.

The 'split' and post-emergence applications of metazachlor proved slightly safer to the crop in the trials carried out on very light soils in 1983/84,(H/800/84). In 1984/85 (H/800/85) when the trials were carried out on light or heavier soils, the differences in crop vigour between the treated and untreated plots were negligible.

The reduction in crop vigour seen in H/800/84 (usually when heavy rain followed the full rate pre-emergence applications of metazachlor) did not adversely affect the yields when compared with either post or split treatments. This agrees with other data. (Anon, 1985).

Table 4: H/800/84 and H/800/85: comparison of single (1.25kg a.i./ha) and split (0.75 + 0.5kg a.i./ha) applications of metazachlor on % overall broad leaved weed control, crop vigour and yield

		Untreated	T1	T2	T1+T2	No sites
% overall broad leaved weed control						
H/800/84:	Autumn	19	97	75	98	5
	Spring	44	95	91	95	3
		(24)	(100)	(88)	(98)	(1)
H/800/85:	Autumn	22	99	98	99	3
	Spring	38	100	96	98	1
% crop vigour:						
H/800/84:	Autumn	100	94	96	96	6
H/800/85:	Autumn	100	98	98	96	5
Yield (t/ha)						
H/800/84		3.43	3.82	3.92	3.66	2
		(100)	(111)	(114)	(107)	

T1 = pre-emergence: T2 = post-emergence at the crop cotyledon to first true leaf stage: T1+T2 = split (pre + post-emergence) treatment.
( ) = Capsella bursa-pastoris on 1 site where control at T2 was poor.

In oilseed rape the need for control of volunteer cereals and autumn pests is well established. Grass weed and volunteer cereal control with fluazifop-p-butyl has been shown to have a yield advantage compared to the use of TCA (Anon, 1985). Pyrethroid insecticides are extensively used in oilseed rape for the control of both the adult and larval stages of Cabbage Stem Flea Beetle (*Psylliodes chrysocephala*) and for the control of the Rape Winter Stem Weevil (*Ceutorhynchus picitarsis*).

In 1984/85 the pesticides, fluazifop-p-butyl and cypermethrin were added to the post-emergence component of the 'split' application and caused no adverse effects on the control of blackgrass, broad leaved weeds or crop vigour (Table 5).

Table 5: H/800/85: the effect on % weed control and crop vigour of the addition of either fluazifop-p-butyl or cypermethrin to the post-emergence component of the split treatment of metazachlor

	Untreated	Split *	Split ** + fluazifop-p-butyl	Split ** + cypermethrin	No sites
Overall broad leaved weed control	22	99	99	98	3
A.myosuroides	22	97	95	93	2
% crop vigour	100	96	96	98	5

Timing of post-emergence component of split treatment was:
* Crop cotyledon - 1st true leaf stage (late September)
** Crop 1st - 2nd true leaf stage (mid-late October)
Split treatment = metazachlor 0.75kg a.i./ha pre + 0.5kg a.i./ha post-emergence.
Assessment time: Autumn

Further trials carried out in 1984/85 on two sites using drilled weeds to evaluate how critical the timing of the post-emergence component was when using the split programme of metazachlor (Table 6) indicated that there was considerable flexibility as to the time when the post-emergence part of the split could be applied. The final levels of weed control were generally as high from the split treatments as from the single dose pre-emergence treatment, but were superior to the single dose post-emergence treatment on *S.media*

Flexibility in the timing of the post-emergence component of the split treatment will be of considerable practical advantage in allowing combination with other treatments such as fluazifop-p-butyl or cypermethrin which are made post-emergence in the oilseed rape crop.

