INCIDENCE OF PESTS AND DISEASES AND EFFECTS OF CROP PROTECTION ON DOUBLE- AND SINGLE-LOW WINTER RAPE CULTIVARS

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INTRODUCTION

The glucosinolates and their volatile hydrolysis products are generally considered to influence insect pest behaviour and to contribute to disease resistance in brassicas. With the recent replacement of single-low (low erucic acid, high glucosinolate) winter oilseed rape cultivars with double-low (low erucic acid, low glucosinolate) types has come concern that the lower glucosinolate levels in the new cultivars may make them more susceptible to attack by pests and diseases. This paper reports the incidence of pests and diseases and responses to their control in a range of double-low cultivars compared to the single-low cultivar Bienvenu.

Field experiments tested separate and combined treatments with insecticides and fungicides in 1987-88 and 1988-89, and fungicides (with standard insecticide treatments) in 1989-90 (Table 1). In each experiment six cultivars were sown in plots arranged in two randomized blocks each of 24 plots (of 6 x 2 x 2). Full details of management are given elsewhere (Rothamsted Experimental Station 1988; 1989; 1990). Pest and disease incidence was assessed on up to seven occasions in each season.

Table 1. Treatments and their dates of application

	1987-88	1988-89	1989-90
Insecticides			
deltamethrin	13 Nov.	1 Oct + 7 Nov.	9 Nov.
azinphosmethyl + demeton-S-methyl sulphone	18 Apr.	29 Mar.	-
triazophos	16 June	2 June	23 May
Fungicides			
prochloraz	18 Nov. + 11 Apr.	7 Nov. + 29 Mar.	7 Dec. + 28 Mar.
iprodione	16 June	2 June	23 May

INCIDENCE OF PESTS AND DISEASES

Mild winters in each year encouraged leaf disease but transfer of inoculum onto pods was restricted by dry summers in 1989 and 1990. Fungal infection was severe in 1987-88 and pest damage severe in 1988-89, but incidence of pests and diseases was slight in 1989-1990 (Tables 2 & 3). Double-lows were neither consistently more nor less attacked by pests and diseases than Bienvenu in 1987-88 and 1988-89; differences between double-lows and Bienvenu were often no greater than those among the double-lows.

The main pests recorded were Psylliodes chrysocephala (cabbage stem flea beetle), Meligethes aeneus (pollen beetle), Ceutorhyncus assimilis (cabbage seed weevil) and Dasineura brassicae (brassica pod midge). Incidence of P.

chrysocephala was low in 1987-88 but it considerably exceeded the economic spraying threshold of five larvae per plant on all cultivars in 1988-89. In 1987-88, four of the five double-lows (Cosmic, Corvette, Cobra and Capricorn) were significantly more heavily infested than Bienvenu, while in 1988-89, only Cobra was significantly more infested. M. aeneus were scarce in 1987-88 (0.2 adults per plant) and although slightly more numerous in 1988-89 (2.5 adults per plant) they remained well below the economic spraying threshold of 15 per plant; differences between cultivars were not significant. Infestation by C. assimilis larvae was less in 1987-88 than in 1988-89; in 1987-88, Corvette was significantly more infested than Bienvenu while in 1988-89, only Ariana was significantly less infested than Bienvenu. The economic spraying threshold of 15% pods infested was exceeded only in insecticide-untreated Bienvenu. Infestation by D.brassicae Larvae was slight and never exceeded 10% pods infested. In 1987-88, only Cobra was significantly more infested than Bienvenu, while in 1988-89 there were no significant differences between cultivars.

The main diseases recorded were downy mildew (Peronospora parasitica), light leaf spot (Pyrenopeziza brassicae) and dark leaf and pod spot (Alternaria brassicae and A.brassicicola). Downy mildew was prevalent throughout vegetative growth, affecting most plants in each season but dark leaf and pod spot are considered more important because they affect developing pods. Details of other diseases recorded during these experiments are given in a previous report (Rawlinson *et al.*, 1989). Double-lows differed widely in susceptibility to these diseases. For example, Cobra and Tapidor were most susceptible to dark leaf spot; during a period of heavy infection in February 1989 plants from plots not treated with fungicides had 86 and 80 lesions per plant, respectively, but Bienvenu, Lictor, Ariana and Capricorn were significantly less affected (43, 27, 24 and 13, respectively, SED = 11.46). Cobra was also consistently the most susceptible cultivar to light leaf spot; Tapidor was often the least affected by this disease (Table 3).

