WEED COMPETITION IN WINTER OILSEED RAPE, 1992-94
(Sponsored by HGCA)

J B S Freer, F C Andrews and G M Palmer

Summary

These experiments set out to investigate the effects of a range of densities of contrasting broad-leaved weed species on the growth and yield of oilseed rape and to determine the best method for predicting yield effects from assessments made in the autumn. Chickweed and cleavers were competitive and resulted in yield losses. There was some evidence to suggest that the crop was able to compete more effectively at higher spring nitrogen levels. There was little correlation between weed numbers and yield loss. Ground cover and weed dry matter gave a slightly better correlation with yield. Precise prediction of yield response to weed control in winter oilseed rape is not yet possible because there is no reliable method of relating weed growth to yield. In addition, the length of the growing season means that early assessment, required due to the lack of late post-emergence broad-spectrum herbicides, is likely to fail due to seasonal effects that occur over winter and in the spring.

Introduction

A well established, vigorous crop of oilseed rape competes effectively with most weed species, the exceptions being cereal volunteers (Ogilvy, 1989). Broad-leaved weed control in oilseed rape is often considered uneconomic and there is often scope to reduce costs by not treating broad-leaved weeds.

The one exception to this rule are cleavers which even at low levels, whilst not affecting yield, can be costly in terms of harvesting difficulty and seed contamination. This has been quantified in Germany (Bodendorfer *et al.*) who concluded that even one cleaver/m^2 will cost the grower approximately 220 DM/ha (£74/ha).

With other broad-leaved weeds the difficulty is in making the correct decision in the autumn before the window for effective weed control closes. Previous studies (Sansome, 1991) have concentrated on effects seen in April, but not when a decision on herbicides has to be made.

There is a clear need to assess likely yield loss in autumn when contemplating herbicide use. This would help to identify when broad-leaved weed control is economic an area where the greatest savings in weed control can be made. Counting weeds is a time consuming business and in any case there is often a poor correlation with actual competition effects. Assessing ground cover is a quick and simple assessment for single species.

The experiments reported here formed part of a national series funded by the Home-Grown Cereals Authority which are reported more fully elsewhere (Lutman *et al.*, 1995).

Method

Experiment A

Different populations of common chickweed and cleavers (1992 and 1993 only) were broadcast into plots of winter oilseed rape. The highest and nil weed populations were repeated in 1993 and 1994 and received less spring nitrogen (130 kg/ha) in comparison to the main trial (200 kg/ha). Details of these treatments are given in Table 1.

Table 1. *Range of weed populations sown (no./m²)*

Target	Common chickweed			Cleavers	
population	1992	1993	1994	1992	1993
200 kg/ha N					
Nil	0	0	0	0	0
Level 1	62	50	62	10	4
Level 2	125	200	125	50	16
Level 3	250	600	250	100	32
Level 4	500	1200	500	200	64
Level 5	1000		1000	400	
130 kg/ha N					
Nil*		0	0		0
Level 5*		1200	1000		64

* Reduced nitrogen

Experiment B

In 1994, an additional trial was included comparing high and low levels of seven broad-leaved weed species (Table 2).

Table 2. *Target populations for different weed species (no./m²)*

Weed species		Low population	High population
common chickweed	*(Stellaria media)*	50	450
cleavers	*(Chenopodium album)*	10	50
red dead-nettle	*(Lamium purpurem)*	50	450
mayweed	*(Matricaria perforata)*	50	200
charlock	*(Sinapis arvensis)*	50	200
poppy	*(Papaver rhoeas)*	50	200
speedwell	*(Veronica persica)*	50	450

Situated at Morley in 1992 and the Mid Anglian Trials Site at Little Stonham, Suffolk in 1993 and 1994, the trial was a randomised block design with four replicates. The plot area sown with weeds was 10 m by 1.79 m. Normal farm inputs of fertiliser (except spring application) and pesticides were applied overall. The spring nitrogen treatment was applied by hand to selected plots.

Site and assessment details are given in Table 3. Randomly selected quadrats within each plot were used for plant counts and biomass samples. Ground cover scores were assessed on a whole plot basis. Plots were harvested using a Claas Compact combine which was modified for plot work.

