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THE NITROGEN AND FUNGICIDE REQUIREMENTS OF WINTER OILSEED RAPE, 1993-95

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Summary

Over the three years, 1993-95, there was an economic response to spring nitrogen up to 220 kg/ha, the highest level tested at a heavy land site in Suffolk. The response to extra nitrogen above 180 kg/ha was most marked with the late maturing, short stemmed variety Capricorn compared with the earlier maturing, taller varieties Bristol and Apex. The application of fungicides tended to result in higher yields and improved financial margins compared with untreated rape. Fungicide use under conditions of low disease infection did not generally affect the nitrogen response.

Introduction

Following the introduction of low glucosinolate and low erucic acid varieties (so called double-low varieties) to meet new industry standards in 1990, a programme of experiments was initiated by Morley Research Centre to assess what changes in husbandry might be appropriate for these varieties in order to achieve the best economic returns. An initial study looked at the responses of four representative double-low varieties to a range of seedrates and fungicide regimes (Palmer & Stevens, 1993) in order to assess the influence of crop structure on disease and yield. The results confirmed the adaptability of the new varieties of winter oilseed rape to different plant densities, but also demonstrated the importance of good disease control, especially for stem canker (*Phoma lingam*).

Subsequently, the experiment reported here explored the influence of husbandry on yield and economic potential of currently popular double-low varieties through the study of nitrogen level and its interaction with fungicide programmes. These are also important aspects of management that have assumed greater significance with the introduction of a lower price regime for oilseeds following revisions to the Common Agricultural Policy of the EU.

Method

The experiment was sited on sandy clay loam soil (Beccles series) at Little Stonham, near Stowmarket, Suffolk. In each of the first two years the varieties were Capricorn and Bristol while in the third year Apex was substituted for Capricorn as only a relative small area of this latter variety was being grown commercially. Each variety was grown at a range of spring nitrogen treatments from 60 to 220 kg/ha. This was additional to autumn nitrogen applied overall at 38 to 45 kg/ha. Apart from the lowest rate, all spring nitrogen treatments were applied in two parts with 60 kg/ha overall as an aqueous solution of ammonium sulphate by farm sprayer in late February, followed by the remainder, as solid ammonium nitrate by hand in mid March.

Each combination of variety and nitrogen rate received either a nil, low or high input fungicide regime based on the programmes used in the earlier study. Details of the fungicide programmes are shown in Table 1.

An important part of the experiment design was the isolation of treatments to minimise edge effects arising from contrasting applications on adjacent plots. To this end individual treatment combinations were grown in plots 6.3 m wide and 12.0 m long of which a central strip of 4.0 m wide strip received fungicide sprays. Within this a subplot 2.1 m wide and 9.0 m long was harvested from the centre for yield determination, using a Claas Compact combine harvester modified for plot work and fitted with a Novatech M964 weigh meter.

Up to the flowering stage of the crop fungicide sprays were applied by hand using a CO_2 powered knapsack sprayer calibrated to deliver a volume of 200 l/ha using Lurmark F110-03 size fan nozzles. After that stage the late fungicide was applied by a high clearance farm sprayer in a water volume of 240 l/ha as part of the intensive programme in 1993 and 1994. In 1995, crop lodging at the end of flowering prevented access to the plots and no late treatment was applied. The critical husbandry details are shown in Table 2.

Table 1. *Fungicide treatments - rate of product l/ha (active ingredient; g ai/l)*

Autumn	Spring	Early flower	Late flower
Low input	Sportak 45, 0.7	Compass, 1.5	-
-	(prochloraz; 450)	(iprodione + thiophanate-methyl;167+167)	
High input	Sportak Alpha,	Ronilan FL, 1.0	Rovral Flo, 2.0
Sportak Alpha, 1.1 (carbendazim + prochloraz; 100 + 267)	0.75	(vinclozolin; 500)	(iprodione; 255)

No recording was carried out during the season except to note overall disease levels and crop vigour. The main assessment in each year was seed yield.

Table 2. *Critical dates of husbandry treatments*

	1993	1994	1995
Sowing date	8 Sept. 1992	7 Sept. 1993	7 Sept. 1994
Autumn fungicide	20 November	26 November	27 November
Spring nitrogen	10 & 16 Feb. 1993	10 Feb. 1994	20 Feb. 1995
Spring fungicide	19 March	29 March	30 March
Early flower fungicide	26 March	29 March	4 April
Late flower	29 April	9 May	3 May
fungicide	8 June	11 June	-
Harvest date	28 July	2 August	24 July

Results

Soil nitrogen

Soil samples (0-90 cm) taken across the trial sites in February each year showed estimated amounts of available nitrogen to be 92, 72 and 89 kg/ha in 1993, 1994 and 1995 respectively. In 1993 the oilseed rape followed two wheat crops, while in 1994 and 1995 the rape was grown after a one year fallow (set-aside) following two wheat crops.