EFFECTS OF CROP PROTECTANTS

Insecticides and fungicides effectively killed pests (Table 2), controlled diseases, (Table 3) and increased yield (Table 4). While double-lows were not, as a group more, susceptible to pests and diseases, they gave greater yield responses to crop protection than Bienvenu in 1987-88 and 1988-89. Fungicide treated plots of all the double low cultivars in 1987-88 gave significantly greater yields (range +0.96 t to +1.58 t ha^{-1}) than untreated plots, but not in Bienvenu (+0.16 t ha^{-1}). In 1988-89 the response to fungicides was again greater among the double-lows (range +0.12 t to +0.66 t ha^{-1}) than Bienvenu (+0.06 t ha^{-1}). In 1989-90 yields were small even on treated plots due to poor establishment and drought; only Tapidor gave a significant response (+0.83 t ha^{-1}) to fungicides.

Insecticides had a lesser effect on yield than fungicides in 1987-88 but the responses were again greater among double-lows (range +0.09 to +1.03 t ha^{-1}) than Bienvenu (+0.07 t ha^{-1}). In 1988-89, insecticides significantly increased the yields of all double-lows except Ariana (range +0.30t to +1.46 t ha^{-1}) but slightly decreased the yield of Bienvenu (-0.25 t ha^{-1}).

Yields from untreated plots of double-low cultivars were consistently smaller than those of Bienvenu, but when treated with pesticides, double-lows generally yielded more than Bienvenu. In 1987-88 and 1988-89 Capricorn gave the greatest yield response to pesticides of all cultivars: yields from untreated plots were significantly smaller than those of Bienvenu in both years (2.89 vs. 3.72 t ha^{-1}, SED=0.243 and 2.54 vs. 3.36 t ha^{-1}, SED=0.325, respectively) but yields from fungicide-treated plots of Capricorn in 1988 and from insecticide-treated plots in 1988-89 were significantly greater

(4.47 vs. 3.88 t ha^{-1} and 4.03 vs. 3.11 t ha^{-1}, respectively). In 1989-90, Tapidor gave the greatest response to treatment (+ 0.83 t ha^{-1}), although pesticide-treated Capricorn still gave the greatest yield.

DISCUSSION

Our results showed that the double-low cultivars tested were not visibly attacked more by pests and diseases than the single-low Bienvenu. Indeed, their "ranking order" of susceptibility differed with different pests and diseases. Thus they cannot, as a group, be described as more susceptible. However, they consistently gave greater yield responses to pesticides than Bienvenu and when treated generally yielded more.

Although visual assessment of disease is the most practicable method, latent, symptomless infections, for example by Leptosphaeria maculans (Nathaniels and Taylor 1983) may not be recorded. Thus, in relating symptoms to yield, we assume that the stress imposed by a given visible level of infection is similar for all cultivars. The discrepancy between the observed incidence of the principal pests and diseases and the yield responses of cultivars to pesticide treatment suggests that this is not so. The double-low cultivars tested and in particular Capricorn, appeared to be comparatively intolerant of infestation and infection.

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ROTHAMSTED EXPERIMENTAL STATION 1989. Winter oilseed rape varieties pests and diseases. Yields of the field experiments 89/R/RA/3.

ROTHAMSTED EXPERIMENTAL STATION 1990. Winter oilseed rape varieties pests and diseases. Yields of the field experiments 90/R/RA/2.

Table 2. Mean numbers of Psylliodes chrysocephala larvae/plant in March and the mean percentages of pods infested by Ceutorhynchus assimilis and Dasineura brassicae larvae in July on cultivars of winter rape grown without (-I) and with (+I) insecticides.

	1987-88						1988-89					
	P.chrysocephala		C. assimilis		D. brassicae		P.chrysocephala		C. assimilis		D. brassicae	
	-I	+I	-I	+I	-I	+I	-I	+I	-I	+I	-I	+I
Bienvenu	0.07	0	3.1	0	3.8	0.6	32.3	1.3	15.3	1.5	1.5	2.0
Ariana	0.20	0	8.1	0	1.9	0.6	41.0	1.4	7.0	1.5	2.5	2.3
Cosmic	0.35	0.15	3.8	0.6	1.3	0.6	-	-	-	-	-	-
Corvette	1.13	0.08	10.6	1.9	5.6	0.6	-	-	-	-	-	-
Cobra	0.65	0.02	3.1	0	10.0	2.5	57.5	2.6	10.3	1.5	2.8	0.3
Capricorn	0.55	0	7.5	2.5	4.4	0.6	23.6	1.9	11.8	1.3	2.3	0
Libravo	-	-	-	-	-	-	40.4	1.2	14.3	2.5	1.8	0.5
Tapidor	-	-	-	-	-	-	34.5	2.4	10.3	1.0	0.8	1.0
SED (C x I)	0.118		1.73		0.86		7.30		2.11		1.08	
Mean	0.49	0.04	6.0	0.8	4.5	0.9	38.21	1.77	11.5	1.5	1.9	1.0
SED (x I)	0.236		3.5		2.98		2.980		0.86		0.44	

Table 3 Incidence of light leaf spot and dark leaf spot on leaves and pods on cultivars of winter oilseed rape grown without (-F) or with (+F) fungicides.