Table 3. *Site and assessment details*

	1992	1993	1994
Site	Morley	Stonham	Stonham
Soil type	Sandy loam	Sandy clay loam	Sandy clay loam
Series	Ashley	Beccles	Beccles
Crop drilled	1.10.91	8.9.92	7.9.93
Variety	Capricorn	Capricorn	Apex
Crop counts	5.12.91	16.10.92	1.11.93
Weed counts	5.12.91	26.10.92	1.11.93
Score 1	-	6.11.92	10.12.93
Score 2	-	11.12.92	17.3.94
Score 3	-	8.4.93	11.4.94
Biomass 1	-	16.1.93	17.1.94
Biomass 2	-	14.4.93	11.4.94
Harvest	-	26.7.96	29.7.94

The trial at Morley was aborted in January 1992, owing to severe damage to the crop by pigeons and frost.

Results

Plant populations

Table 4. *Population of chickweed (plants/m²) in Experiment A*

Population levels	Common chickweed				Cleavers (1992/3)and other weeds (1993/4)	
	1992	1993	1994	Mean	1992-94	
200 kg/ha N						
Nil	0	14	9	8	0	0
Level 1	108	145	106	120	18	3
Level 2	199	-	222	211	91	-
Level 3	399	363	426	396	188	9
Level 4	723	690	590	668	330	18
Level 5	1175	1052	866	1031	594	34
130 kg/ha N						
Nil	-	5	6	5	-	0
Level 5	-	1023	814	918	-	34

Distinct populations of common chickweed were established each year, however cleaver populations were less successfully achieved, being approximately half the target population.

Table 5. *Actual populations of different weed species established in Experiment B (no./m²)*

Weed species	Target population Low	High	Mean
Chickweed	155	620	388
Cleavers	0	0	0
Deadnettle	104	542	323
Mayweed	56	156	106
Charlock	123	276	199
Poppy	205	496	350
Speedwell	96	795	445

Despite being lower than the target populations, distinct populations of each species were established with the exception of cleavers which failed to germinate.

In 1992, following dry weather, the crop was established late and remained slow growing in the autumn and winter. High densities of chickweed and cleavers appeared to reduce the initial crop density. In 1993 and 1994 when crop establishment was earlier and better there was no obvious trend (Table 5a).

Table 5a. *Established populations of rape (plants/m²) Experiment A*

Target chickweed population	9 December 1991 (70 DAT)	16 October 1992 (38 DAT)	1 November 1993 (55 DAT)
Nil	69	87	63
Level 1	58	92	69
Level 2	59	-	65
Level 3	56	79	60
Level 4	55	67	50
Level 5	47	78	62
LSD	12.9	15.6	18.3

LSD = least significant difference at 95% probability

Ground cover scores

Table 6. *Percent ground cover of crop and chickweed (score 0 = no cover and 100 = complete cover), Experiment A, mean of two years, 1993 and 94*

Population levels	Crop November	Crop December	Crop April	Chickweed November	Chickweed December	Chickweed April
200 kg/ha N						
Nil	28.8	54.4	86.2	0.4	15.6	20.4
Level 1	26.9	30.6	52.5	17.4	60.0	78.8
Level 2	30.1	20.3	51.8	39.3	78.9	89.4
Level 3	27.4	25.4	40.0	42.5	68.4	90.2
Level 4	25.0	20.8	35.2	56.5	75.7	90.4
Level 5	22.4	19.1	37.3	60.0	82.9	89.5
130 kg/ha N						
Nil	28.6	54.5	81.0	1.8	15.6	22.9
Level 5	22.6	18.9	34.4	61.2	84.1	89.9
LSD	8.83	33.74	24.46	28.90	23.24	26.15

Increasing the level of chickweed resulted in higher ground cover scores. Crop ground cover was reduced significantly at the higher levels of chickweed population (levels 4 & 5). Reducing the amount of nitrogen in the spring did not affect the ground cover scores in April.