Crop establishment

Crop establishment was satisfactory and in each year plant populations exceeded $60/m^2$. The greatest variation in overall plant density occurred between years and ranged from 62 to 116 plants/m^2.

Disease

During the first two seasons disease levels were very low. In 1993, there was some phoma leaf spot present during the winter, but this failed to develop into a significant level of stem canker. There were detectable amounts of light leaf spot (*Pyrenopeziza brassica*) and alternaria pod spot (*Alternaria* spp.) on untreated plots. These infections were eliminated or reduced by the high and low input fungicide programmes respectively. In the 1994 season, low levels of phoma leaf spot and light leaf spot were again present, but there was little stem canker development and insufficient disease to detect treatment differences. In 1995, phoma leaf spot was widespread in the open autumn and resulted in stem cankers. Also, moderate levels of light leaf spot were present during the spring on untreated plots. Further development of light leaf spot was inhibited by the mainly dry conditions during and after flowering. Alternaria leaf and pod spot did not feature in either 1994 or 1995.

Yield

1993-1994 In the first two years of the experiment, when disease levels were low, untreated Bristol produced high yields and consistently out yielded the late maturing variety Capricorn (Table 3).

However, both fungicide programmes significantly improved the yield of Capricorn, bringing it closer to that of Bristol, which was not significantly affected by fungicide treatment. The response to nitrogen was also affected by choice of variety. The yield of Bristol increased significantly with increasing dose of spring nitrogen up to 140 kg/ha only, while that of Capricorn increased significantly with each extra increment of nitrogen. These trends in nitrogen response appeared to be unaffected by fungicide treatment.

Table 3. *Mean seed yield 1993-1994 (t/ha at 91% dm)*

	Bristol		Capricorn	Mean
Fungicide programme				
Untreated	4.53		3.87	4.20
Low input	4.59		4.26	4.42
High input	4.64		4.47	4.56
LSD		0.176		0.125
Nitrogen (kg/ha) without fungicide				
60	3.84		3.32	3.58
100	4.28		3.89	4.09
140	4.84		4.29	4.57
180	5.02		4.62	4.82
220	4.96		4.88	4.92
LSD		0.228		0.161
Mean	4.59		4.20	
LSD		0.102		
Fungicide nitrogen interaction			Fungicide programme	
Nitrogen (kg/ha)	Untreated		Low input	High input
60	3.37		3.56	3.82
100	4.01		4.02	4.23
140	4.35		4.65	4.70
180	4.55		4.93	4.97
220	4.73		4.96	5.07
LSD			0.279	

LSD = least significant difference at 95% probability level

1995 In this season disease appeared to affect Bristol more than in the previous two but did not affect Apex (Table 4). The yield of Bristol grown without fungicides appeared to respond to increasing nitrogen up to 140 kg/ha.

With fungicide treatment (data not shown), the response to nitrogen reached a maximum at 180 and 140 kg/ha, where the low and high input programmes respectively were used. By contrast Apex did not respond to fungicide treatment and its response to nitrogen above 140 kg/ha was small.

Overall, where no fungicide was used, Apex out yielded Bristol but, in the presence of fungicides, Bristol generally gave similar yields to Apex.

Table 4. *Mean seed yield 1995 (t/ha at 91% dm)*

	Bristol	Apex	Mean
Fungicide programme			
Untreated	4.51	4.83	4.67
Low inputs	4.87	4.83	4.85
High inputs	4.90	4.94	4.92
LSD	0.193		0.137
Nitrogen (kg/ha) without fungicide			
60	4.46	4.66	4.56
100	4.57	4.76	4.66
140	4.83	4.97	4.90
180	4.93	4.83	4.88
220	5.02	5.12	5.07
LSD	0.250		0.176
Mean	4.76	4.87	
LSD	NS		
Fungicide nitrogen interaction		Fungicide programme	
Nitrogen (kg/ha)	Untreated	Low input	High input
60	4.58	4.51	4.58
100	4.47	4.64	4.88
140	4.67	4.90	5.12
180	4.70	5.00	4.94
220	4.92	5.19	5.10
LSD		0.306	

NS = no significant difference

Means 1993-95 Over the three years, yields tended to increase with increasing nitrogen dose, with significant (P=0.05) increases in response to nitrogen up to 180 kg/ha (Table 5). This was apparent at all levels of fungicide use. In general, yield was increased by fungicide use, but the mean yields aggregate differences between varieties and seasons as indicated above.