Table 6: H/801/85: Effect of timing of the post-emergence component of the split treatment of metazachlor on % weed control compared with pre or early post-emergence applications. (2 sites)

	T1	T2	T1+T2	T1+T3	T1+T4
Alopecurus myosuroides	100	100	100	100	100
Poa annua	100	100	100	100	100
Capsella bursa-pastoris	99	98	100	97	98
Galium aparine	78	93	89	86	78
Geranium dissectum	91	92	91	80	82
Lamium purpureum	100	100	100	100	99
Matricaria inodora	99	100	99	98	98
Myosotis arvensis	97	97	97	96	96
Stellaria media	98	86	99	97	93
Viola arvensis	28	20	25	24	20
Veronica persica	100	100	100	100	100
Papaver rhoeas	79	79	68	58	61

Pre-emergence timing T1: Post-emergence (full rate) timing T2 80% crop cotyledons full spread.
Timing of post-emergence component of 'split' treatment
T2 80% crop cotyledons fully spread
T3 crop beyond 1 true leaf stage
T4 crop beyond 3 true leaf stage
Assessment date: End February
'split' treatment - metazachlor 0.75kg a.i./ha pre + 0.5kg a.i./ha post-emergence.

DISCUSSION

In continuing the development of metazachlor beyond its use as a pre-emergence herbicide, the objective has been to identify opportunities for tank-mixing with other pesticides in order to reduce the number of entries into the crop at what is a busy time of year on the farm.

The results show that it is not possible to delay the total application of metazachlor in order to apply it with a graminicide, or insecticide, because the weeds would be at an advanced stage of development and would not be effectively controlled.

Satisfactory weed control can however be achieved by early post-emergence applications of metazachlor when the weeds are in early development stages (cotyledon to first true leaf stages), the crop generally being in the 1 to 1½ true leaf stage at that time. In our experience this can be up to 30 days prior to the optimum timing of an application of fluazifop-p-butyl. This early post-emergence application is usually slower to take effect than a pre-emergence treatment and levels of weed control equivalent to those given by the pre-emergence treatment are not reached until the early spring. In some instances e.g. C.bursa-pastoris (H/800/84), S.media (H/801/85) and A.myosuroides (H/800/85), the level of control given by the post-emergence treatment has been slightly lower than that given by the pre-emergence treatment. In these cases therefore, the use of a pre-emergence or split treatment should be considered.

Where early weed control is required a split (pre + post-emergence) treatment can be used. Because there is usually sufficient residual activity from the pre-emergence component to provide weed control into early autumn, the timing of the post-emergence component of the split application can be delayed to coincide with the application of a graminicide or insecticide.

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REFERENCES

Anon, 1985. Oilseed rape: recent ADAS experimental work 1985. Ministry of Agriculture, Fisheries and Food. Booklet 2285 (85). p13.

Stormonth, D.A.; Woodroffe, R (1982). The use of metazachlor for the control of weeds in winter oilseed rape. Proceedings 1982 British Crop Protection Conference - Weeds, 103-108.

Ward, J.T.; Askew, M.F.: (1984). The control of annual grass and broad leaved weeds in winter oilseed rape. Aspects of Applied Biology 6: Agronomy, Physiology, Plant Breeding and Crop Protection of oilseed rape. 239-250, 1984.

OILSEED RAPE HARVESTING, SPRAY OR DIRECT CUT

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ABSTRACT

In two years of contrasting weather patterns at harvest time no consistent differences in yield were found in five trials between treating with diquat, glyphosate, di-1-p-menthene or direct combining. On an exposed site in adverse weather swathing gave a considerable yield advantage over all other treatments.

INTRODUCTION

A major problem with the production of oilseed rape is its harvesting. Maturing of pods is uneven, particularly in winter sown crops, and loss of seed by shedding can be considerable.

The two methods of harvesting with a combine harvester most widely practiced in UK on autumn sown crops are, threshing a previously windrowed swath, or cutting and threshing following treatment with a chemical desiccant. Recently farmers have been direct combining the crop without any previous treatment and chemicals have been introduced to prevent pod shatter.

Survey data of swathed and desiccated autumn sown crops has shown losses to be in the range of 25-1654 kg/ha in extreme conditions, with a figure of around 120 kg/ha being a reasonable average (Bailey 1982). Other surveys by ICI have shown no differences in yield from crops harvested by either system (Hill and Hollies 1980 and Rance 1982).