Table 6a. *Percent ground cover of crop and cleaver (score 0 = no cover and 100 = complete cover), Experiment A, 1993*

Population (actual)	November		December		April	
Plants/m²	Crop	Weed	Crop	Weed	Crop	Weed
200 kg/ha N						
Nil	13.5	0.0	28.8	8.8	83.7	15.0
4	14.5	0.0	29.5	4.5	87.2	10.8
16	14.8	0.2	32.5	7.5	82.5	11.3
32	14.5	0.2	30.0	7.5	78.7	17.0
64	14.5	0.5	33.8	6.5	72.5	27.5
130 kg/ha N						
Nil	14.5	0.0	30.8	5.0	78.0	15.3
64	13.8	0.4	31.3	8.3	53.8	38.7
LSD	1.32	0.16	4.10	4.63	11.91	13.05

Cleavers showed no significant differences in ground cover until April when increasing the weed density reduced crop cover slightly.

Table 7. *Percent ground cover of crop and weed species, Experiment B, 1994*

Species	Population	Crop		Weed	
		December	April	December	April
Chickweed	Low	45.0	78.3	50.0	89.3
	High	38.3	76.7	88.3	89.3
Cleavers	Low	48.3	93.3	0.0	12.0
	High	46.7	92.0	0.0	27.0
Deadnettle	Low	48.3	91.7	23.3	66.0
	High	43.3	83.3	66.7	78.3
Mayweed	Low	50.0	92.7	5.3	43.3
	High	41.7	90.0	12.7	65.0
Charlock	Low	36.7	66.7	80.0	8.67
	High	25.0	38.3	91.7	10.3
Poppy	Low	41.7	88.3	31.7	71.7
	High	51.7	87.7	56.7	76.7
Speedwell	Low	48.3	95.0	18.3	33.3
	High	46.7	86.7	70.0	71.7
LSD		7.54	9.15	9.35	14.95

Dry matters

Table 8. *Crop and weed biomass (kg dry matter/m²) Experiment A, mean of two years, 1993 and 1994*

Population levels	Crop January	Crop April	Chickweed January	Chickweed April
200 kg/ha N				
Nil	42.5	282.4	5.8	143
Level 1	29.1	124.8	29.6	383
Level 2	21.0	86.4	67.7	405
Level 3	19.1	92.1	63.2	405
Level 4	15.7	73.2	75.0	411
Level 5	14.4	60.5	66.6	402
130 kg/ha N				
Nil	40.6	221.1	3.0	97
Level 5	14.1	43.4	74.7	328
LSD	16.06	82.55	45.3	196.5

Crop biomass was reduced by the lowest level of chickweed equivalent to 68 plants/m² (Table 8).

Table 8a. *Dry matter yields of crop and cleaver (kg/m²), Experiment A, 1993*

Population (plants/m²)	January Crop	January Weed	April Crop	April Weed
200 kg/ha N				
Nil	46.0	3.9	271.2	80.8
4	37.9	3.0	259.3	48.0
16	42.0	2.8	281.5	97.2
32	38.6	5.1	287.8	104.6
64	34.0	5.9	270.1	115.0
130 kg/ha N				
Nil	38.7	2.1	261.7	80.7
64	35.9	5.8	185.4	108.9
LSD	11.83	4.01	116.61	68.85

There was less correlation between cleavers and crop biomass than with chickweed reflecting the growth habit of this weed which does not start rapid growth until the spring.

Table 9. *Dry matter yields of crop and weed (kg/m²), Experiment B, 1994.*

Species	Population	Crop		Weed	
		January	April	January	April
Chickweed	Low	29.9	91.5	31.7	442.7
	High	21.7	127.0	115.5	463.8
Cleavers	Low	58.8	343.7	2.4	83.4
	High	39.5	412.0	4.3	81.1
Deadnettle	Low	49.3	248.5	11.2	130.4
	High	29.7	170.2	83.1	296.1
Mayweed	Low	38.9	349.6	1.3	50.5
	High	34.2	255.1	6..6	226.6
Charlock	Low	23.9	220.8	75.0	82.7
	High	10.1	71.6	66.9	77.0
Poppy	Low	33.7	165.3	12.8	160.3
	High	38.3	253.6	27.2	258.9
Speedwell	Low	55.3	230.4	9.0	112.8
	High	20.4	190.6	49.7	141.7
LSD		14.19	69.04	21.88	82.86

There were reductions in dry weight of the crop with an increase in weed population which were significant for species such as deadnettle, charlock and speedwell.

