LATEST FINDINGS ON VARIETY AND FUNGICIDE INTERACTIONS

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ABSTRACT

UK Recommended List trials provide a comprehensive data base for exploring variety fungicide interactions. Disease control in trials is mainly directed at light leaf spot(*Pyrenopeziza brassicae*) and stem canker (*Leptosphaeria maculans*). In the UK disease incidence varies between seasons and regions. Overall there is a good correlation between fungicide treatment and yield response with light leaf spot but a less clear correlation with stem canker. In recent years new varieties have shown much improved light leaf spot resistance. However, large yield responses to fungicide treatment are still sometimes observed with resistant varieties or in the absence of visible disease symptoms.The implication of the trial results for managing varieties with different resistance profiles in the field is considered.

KEYWORDS varieties, fungicide response, disease resistance

INTRODUCTION

Yield potential of oilseed rape varieties on the UK Recommended List is assessed by a series of trials where optimum crop management techniques are employed to minimise the effects of fungal diseases. However, given the variable nature of subsidy available to the crop through the European Union, it is considered essential to provide growers with information on variety performance under lower input systems. To achieve this, a series of paired trials has been carried out each year in the UK since 1992. One set receives a comprehensive fungicide programme, while the other is untreated. In addition, the resistance of varieties to two major diseases is assessed routinely in inoculated trials, and in any natural infection which develops on the untreated trials. Results from these trials have been used to provide growers with information on the responsiveness of varieties to fungicide inputs, and to formulate strategies for treating varieties under varying disease pressures in different regions of the country. This paper will review results from the trials programme, and describe some of the ways in which growers could use the information produced.

MATERIALS AND METHODS

Varieties were sown at between nine and eleven sites representing all major rape growing areas each year. Trials were either grown separately in the same field, or as a split lattice design. Plots were a minimum of 45m^2. A standard protocol was applied to trial management and harvesting (Anon. 1998). For the majority of the trial period analysed, the treated plots received 0.4l/ha of fluzilazole and carbendazim (Punch C) in the autumn and at early stem extension, and 3l/ha of iprodione and thiophanate methyl (Compass) at mid to full flower. Regional yield responses to fungicide were derived from fitted constants analyses of treated and untreated yields for the periods 1994 to 1996, 1994 to 1997 and 1995 to 1998. Years were combined to increase trial numbers for the north of England and Scotland (N and Sc region). The remaining regions were designated south (S) and east (E). Variety sets differed in each period, though some varieties were common to all. Untreated trials

were examined regularly for disease. Severity of light leaf spot was assessed as the % leaf area infected on a plot basis. Stem canker was assessed by examining 30 stems at GS 6.3, assigning external and internal symptoms to a standard scale, and calculating a canker index (0-100). Inoculated tests and production of resistance ratings on a 1-9 scale (9=most resistant) for both diseases were carried out as described previously (Thomas and Wright, 1995).

RESULTS

Light leaf spot occurred at moderate or high levels in the north of England and Scotland in most years, but the disease was also severe over most of the UK during 1994 and 1995 (Table 1). Severe stem canker was not observed in the north of England or in Scotland, but records of serious infection were taken from single trials in 1994, 1995, 1996 and 1998 from the south and east of the UK. Maximum canker indices were 46.6, 58.1, 55.4 and 60.8 respectively. No records of *Sclerotinia sclerotiorum* were received during the period analysed, but up to 30% pod infection with *Alternaria brassicae* recorded in one trial in 1998.

Table 1 Incidence (number of trials infected) and severity (maximum % infection) of light leaf spot in untreated trials 1994-1998*

Year	N&Sc region		S&E region	
	Trials infected	Maximum %	Trials infected	Maximum %
1994	3	40	8	50
1995	3	35	7	38
1996	3	40	2	15
1997	3	30	0	0
1998	2	20	1	9

*maximum trial number was 3 in N and Sc, 8 in S&E for any year

Mean yield responses to fungicide over all varieties were greatest in the north of England and Scotland, and moderate in the rest of the country (Table 2)

Table 2 Mean yield responses (t/ha), and as a percentage of treated yields, over all varieties in different regions of the UK

Period of analysis	N and Sc		S & E	
	t/ha	%	t/ha	%
1994-1996	0.58	11.3	0.32	8.0
1994-1997	0.61	11.9	0.36	8.8
1995-1998	0.65	14.2	0.34	8.3

Mean individual variety responses ranged from +0.08 t/ha to +1.23. Correlation coefficients between individual variety responses and mean light leaf spot or stem canker scores derived from inoculated and natural infections assessed in each analysis period are shown in Table 3. Responses in the north and Scotland were highly correlated with light leaf spot, but not stem canker. In the other regions, there were variable correlations with light leaf spot, and correlations with stem canker scores were weak.

