The seed-borne source of *Alternaria spp.* and *Leptosphaeria maculans* in oil-seed rape in the United Kingdom. Prospects for control

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SUMMARY

Tests on samples of rape seed stocks used for 1982 sowings in the United Kingdom indicated that diseased seed may be an important primary source of *A. brassicae* and *L. maculans*. Of 30 samples tested 17 were infected with *Alternaria* spp. (maximum incidence 19%) and 16 with *L. maculans* (maximum incidence 5%). Highly virulent strains of *L. maculans* were identified in some seed samples. Crop surveys made in 1982 showed that such strains were confined to certain geographical areas. Oil-seed rape is an expanding crop in the United Kingdom and seed treatments must be used to minimise the danger of introduction of the pathogens into new growing areas. Fungicides such as iprodione and fenpropimorph have given effective control of both fungi on horticultural brassica seed. The potential for their use on rape seed is discussed.

INTRODUCTION

Two major diseases of oil-seed rape in England are stem canker caused by *Leptosphaeria maculans* (*Phoma lingam*) and dark leaf and pod spot caused by *Alternaria brassicae* and to a lesser extent *Alternaria brassicicola*. Stem canker first became a serious problem in 1976 and threatened the cultivation of oil-seed rape in several areas. However, since 1978 the widespread use of the canker-resistant cultivars 'Jet Neuf' and 'Rafal' has minimised the damage due to this disease, although the fungus continues to be present at high levels in crops of these cultivars (Evans & Gladders, 1981). Since 1979 *Alternaria* infection has increased in some regions and yield losses of up to 22% have been reported (Evans & Gladders, 1981). All three fungi are seed-borne and it is possible that infected seed may be an important primary source of these diseases.

The present paper reports tests made in 1982 to determine the significance of seed-borne infection in seed merchants' winter rape seed stocks and on fungicide seed treatment studies on the control of the three pathogens. Because both weakly virulent and highly virulent strains of L. maculans may occur in oil-seed rape crops in England (Humpherson-Jones, 1983) tests were also made to determine the virulence of the strains of this fungus occurring in seed stocks. Results of preliminary investigations on the distribution of highly virulent strains of L. maculans in winter rape crops are also reported.

METHODS AND RESULTS

Incidence of infected seeds in commercial rape seed stocks

A total of 30 samples of rape seed stocks produced in England in 1982 was provided by seed merchants. All samples were ex-farm and none had received a seed treatment. The incidence of seed infection by L. maculans and Alternaria spp was determined on 200 surface-sterilised seeds per sample using a standard nutrient agar test (Maude & Humpherson-Jones, 1980a).

Table 1 The occurrence of Leptosphaeria maculans and Alternaria spp. in rape seed stocks, 1982.

Number of samples			Mean and (maximum) incidence of infection (%)	
tested	infected with L. maculans	infected with Alternaria	L. maculans	Alternaria
30	16	17	0.7(5.0)	1.7 (19.0)

More than 50% of the samples were infected with L. maculans and a similar proportion with Alternaria spp. (Table 1). 94% of Alternaria infections were caused by A. brassicae and the remainder by A. brassicicola. In some samples up to 5% of seeds were affected by L. maculans and up to 19% by Alternaria.

Distribution of highly virulent strains of L. maculans in crops and seed stocks.

In 1982, in collaboration with the Agricultural Development and Advisory Service, a total of 370 isolates of L. maculans were obtained from 82 rape crops in the major rape growing areas of England. The pathogenicity of these isolates was tested by inoculating the hypocotyls of seedlings of a canker-susceptible cabbage cultivar, Avon Coronet, with a concentrated spore suspension of the fungus. On this host highly virulent isolates caused plant death or severe cankers whereas weakly virulent isolates produced only superficial lesions.

Table 2 The occurrence of highly virulent isolates of Leptosphaeria maculans in England, 1982 survey.

Region	Number of crops sampled	Number of crops in which highly virulent isolates occurred
South-east	38	6
South-west	9	3
East	18	8
Midlands	12	12
North	5	0
Total	82	29

In most regions highly virulent types occurred in a relatively small proportion of the crops; however, in the Midlands region, highly virulent strains were found in the 12 fields sampled (Table 2). In contrast, highly virulent types were absent from all 16 fields surveyed in the county of Kent (South-east region) and from the five fields sampled in the North region. Similar tests made on the 30 seed stocks supplied by seed merchants indicated that three of these carried highly virulent strains of L. maculans.

Fungicide tests

For many years new compounds have been screened at NVRS, Wellesbourne as potential seed treatment fungicides for the control of L. maculans, A. brassicae and A. brassicicola on horticultural brassica seed. Although in early tests chemicals, such as thiabendazole and benomyl, were found to eliminate seed-borne L.maculans they gave poor control of Alternaria. Until the mid-1970s the only fungicide seed treatment that controlled all three pathogens was a thiram soak (Maude, Vizor & Shuring, 1969). More recently fungicides selected in screening tests have been highly effective in controlling the seed-borne phases of all three fungi when applied to diseased seed as dusts or slurries (Table 3). However, certain of these chemicals were phytotoxic at the doses needed to give disease control but two, iprodione and fenpropimorph did not have this limitation.

Table 3 Spectrum of activity of fungicides selected in agar screening tests.

Chemical	Toxic to L.maculans	A. brassicae	A.brassicicola
thiram	+	+	+
iprodione	+	+	+
fenpropimorph	+	+	+
imazalil*	+	+	+
fenarimol*	+	+	+
nuarimol*	+	+	+
carbendazim	+	-	-
thiabendazole	+	-	-
benomyl	+	-	-
carboxin	+	-	-

\+ Fungitoxic at low concentrations
\- Little or no fungitoxicity.
* Phytotoxic when tested at fungitoxic rates on seeds.

DISCUSSION

Tests of seed merchants' rape seed stocks in 1982 showed

that infected seeds may be a significant primary source of Leptosphaeria maculans and Alternaria spp. It is of particular concern that a proportion of these samples carried highly virulent strains of L. maculans as it is these strains that are responsible for the severe stem canker phase of the disease. Oil-seed rape cultivation is still expanding in the United Kingdom and each year crops are sown in new areas. The present results emphasise the need to plant only healthy seed or seed that has been treated with chemicals active against these fungi, otherwise there is a real danger of introducing the pathogens, especially highly virulent strains of L. maculans, into hitherto disease-free areas.

Fungicide sprays are being used increasingly in the maturing rape seed crop and these treatments may be expected to reduce the levels of seed-borne infection in stocks destined to be sown for crop production. Similarly, seed testing has enabled merchants to select only the healthiest seed stocks; nevertheless significant numbers of infected stocks continued to be used in 1982. Seed treatments based on thiabendazole or benomyl have been used on rape seed in England for several years to control seed-borne L. maculans but until now no effective means of controlling this fungus and Alternaria spp. has been available. The identification of fungicides such as iprodione and fenpropimorph (Humpherson-Jones, Maude & Kennedy, 1980; Maude & Humpherson-Jones, 1980b; Maude, Bambridge & Spencer, 1982) active against both fungi provides the potential for practical control of the seed-borne phases of these pathogens on rape seed.

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