Yield

Table 10. *Yield of oilseed rape affected by differing population levels of chickweed (t/ha at 91% dm) Experiment A, 1993 and 1994*

Population level (1993 actual) [1994 actual]	1993	1994	Mean
([weeds/m²])			
Nil (14) [9]	4.14	3.90	4.04
Level 1 (145) [106]	2.36	2.56	2.46
Level 2 (-) [222]	-	2.36	2.36
Level 3 (363) [426]	1.57	2.37	1.97
Level 4 (690) [590]	1.47	1.88	1.67
Level 5 (1052) [866]	1.15	2.15	1.65
Level 1(0) [6]	3.08	3.50	3.29
Level 2 (1023) [814]	0.77	1.34	1.06
LSD	0.458	0.604	0.473

There was a significant yield decline from chickweed populations above 145/m². Yield continued to decline at 363/m² but no further in 1993. In 1994 yield was reduced by a population of 106 chickweeds/m² and a further reduction at the highest level of 814/m².

In both years reducing the level of nitrogen tended to exacerbate the yield reduction caused by weed competition but it was only significant in 1994. In 1993 there was a yield reduction where 130 kg/ha was applied compared with 200kg/ha in the absence of weed competition.

Overall, yield levels were reduced when weed populations reached Level 1 (145/m² or 106/m²)and the yield reduction was more severe when nitrogen was reduced from 200 to 130 kg/ha.

Table 10a. *Yield of oilseed rape affected by differing populations of cleavers (t/ha at 91% dm) Experiment A, 1993*

Cleaver population (plants/m²)	Yield (t/ha at 91% dm)
200 kg/ha N	
Nil	3.97
3	4.16
9	3.82
18	3.81
34	3.23
130 kg/ha N	
Nil	3.17
34	2.79
LSD	0.458

Yield was reduced by the highest infestation of cleavers (34/m²), and reducing the nitrogen exacerbated the yield loss (Table 10a).

High populations of deadnettle, mayweed and speedwell resulted in yield reductions compared with low populations. Chickweed populations resulted in the lowest yield (Table 11) confirming work at other sites (Lutman *et al.* in press).

Table 11. *Yield of oilseed rape, Experiment B, 1994 (t/ha at 91% dm)*

Species	Low		High	Mean
Chickweed	2.70		2.37	2.53
Cleavers	4.05		3.74	3.89
Deadnettle	3.77		3.07	3.42
Mayweed	4.17		3.20	3.68
Charlock	3.52		3.21	3.36
Poppy	3.07		3.17	3.12
Speedwell	4.11		3.45	3.78
LSD		0.461		
Mean	3.63		3.17	
LSD		0.247		

Figure 1. *Relationship between ground cover assessments in November, December and January (GC %) and dry weight measurements in January or April of chickweed (DW g/m²)*

