Oilseed Rape : Disease Development and Yield Loss Relationships

C.E. SANSFORD, B.D.L. FITT (1), P. GLADDERS (2) and K.G. SUTHERLAND (3)

ADAS Rosemaund, Preston Wynne, Hereford, HR1 3PG (UK)

(1) Rothamsted Experimental Station, Harpenden, Hertfordshire, AL5 2JQ (UK)
(2) ADAS Boxworth, Boxworth, Cambridge, CB3 8NN (UK) and
(3) SAC, 581 King Street, Aberdeen, ANB9 1UD (Scotland)

Introduction

In England and Wales there are a range of diseases which are detrimental to the yield of oilseed rape. Stem canker (*Phoma lingam*), stem rot (*Sclerotinia sclerotiorum*), light leaf spot (*Leptosphaeria maculans*), and dark leaf and pod spot (*Alternaria* spp.) are currently considered to be the diseases with the greatest potential to cause economic loss. (Hardwick *et al.*, 1991).

Adequate control by fungicides is available for a number of pathogens but their routine application is not justified, particularly following the introduction of the area payment scheme for crops harvested since 1991, when the price of rape seed paid was equivalent to a reduction in payment to the grower of 50%. This led to a requirement for yield responses to fungicides in the order of twice that required previously.

A series of experiments to establish the effect of disease on the yield and quality of oilseed rape, and to determine the economic threshold for disease control was initiated in the autumn of 1991. The experiment was replicated at four sites in the first year and five in the two subsequent years. This paper summarises the results of the first year of the trial which was located at Rosemaund, Herefordshire; Kington Langley, Wiltshire; Foveron, Aberdeenshire; and Rothamsted, Hertfordshire.

Materials and Methods

A mixture of fungicide products effective against all of the major and most of the minor fungal diseases of oilseed rape (Compass @ 1.5 l/ha (ai = iprodione 167 g/l plus thiophanate-methyl 167 g/l) **plus** Sportak 45 @ 0.55 l/ha (ai = prochloraz 450 g/l)) was applied at four-weekly intervals from the beginning of October. The experiment design was planned to allow two series of epidemics to occur by the sequential application of the fungicide mixture to the plots. The first series of sprays all began in the autumn and finished progressively later, continuing until harvest; the second series of sprays all finished at harvest and started progressively earlier (see Table 1).

Table 1. Target fungicide application dates

Treatment	Date										
	7/10	4/11	2/12	30/12	27/1	24/2	23/3	20/4	18/5	15/6	13/7
1	-	-	-	-	-	-	-	-	-	-	-
2	X	-	-	-	-	-	-	-	-	-	-
3	X	X	-	-	-	-	-	-	-	-	-
4	X	X	X	-	-	-	-	-	-	-	-
5	X	X	X	X	-	-	-	-	-	-	-
6	X	X	X	X	X	-	-	-	-	-	-
7	X	X	X	X	X	X	-	-	-	-	-
8	X	X	X	X	X	X	X	-	-	-	-
9	X	X	X	X	X	X	X	X	-	-	-
10	X	X	X	X	X	X	X	X	X	-	-
11	X	X	X	X	X	X	X	X	X	X	-
12	X	X	X	X	X	X	X	X	X	X	X
13	-	-	-	-	-	-	-	-	-	-	X
14	-	-	-	-	-	-	-	-	-	X	X
15	-	-	-	-	-	-	-	-	X	X	X
16	-	-	-	-	-	-	-	X	X	X	X
17	-	-	-	-	-	-	X	X	X	X	X
18	-	-	-	-	-	X	X	X	X	X	X
19	-	-	-	-	X	X	X	X	X	X	X
20	-	-	-	X	X	X	X	X	X	X	X
21	-	-	X	X	X	X	X	X	X	X	X
22	-	X	X	X	X	X	X	X	X	X	X

X = Compass plus Sportak 45

The trial design was a randomised block (design similar to that of Thomas *et al.*, 1989). Plots were located in commercial crops of winter oilseed rape. All treatments other than fungicides were as farm practice.

On each spray date 25 plants were taken from untreated plots and plots where treatment was complete, for disease assessment. Plots were harvested and yields adjusted to 91% dry matter. Ripening and lodging assessments were made as appropriate before harvest.

Growth stages were recorded using the key produced by Sylvester-Bradley and Makepeace (1985).

Summary of results

The spectrum and severity of diseases that developed during the first year of the experiment was different at each of the four sites. Useful data were obtained on a range of diseases; in particular stem rot, stem canker, light leaf spot, and pod spot (*Alternaria* spp.).

Extremely high levels of *Sclerotinia* infection occurred on the main stems and racemes at Rosemaund. The design of the experiment facilitated the identification of the key spray timings that led to highly effective disease control, and which resulted in large yield responses. The most effective timing (GS 4.8, 18 May, treatment 10) led to a reduction from 84 to 12 per cent of plants affected by *Sclerotinia* in July (GS 6.5) and a yield increase of 53 per cent when compared to the untreated. Regression analyses of yield data versus disease incidence and severity in July (GS 6.5) showed that there were strong and highly significant relationships between the variables. For every 1 per cent increase in the incidence of *Sclerotinia* on the main stem 0.016 tonnes per hectare was lost, compared to 0.0319 tonnes where infection of the raceme occurred. This two-fold increase in damage to yield is possibly due to a greater chance of the disease girdling the racemes compared to the thicker main stems.