In ADAS trials little difference in yield was found between swathing and desiccating and where direct combining was compared with desiccation, the former gave a yield increase on one occasion and yields were similar over six years at one site (Bowerman 1984). Yields following the use of glyphosate were similar to those following diquat used as a desiccant. The application of di-1-p-menthene (an anti pod-shatter substance) with an adjuvant gave a yield increase in one out of four trials. In all of these trials each pre-harvest treatment was combined on one date and usually all were harvested on the same date.

In a new trial series covered by this report, combining was on two dates to evaluate the effect of delayed harvest following various treatments.

MATERIALS AND METHOD

Five trials were carried out in 1984 and 1985 at Bridgets EHF, Martyr Worthy, Hampshire; High Mowthorpe EHF, Malton, North Yorkshire; and Wood Farm, Runhall, Norfolk on plots with a minimum harvest area of 65 square metres.

The varieties were Bienvenu at Bridgets and High Mowthorpe 1984, and Rafal at High Mowthorpe 1985 and Wood Farm.

Treatments were applied as near to the recommendations as possible with diquat (Reglone 40) at 0.6 kg/ha a.i. in 300-500 l/ha water at 1-2 weeks before harvest, glyphosate (Roundup) at 1.92 kg/ha a.i. in 1984 and 1.44 kg/ha a.i. in 1985 in 200 l/ha water at 2-3 weeks before harvest. Di-1-p-menthene plus adjuvant (Spodnam DC) was applied at 1.25 l/ha product in 560 l/ha water at 2½-4 weeks after petal fall. In addition there were direct cut treatments at each site, swathing treatments at High Mowthorpe and sequences of di-1-p-menthene with swathing or diquat. The first date of harvest was when the diquat treatment was judged to be fit for combining and the second was 7-14 days later (Table 1).

TABLE 1

Dates of application of treatments and harvest.

Site	Bridgets EHF		High Mowthorpe EHF		Wood Farm
Year	1984	1985	1984	1985	1985
Swathed	-	-	31/7	9/8	-
Diquat	23/7	23/7	1/8	10/8	1/8
Glyphosate	19/7	15/7	27/6	7/8	-
Di-1-p-menthene	2/7	10/7	17/6	25/7	9/7
Normal harvest	31/7	10/8	15 & 16/8	27/8	10/8
Later harvest	6/8	20/8	21/8	10/9	20/8

RESULTS

TABLE 2

Seed yield, t/ha at 91% dry matter, and % dry matter, Bridget's 1984.

Harvest timing	Yield Normal	Yield Late	Dry matter Normal	Dry matter Late
	±0.098		± 0.45	
Direct	3.91	4.18	76.8	87.5
	±0.131		± 0.68	
Diquat	4.39	3.94	88.5	90.1
Glyphosate	4.50	3.96	85.6	89.9
Di-1-p-menthene	3.87	4.24	76.1	87.0
SED for comparisons between chemical treatments on same date of harvest.	±0.123		±0.72	

SED for comparisons between direct and treatments on same date of harvest.	±0.107	±0.62
SED for comparisons between direct treatments on different dates of harvest.	±0.116	±0.57
df = 32 CV	4.3%	6.5%

At Bridgets, 1984, with the first date of harvest the direct combined and di-1-p-menthene treatments gave lower yields and seed with lower dry matter content than those that had been treated with diquat or glyphosate. A delay in harvest of six days produced yields and seed dry matter for the direct combined and di-1-p-methene treatments similar to those of the diquat or glyphosate treatments at the first harvest date. These latter treatments gave a significant reduction in yield with a further increase in dry matter of the seed at the second date of harvest.

The oil content in the seed was significantly greater only at the first harvest with the direct and di-1-p-menthene treatments. With all treatments the oil content was reduced by the delay in harvest.

TABLE 3

Seed yield, t/ha at 91% dry matter, and % dry matter, Bridget's 1985.