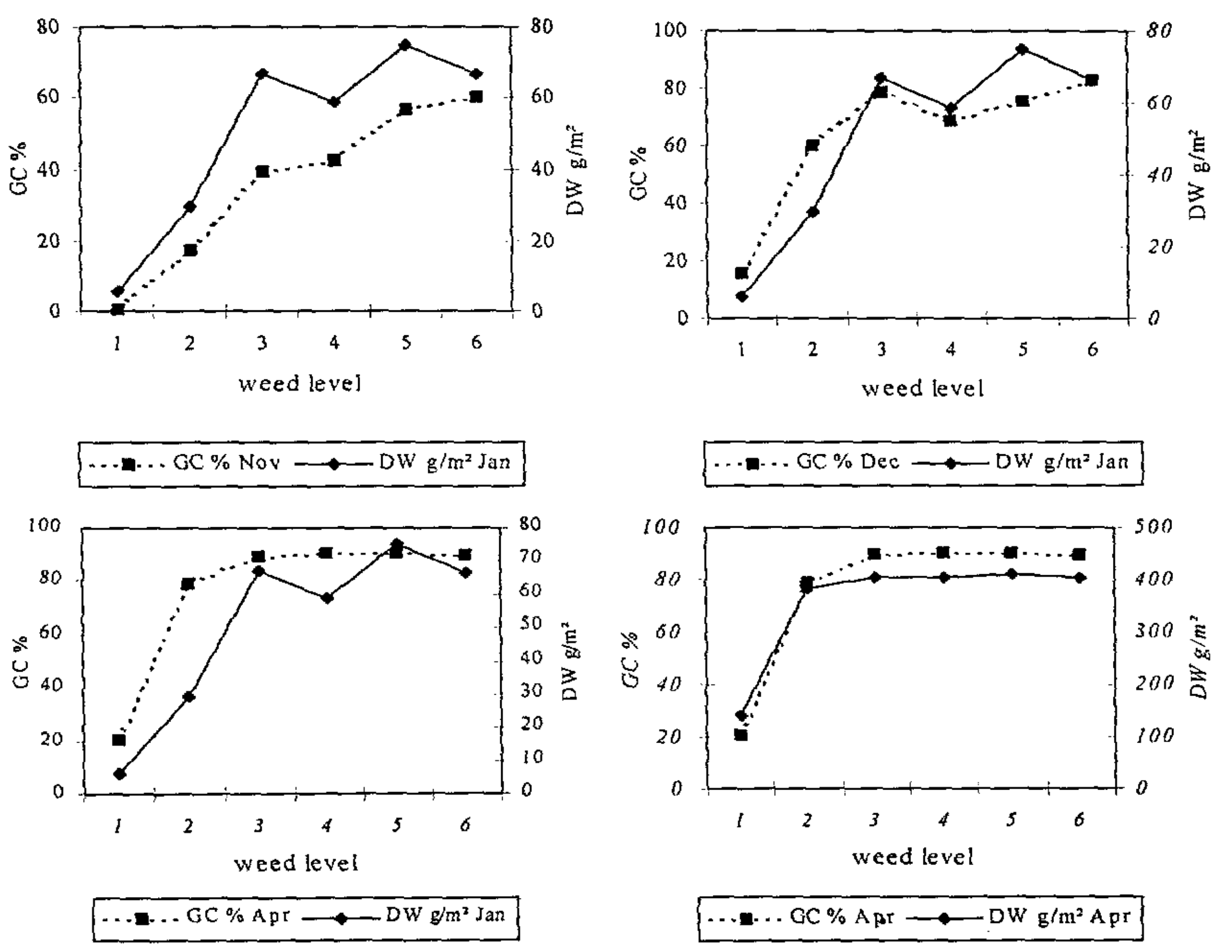
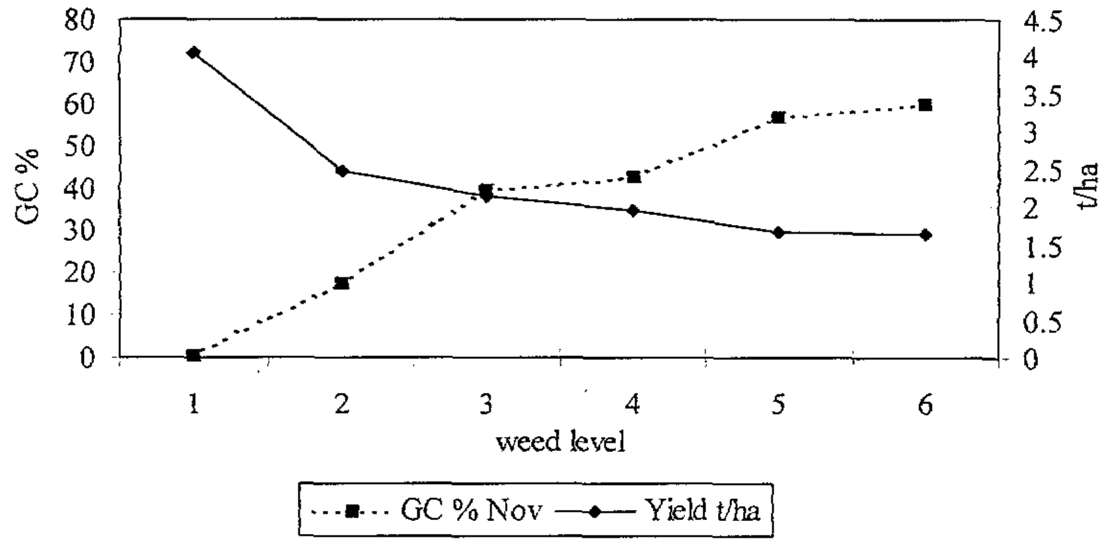