Table 3 Correlation coefficients for variety yield responses and disease severity

Disease	1994-1996		1994-1997		1995-1998	
	N&Sc	S&E	N&Sc	S&E	N&Sc	S&E
Light leaf spot	0.82**	0.78**	0.80**	0.57*	0.72**	0.42
Stem canker	-0.01	0.36	0.02	0.37	0.16	0.51*

*significant at p=0.05, ** significant at p=0.01

All trials in the N and Sc regions during 1994-1997 were affected by light leaf spot, and this period also included the widest range of variety resistances. Responses for varieties with resistance ratings of 8 varied from 0.43 to 0.73 t/ha, but a single variety with a rating of 1 showed a response of 1.23t/ha (Table 4).

Table 4 Treated and untreated variety yields, and responses, (t/ha) to fungicides, and light leaf spot resistance ratings for 1994-1997, N and Sc region

Variety	Treated	Untreated	Response	Resistance rating (1-9, to 1 d.p.)
Amber	4.85	4.52	0.33	7.3
Lightning	4.91	4.51	0.40	7.2
Lipton	5.13	4.70	0.43	7.5
Express	4.98	4.54	0.44	7.5
Artus	5.56	5.06	0.50	7.1
Pronto	5.40	4.89	0.51	6.6
Herald	5.39	4.87	0.52	6.9
Commanche	5.07	4.53	0.54	7.3
Falcon	4.97	4.42	0.55	6.6
Contact	5.08	4.48	0.60	7.2
Alpine	5.16	4.53	0.63	7.1
Meteor	5.13	4.43	0.70	7.4
Synergy	5.61	4.91	0.70	6.7
Capitol	5.12	4.39	0.73	7.8
Gazelle	5.15	4.38	0.77	5.8
Apex	4.88	4.11	0.77	5.9
Jazz	4.91	4.11	0.80	5.4
Licrown	5.29	4.46	0.83	6.8
Bristol	4.70	3.47	1.23	1.0

Resistance ratings for varieties on the UK Recommended List from 1994 to 1998 are summarised in Table 5. The proportion of varieties classified as susceptible to light leaf spot has declined, but most varieties are still susceptible to stem canker. Combinations of good light leaf spot resistance and ratings of 7 for stem canker resistance were rare, and on the Recommended List for 1998 only the variety Express had these ratings.

Table 5 Number of varieties in resistance rating categories for light leaf spot (lls) and stem canker from 1994 to 1998

Year	1-5 (susceptible)		6-7(moderate resistance)		8-9 (good resistance)	
	lls	canker	lls	Canker	lls	canker
1994	4	8	7	3	0	0
1995	3	10	6	3	4	0
1996	1	14	6	2	9	0
1997	1	16	11	7	11	0
1998	0	11	11	8	8	0

DISCUSSION

Variety responses to the fungicide programme were most clearly related to susceptibility to light leaf spot. Under the high disease pressure which occurred in the north of England and in Scotland during the trial period, even the most resistant varieties available gave yield responses to the three-spray programme which would have been economic at some crop prices during the trial period. However, if income from the crop stabilises at a lower level under the EU's Agenda 2000 proposals, growers may consider exploiting resistance to light leaf spot by reducing inputs. Regression analysis between responses and light leaf spot rating in north of England and Scotland trials for 1994-1997 indicated that response was reduced by 0.11t/ha every 1 point increase on the rating scale ($y = -0.111x + 1.36$, 64 % variance accounted for). However, it was apparent that some resistant varieties, such as Capitol, where only very low levels of disease were recorded even under high disease pressure, still gave a large response to fungicide. The reason for this is not clear. Physiological effects of fungicide, cryptic disease, or genotypic sensitivity to disease may all be implicated.

The lack of any strong correlation between yield response and stem canker resistance is probably related to the low number of trials with severe infection but may also be partly due to the relatively small differences in resistance between varieties, poor control of the disease, and the overriding effects of light leaf spot in many trials. Previous work (Thomas and Wedgwood, 1998) at a site where light leaf spot was not detected and canker was severe showed that higher yield responses were obtained from the canker susceptible varieties Nickel and Synergy than from the resistant variety Express, in plots where good canker control was achieved. In plots where canker control was less effective due to poor timing of fungicide application, responses were very similar.

A large range of varieties, including hybrid and conventional material, with good light leaf spot resistance is now available to growers. However, the number with even moderate resistance to stem canker is very limited, and no variety on the UK Recommended List has a high level of resistance. Stem canker is a serious risk in the south and east of the country in most years (Hardwick *et al*., 1991), and autumn spraying to control the leaf spot phase is usually necessary. Though the more resistant varieties may suffer less if sprays are poorly timed, they are still likely to benefit from an autumn fungicide application, but it is possible they may not require an additional spray at early stem extension, particularly if they have good light leaf spot resistance. Varieties susceptible to stem canker may need autumn and early stem extension spraying depending on the development of *Phoma* leaf spots during the winter, susceptibility to light leaf spot, and the seasonal risk of the latter.

Responsiveness of varieties to fungicide was clearly affected by factors other than disease resistance, and growers are provided with resistance information and response data so that decisions can be made on the likely benefits of application.

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