Additional data on the control of *Sclerotinia* and its effect on yield was obtained at the Kington Langley site. At pod-ripening (July, GS 6.8) 18 and 27 per cent of plants respectively showed symptoms of infection on the main stem or racemes. Treatments which received sprays from October onwards finishing in February, March or April had considerably more disease than the untreated. The worst treatment had 66 per cent of stems affected and received six sprays between October and the end of February (treatment 7). This resulted in a yield loss of 9 per cent (0.32 tonnes/hectare). The cause of this upsurge in disease in treated plots is unknown but it is possible that the early sprays reduced levels of naturally-occurring competitive micro-organisms thus allowing higher levels of infection to occur once fungicide application ceased. Lodging of the crop at Kington Langley led to late development of *Sclerotinia* by mycelial growth between adjacent plants. Hence post-flowering sprays (treatment 14) gave some reduction in the incidence of disease.

Regression analysis of yield data versus disease incidence from Kington Langley showed that for every 1 per cent increase in the incidence of *Sclerotinia* on main stems or racemes in July (GS 6.8), there was a loss in yield of approximately 0.01 tonnes per hectare. The disease therefore appears to have been less damaging at this site when compared to Rosemaund, probably because it did not develop to the same extent. Infection of the racemes resulted in the same yield loss as infection of the main stems.

Data on stem canker was obtained from two sites. At Kington Langley 79 per cent of plants in untreated plots developed stem symptoms by early July (GS 6.8). Both penetrating and non-penetrating lesions were controlled by treatments that received sprays in the autumn and late February (less than 10% of plants were affected). There was no relationship between the control of stem canker and yield at this site, possibly because the disease severity was low (severity score of less than 1.0 at pod-ripening).

At Rothamsted, 94 per cent of plants developed symptoms of stem canker by July (GS 6.5). Treatments which commenced spray applications between October and February and finished in June were very effective, reducing disease incidence to less than 30 per cent. There was again no relationship between disease control and yield even though the severity score of stem canker in untreated plots at this site was worse than at Kington Langley (2.5 at pod-ripening).

The majority of data on light leaf spot came from the Foveron site. Foliar symptoms (assessed in April, GS 4.0) were controlled by treatments that received a spray between November and February, prior to stem extension. Control of stem symptoms was obtained from virtually the same treatments. Pod infection was made worse by all of the treatments, particularly treatments finishing between December and March and those starting between April and July. There was therefore no relationship between the time of spray applications and the enhancement of symptoms. Treatments that led to a significant reduction in light leaf spot on the stem also gave large reductions in premature ripening of the pods.

Yield responses at Foveron were not significantly different from the untreated but the largest responses appeared to arise from control of light leaf spot on the stem. The most effective treatment received seven sprays between October and March, disease incidence (assessed in August, GS 6.5) was reduced from 100 to 5 per cent and the yield response was 41 per cent (1.37 tonnes per hectare).

The relationship between yield and light leaf spot on the stem at Foveron was virtually the same as that between yield and premature ripening of the pods. For every 1 per cent increase in disease incidence or in the incidence of prematurely ripened pods there was a loss of approximately 0.01 tonnes per hectare. The correlation coefficients for both relationships with yield were highly significant with a value of approximately - 0.78.

The greatest range of pod diseases occurred at Rothamsted. Pod spot (*Alternaria* spp.) affected virtually all of the pods in untreated plots in July (GS 6.5) but the severity of symptoms was slight. Treatments that included both of the sprays in May and June gave good disease control but little response in yield.

Data so far indicates that for every 1 per cent increase in the incidence of *Sclerotinia* or light leaf spot infection there is a loss in yield of approximately 0.01 t/ha. For the first time light leaf spot infection of the stem was found to decrease yield. No relationship has been established between *Alternaria* or stem canker and yield despite the latter being severe at one site.

Acknowledgements

This work was supported by funding from the Home Grown Cereals Authority and the Ministry of Agriculture, Fisheries and Food. Collaborative work was carried out by SAC, Aberdeen; IACR, Rothamsted; and ADAS.

References

Hardwick, N. V., Fitt, B. D. L., Wale, S. J., and Sweet, J. B. (1991). Oilseed Rape Diseases. HGCA Oilseeds Research Review No. 0S4.

Sylvester-Bradley, R. (1985). Revision of a code for stages of development in oilseed rape (*Brassica napus* L). Aspects of Applied Biology **10**, 395-400.

Thomas, M. R., Cook, R. J., and King, J. E. (1989). Factors affecting development of *Septoria tritici* in winter wheat and its effect on yield. Plant Pathology **38**, 246-257.