Figure 2. *Relationship between ground cover assessment (% cover) of chickweed in November and yield of oilseed rape (t/ha)*



Discussion

Distinct populations of weeds were satisfactorily established in these experiments although in some instances populations were lower than the target and in the case of Experiment B cleavers failed to germinate. There were some naturally occurring weeds which added to the background variation. These experiments have shown the benefit of establishing a vigorous crop capable of smothering weeds and that providing adequate nitrogen was an effective way to reduce the effects of weed competition.

The data also suggest that with respect to yield, up to 18 cleaver plants/m^2 can be tolerated, however this is based on one years work and does not take into account the difficulties of harvesting a crop infested with this level of the weed nor the contamination (admixture) or increased moisture content the weed causes.

From Experiment B the yield reduction from populations of chickweed were in line with the results from Experiment A, in addition populations of poppy at 68/m^2, deadnettle of 54/m^2, mayweed of 63/m^2 and charlock of 38/m^2 appeared to warrant control whilst 62 speedwells/m^2 could be tolerated.

Reliance on weed numbers alone is not sufficient as this does not take into account the relative vigour of crop and weed. However assessments of % ground cover correlate well with actual dry matter or biomass yield (Figure 1) which in turn correlates well with yield (Figure 2). Assessments of ground cover made later in the spring tended to correlate better with yield. Nevertheless assessments made in November were a good fit. This is a much quicker and practical assessment to do on a field scale.

Precise prediction of yield response to weed control in winter oilseed rape is not yet possible because there is no reliable method of relating weed growth to yield. In addition, the length of the growing season means that early assessment, required due to the lack of late post-emergence broad-spectrum herbicides, is likely to fail due to seasonal effects that occur over winter and in the spring.

Further work is required to examine other weed control strategies such as the use of low doses of herbicide to slow down weed growth thus enabling the crop to out compete the weed species. Cleavers, poppy and charlock are difficult to control in rape. Their removal elsewhere in the crop rotation is therefore the most effective method of control.

Acknowledgements

The authors gratefully acknowledge the support of the Home-Grown Cereals Authority for sponsoring this work and would like to thank staff at Morley for their assistance in collecting and processing the data. We would also like to thank W Hamilton and Sons, Stonham Parva, Suffolk for hosting the experiments.

References

Bodendorfer, H, Werner, B & Heitefuss, R (1994). RAPUS - eine computergestutzte Entscgeidungshilfe zur gezielten Unkrautbekampfung in Winterraps. *Zeitschrift fur Pflanzenkrankheiten und Pflantzenschutz, Sonderh.* **XIV**, 167 - 176.

Cousens, R D (1985). A simple model relating yield loss to weed density. *Annals of Applied Biology,* **107**, 239-52.

Lutman, P J W, (1991) Weeds in Oilseed crops. *Home Grown Cereals Authority, Oilseeds Research Review,* **OS2**, 70.

Lutman, P J W, Bowerman, P, Palmer, G M & Whytock, G P (1993). The competitive effects of broad-leaved weeds in winter oilseed rape. *Proceedings 1993 Brighton Crop Protection Conference (Weeds),* 1023-28.

Lutman, P J W, Bowerman, P, Palmer, G M, Andrews, F & Whytock, G P (1995). Cost-effective weed control in winter oilseed rape. *Project Report No. OS15* Home Grown Cereals Authority, London, 53.

Lutman, P J W, Bowerman, P, Palmer, G M & Whytock, G P. Response of oilseed rape to interference from *Stellaria media. Weed Science* (in press).

Ogilvy, S E (1989). The effects of severity and duration of volunteer barley competition on the yield of winter oilseed rape - a review of ADAS trials, 1986 - 87. *Aspects of Applied*

Biology **23**, Production and Protection of Oilseed Rape and other Brassica Crops, 237-47.

Sansome, G (1991). The effect of oilseed rape populations on weeds, herbicide performance and crop yields. *Proceedings 1991 Brighton Crop Protection Conference (Weeds), 1225-32.*