Table 5. *Mean seed yield 1993-95 (t/ha at 91% dm)*

	Fungicide programme			
Nitrogen (kg/ha)	Untreated	Low input	High input	Mean
60	3.77	3.88	4.07	3.91
100	4.16	4.23	4.45	4.28
140	4.46	4.73	4.84	4.68
180	4.60	4.96	4.96	4.84
220	4.79	5.04	5.08	4.97
LSD		0.254		0.147
Mean	4.36	4.57	4.68	
LSD		0.114		

Discussion

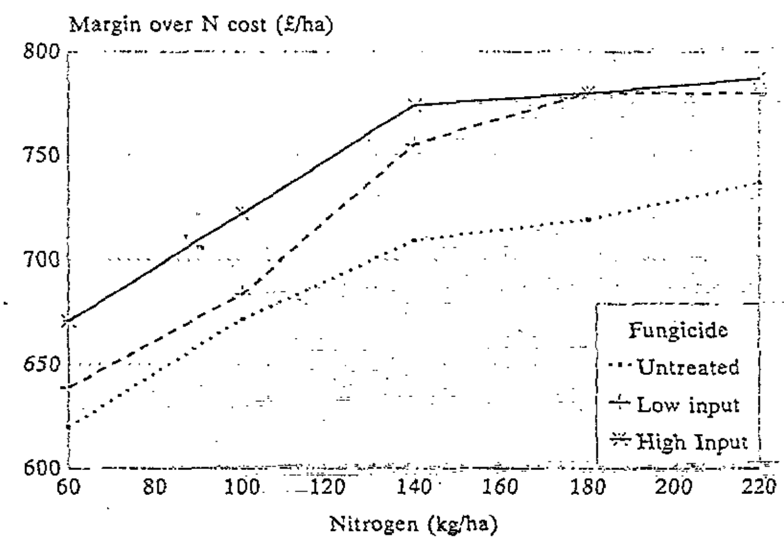
The results confirm earlier studies at Mid Anglian Trials sites (Palmer & Madge, 1988; Palmer & Stevens, 1990 & 1991) and by ADAS (Chalmers, 1989). These showed that yields from potentially high yielding winter oilseed rape, grown in arable rotations on heavy soils (soil N index=0), often respond to up to about 240 kg/ha of spring applied nitrogen and can occasionally benefit from fungicides, depending on the season and disease resistance of the variety grown. Thus the examples of double-low varieties used in this experiment appear to have behaved in ways entirely consistent with the earlier results.

These results further suggest that the response to nitrogen may be, to some extent, a function of both variety and disease control although the evidence is weak because of seasonal differences. Capricorn consistently responded to higher nitrogen levels than the earlier, taller variety Bristol in the years where these varieties were compared, suggesting that the extra nitrogen may have been required to increase its vigour and leaf area. The fact that untreated Bristol plots appeared to respond to higher nitrogen than fungicide treated plots in 1995, when spring growth may have been slightly retarded by light leaf spot and phoma leaf spot, supports this view of the role of the extra nitrogen.

While the yield data are a valuable indication of variety responses to nitrogen application and to effective disease control, the practical application of this information requires an interpretation making allowances for the additional cost of the inputs involved. For the purposes of this discussion arbitrary values have been adopted for both inputs and outputs based on current costings (rape seed valued at £170/t; nitrogen £0.35/kg and fungicide programmes £29/ha and £88/ha for the low and high input sequences respectively). Using these values the effects of varying inputs can be calculated to give net financial returns or margins which are then directly comparable.

Averaged over the three years, the highest margins calculated using these values were produced by the highest nitrogen levels tested together with fungicides (Figure 1). Some of the yield benefit from the high input fungicide programme was offset by the extra cost of that treatment, hence it showed no financial advantage over the low input programme. Although disease levels were not considered to be high, it seems likely that the early winter spray against phoma and light leaf spot was an important element of the high input fungicide programme. If this was the case, then it should be possible to design a fungicide programme offering almost the same degree of activity as the high input programme at much less cost. The elimination of unnecessary sprays is not always easy to achieve, except with hindsight, so that reliance on disease forecasting and disease resistance ratings may give disappointing results at the present time. The authors consider that some degree of prophylactic treatment may still have to be used, especially in areas with a history of intensive oilseed rape growing.

Figure 1. *Financial margins, 1993-95 (£/ha)*



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