Harvest timing	Yield Normal	Yield Late	Dry matter Normal	Dry matter Late
	h=±0.237	v=±0.252	h=±0.08	v=±0.07
Direct	2.79	2.52	88.5	87.5
Diquat	2.61	2.40	88.5	87.3
Glyphosate	2.29	2.55	88.5	87.5
Di-1-p-menthene	2.90	2.53	88.5	87.6
Di-1-p-menthene/diquat	2.96	2.71	88.4	87.4
df = 35 CV	11.8%		0.8%	

There were no significant differences in yield between treatments but there was a trend for a reduction in yield at the second date of harvest. There were no differences in the dry matter contents of the seed between treatments on each date of harvesting and dry matter decreased by approximately one per cent with the ten day delay in harvest.

Differences in oil content between treatments were small and not consistent.

TABLE 4

Seed yield, t/ha at 91% dry matter, and % dry matter content, High Mowthorpe 1984

Harvest timing	Yield Normal	Yield Late	Dry matter Normal	Dry matter Late
	h=$\pm$0.145	v&i = $\pm$0.127	h=$\pm$0.95	v&i = $\pm$0.89
Direct	3.58	3.71	86.1	87.2
Swathed	3.71	3.74	87.5	87.5
Diquat	3.24	3.49	88.3	88.4
Glyphosate	3.53	3.64	87.8	88.2
Di-l-p-menthene	3.46	3.71	85.5	89.2
Di-l-p-menthene/swath	3.40	3.79	87.1	89.0
Di-l-p-menthene/diquat	3.41	3.95	87.7	86.8

df = 23 CV 5.7% 1.5%

Yields of all treatments were similar except for the lower yields on both harvest dates with the diquat treatment. These yield differences were significantly different to the swathed treatment at the first harvest date and the sequence of di-l-p-menthene and diquat at the second date of harvest. Generally yields were greater at the second harvest although following swathing they were unchanged. The increases in yield with the later harvest were significantly greater following the sequences of di-l-p-menthene with swathing or diquat.

At the first harvest dry matter content was lowest with the direct and di-l-p-menthene treatments, but differences between the other treatments on that date were small. The swathed, diquat and glyphosate treatments did not lose any additional moisture between harvests whereas the direct and di-l-p-menthene treatments increased in dry matter by approximately 1% and 3.7% respectively over the five day period.

Treatments did not have a consistent effect upon the level of oil in the seed.

TABLE 5

Seed yield, t/ha at 91% dry matter, and % dry matter content, High Mowthorpe 1985.

Harvest timing	Yield Normal	Yield Late	Dry Matter Normal	Dry Matter Late
	h = ±0.197	v = ±0.189	h = ±2.10	v = ±2.14
Direct	2.27	2.03	74.9	83.4
Swathed	3.22	3.07	77.8	80.8
Diquat	1.92	1.71	76.0	85.6
Glyphosate	2.50	2.58	76.1	83.3
Di-1-p-menthene	2.28	2.09	72.7	82.9
Di-1-p-menthene/swath	3.15	2.96	77.2	81.3
Di-1-p-menthene/diquat	1.82	1.90	79.5	84.6
df = 36 CV	11.1%			3.8%

The yields of the swathed treatments were significantly greater than the standing crops on both dates of harvest. The standing crops had a higher dry matter content in the seed at the second harvest date than the swathed treatments.

TABLE 6

Seed yield, t/ha at 91% dry matter, and % dry matter, Wood Farm 1985.

Harvest timing	Yield Normal	Yield Late	Dry Matter Normal	Dry Matter Late
	h=±0.143	v=±0.162	h=±1.45	v=±1.04
Direct	3.79	3.70	77.7	80.9
Diquat	3.87	3.61	79.9	80.3
Di-1-p-menthene	3.80	3.26	78.8	80.8
Di-1-p-menthene/diquat	3.53	3.44	79.6	82.0
df = 10 CV	5.5%		1.6%	

Yields at the first date of harvest were similar for each treatment although the lowest yield was following the sequence of di-1-p-menthene and diquat. There was a decline in the yields at the second harvest and this was greatest with the di-1-p-menthene treatment.