Light leaf spot

	1987-88				1988-89				1989-90			
	%L		PA		%L		PA		%L		PA	
	-F	+F	-F	+F	-F	+F	-F	+F	-F	+F	-F	+F
Bienvenu	30	0	0.1	<	28	2	<	<	-	-	-	-
Ariana	59	3	0.4	0.1	20	4	<	<	-	-	-	-
Cosmic	32	2	0.3	<	-	-	-	-	-	-	-	-
Corvette	59	2	1.0	0.1	-	-	-	-	-	-	-	-
Cobra	77	3	0.1	<	40	3	<	<	35	5	0.2	0.1
Capricorn	31	2	0.3	<	17	2	<	<	28	4	0.4	0.1
Libravo	-	-	-	-	11	0	<	<	23	2	0.2	0.1
Tapidor	-	-	-	-	16	3	<	<	21	1	0.1	<
Lictor	-	-	-	-	-	-	-	-	19	5	<	<
Score	-	-	-	-	-	-	-	-	17	3	0.2	<
SED	8.0		0.5		9.4		<		6.8		0.3	
Mean	48	2	0.3	0.1	22	2	<	<	23.7	3.3	0.3	0.1
SED	3.3				3.9		<		2.8		0.1	

Dark leaf spot

	1987-88				1988-89				1989-90			
	%L		PA		%L		PA		%L		PA	
	-F	+F	-F	+F	-F	+F	-F	+F	-F	+F	-F	+F
Bienvenu	47	39	3.9	0.1	40	32	1.1	<	-	-	-	-
Ariana	18	15	1.3	<	31	25	0.2	<	-	-	-	-
Cosmic	32	29	8.3	<	-	-	-	-	-	-	-	-
Corvette	39	42	6.1	0.1	-	-	-	-	-	-	-	-
Cobra	53	30	8.9	0.1	40	23	1.5	<	3	3	<	<
Capricorn	56	51	4.6	0.1	35	17	0.5	<	2	1	<	<
Libravo	-	-	-	-	30	26	0.1	<	2	1	<	<
Tapidor	-	-	-	-	43	30	1.2	<	4	1	<	<
Lictor	-	-	-	-	-	-	-	-	2	2	<	<
Score	-	-	-	-	-	-	-	-	7	2	<	<
SED	8.0		2.3		5.9		0.1		1.9		<	
Mean	41	34	5.5	0.1	37	25	0.8	<	3.3	1.7	<	<
SED	3.3		0.2		2.4		0.2		0.8		<	

Sampling dates: 1987-88, leaves 6/6/88, pods 12/7/88. 1988-89, leaves, 4/4/89, pods, 27/6/89. 1989-90, leaves 10/4/90, pods 27/6/90

%L, percent leaves. PA, diseased pod area estimated using a visual scale (ANON. 1985). <, trace infection only.

Table 4 Effect of fungicide (F) and insecticides (I) treatments and combinations of these on yield of cultivar Bienvenu and a range of double-low cultivars (C) in three seasons, 1988-1990

	Bienvenu	Ariana	Capricorn	Cobra	Corvette	Cosmic	Libravo	Lictor	Score	Tapidor	Mean
					1987-88						
-F-I	3.72	3.02	2.89	2.68	3.13	2.83	-	-	-	-	3.05
+F-I	3.88	4.16	4.47	4.20	4.40	3.79	-	-	-	-	4.15
-F+I	3.79	3.36	3.31	3.71	3.22	3.40	-	-	-	-	3.47
+F+I	4.70	3.64	4.65	4.22	4.42	4.22	-	-	-	-	4.31
SED (a)						0.243					
SED (b)											0.14
Mean	4.02	3.54	3.83	3.70	3.79	3.56	-	-	-	-	
SED (c)						0.154					
				1988-89							
-F-I	3.36	2.58	2.54	2.58	-	-	2.78	-	-	2.54	2.73
+F-I	3.42	2.84	3.20	2.70	-	-	2.93	-	-	2.86	2.99
-F+I	3.11	2.88	4.03	3.33	-	-	3.43	-	-	3.53	3.38
+F+I	3.70	3.65	4.01	3.59	-	-	3.61	-	-	3.74	3.72
SED (a)						0.325					
SED (b)											0.133
Mean	3.40	2.99	3.45	3.05	-	-	3.18	-	-	3.17	
SED (c)						0.163					
				1989-90							
-F+I	-	-	2.28	1.88	-	-	1.53	1.83	2.30	1.61	1.75
+F+I	-	-	2.71	2.32	-	-	2.14	1.86	2.22	2.44	2.14
SED (a)						0.326					
SED (b)											0.133
Mean	-	-	2.50	2.10	-	-	1.84	1.85	2.22	2.03	
SED (c)						0.231					

SED (a) - FxIxC; SED (b) - FxI; SED (c) - C