The dry matter contents of seed at the first harvest were 2% and 1% lower with the direct and di-1-p-menthene treatments, respectively, than the diquat treatments. These differences were not maintained at the second harvest, 5 days later, when the dry matters had generally increased to the same level. There were no differences in the oil contents of seed between treatments and with the later harvest the levels had declined by less than 1%.

DISCUSSION

The trials in this report were carried out at Bridgets Experimental Husbandary Farm in Hampshire, Wood Farm in Norfolk and High Mowthorpe Experimental Husbandary Farm, an exposed farm on the Yorkshire Wolds. There was a large contrast in the weather patterns at harvest in the two years.

Conditions were almost perfect for harvesting in 1984 with low rainfall and moderate sunshine and winds. Heavy showers in combination with strong winds dominated at all three sites in 1985.

Bienvenu and Rafal have reasonably good resistance to lodging (NIAB 1985). The only lodging to occur in these trials was at Bridgets in 1985 when all treatments lodged between the two harvest dates.

Accurate measurements of losses were not feasible but visual assessments of shedding indicated very low levels at both sites in 1984. There was considerable shedding with each treatment prior to the first harvest at Bridgets in 1985 with a further loss between harvest dates. Losses were very heavy at High Mowthorpe in 1985, particularly on standing treatments. There were no apparent reductions in shedding where di-1-p-menthene was used. The crop at Wood Farm was short and late to mature and losses were not particularly large.

Comparisons of harvest systems including swathing were done at High Mowthorpe. In the first year there was little difference in yield between swathing and direct combining and both treatments gave higher yields than desiccation with diquat. The wind was particularly damaging to the standing crops in 1985 when the swathed crops gave significantly higher yields. These results show the advantage of swathing on an exposed site and the importance of improving shatter resistance either by breeding or the use of chemicals.

On average there were no differences in yield between direct, diquat, glyphosate and di-1-p-menthene treatments but at individual sites differences did occur.

The first harvest date was assessed to be the first opportunity to combine the diquat treatments at around 85% dry matter. At this timing the direct combine treatment gave a lower yield than the diquat at Bridgets in 1984 only, whereas the reverse occured at High Mowthorpe in both years. The yield advantage from direct harvest over diquat treatment remained at the second harvests, perhaps, indicating that in an exposed site accelerating moisture loss in a standing crop with diquat could make it more vulnerable to seed loss.

Application of glyphosate usually resulted in similar dry matter in the seed as diquat but yield loss was a less with glyphosate in the severe conditions at High Mowthorpe in 1985. A yield reduction at the first harvest date following the use of glyphosate occurred at Bridgets in 1985 and this was associated with early lodging with this treatment only.

Di-1-p-menthene alone or in sequence with swathing or diquat did not affect the rate of moisture loss of seed as dry matter contents following treatment with di-1-p-menthene were similar to those from the direct cut (untreated) crops.

In addition no consistent yield response to di-1-p-menthene was recorded at either date of harvest at any site.

Harvesting systems did not have a consistent effect upon oil content of seed.

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REFERENCES

Bailey, J. (1982). Management of oilseed rape at harvest. Yield of Oilseed Rape Course Papers 1982, National Agricultural Centre Cereal Unit, 67-75.

Bowerman, P (1984) Comparison of harvesting methods of oilseed rape Aspects of Applied Biology 6, The agronomy, physiology, breeding and crop protection of oilseed rape, 157-165.

Hill, D.M. and Hollies, J.D. 1980 Oilseed Rape Survey : 1979. Imperial Chemical Industries Plant Protection Division.

NIAB, (1985) Recommended varieties of oilseed rape 1985. National Institute of Agricultural Botany, Cambridge, Farmers Leaflet number 9.

Rance, D. (1982) Keeping pace with oilseed rape. Imperial Chemical Industries PLC.