EFFECTS OF PROCHLORAZ ON THE PHYSIOLOGY OF OILSEED RAPE

J.A. STAFFORD, G. NORTON, R.K. SCOTT, D.T. STOKES

Departments of Agriculture & Horticulture and Applied Biochemistry & Food Science, University of Nottingham, Sutton Bonington Campus, Loughborough, Leics. LE12 5RD.

K.J. DOUGHTY

Department of Plant Pathology, Rothamsted Experimental Station, AFRC Institute of Arable Crops Research, Harpenden, Herts. AL5 2JQ.

P.E. RUSSELL

AgrEvo UK Ltd., Chesterford Park, Saffron Walden, Essex CB10 1XL.

ABSTRACT

The effects of the imidazole fungicide prochloraz on the physiology of yield production were investigated in the winter oilseed rape variety Capricorn. Prochloraz was applied in autumn, spring and summer and crop growth assessed using stratified sampling. The chemical increased seed yield by 16% due largely to increased pod numbers m^{-2} and a slight increase in seed number per pod. Pod and seed abscission post-flowering were lessened probably through increased leaf persistence that utilised radiation passing through the pod layer more efficiently. These effects were not associated with the fungicidal activity of prochloraz.

INTRODUCTION

Experiments at Rothamsted Experimental Station have shown that applications of the imidazole fungicide prochloraz to oilseed rape sometimes produce yield increases which are not associated with reductions in disease incidence or severity (Bock *et al.*, 1991). A field experiment at Nottingham in 1990-91 was designed to further investigate a possible physiological response to prochloraz.

MATERIALS AND METHODS

Prochloraz (500g.a.i. ha^{-1} Sportak 45) was applied to replicated plots of Capricorn on 22nd November, 23rd April and 2nd July. Detailed analyses in a $1m^2$ area, harvested in 20 cm layers, were made of crop growth and development. Solar radiation interception was measured using tube solarimeters positioned in alternate rows at 20 cm intervals up the crop profile.

RESULTS AND DISCUSSION

Compared with unsprayed controls, prochloraz increased the seed yield (hand-harvested) by 16%, total pod (fertile + split) number m^{-2} by 14% and the number of yield-forming pods by 17% (Table 1). Mean seed number per pod was increased slightly (7%) but the average weight of individual seeds was not affected.

Table 1. Effect of prochloraz on seed yield and yield components

	Seed yield	Pod number m^{-2}		Seed number per pod	1000-seed wt
		Total	Yield-forming		
	(t ha^{-1})				(g)
Control	4.1	4527	4001	16.1	6.63
Prochloraz	4.8	5161	4668	17.2	6.68
S.E.D.*	0.14	340	378	1.09	0.08

(23 df)*

Treatment effects were not evident in late January but by mid-March leaf area index (LAI), stem area index and biomass were greater in prochloraz plots. These differences were maintained through to final harvest when total crop dry matter m^{-2} was increased by 13%because more seeds were retained. Yields reflected biomass production; there was no change in harvest index.

From flowering onwards, LAI declined from the base of the profile upwards in both treatments but more rapidly in the controls. Spraying with prochloraz increased the LAI within the pod canopy and in the layer below. The effect persisted when pods and seeds were developing in mid-late May and also during seed development in June and July. Prochloraz increased the potential number of pods, associated with the greater biomass at flowering (Mendham, Shipway & Scott, 1981) but the proportion of potential pods that set was not affected. The chemical treatment did not affect the initial number of seeds per pod but slightly improved their survival. This is unusual because following an increase in pod number, the extra shading in lower layers would normally result in a compensatory reduction in seed number per pod.

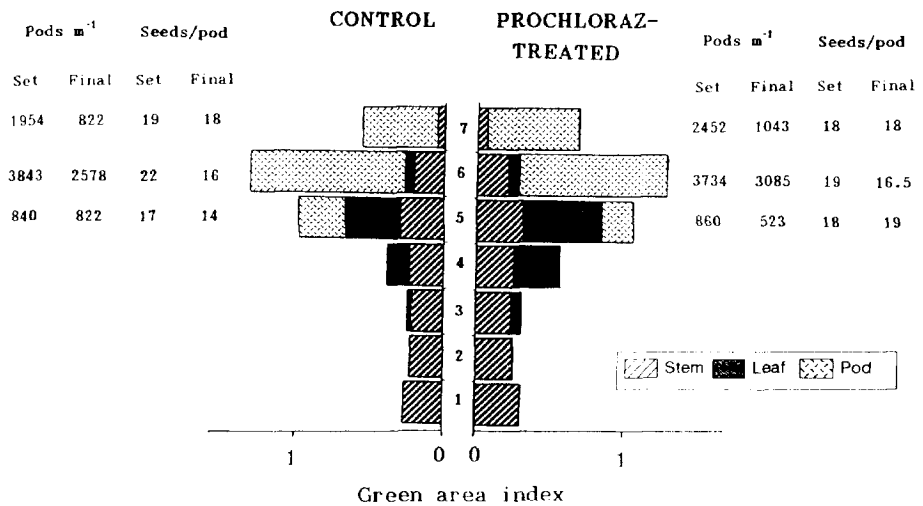

Fig. 1. Crop profiles in 20 cm layers on 4 July showing the components of green area index for each treatment and numbers of pods and seeds per pod set and at final harvest.

Prochloraz had only minor and transitory effects on disease incidence (light leaf spot (*Pyrenopeziza brassicae*) was slightly less in mid April but there was no effect in May; light stem and pod spot was reduced in early July). Thus the effects of prochloraz (which is structurally related to the growth regulatory triazoles used to modify growth in oilseed rape) on growth and yield are attributed to phytotonic rather than fungicidal properties. The effects were mediated through a change in the relationship between leaf and non-leaf photosynthesis which is important because on an area basis leaves are more efficient than pods and stems (Bilsborrow & Norton, 1988).

Fig. 1 represents the crop profiles divided into 20 cm layers on 4 July when thee top three layers formed the pod canopy. Prochloraz increased the LAI substantially in layer 5 and slightly in layer 6. It also maintained more leaf in layer 4 directly below the pod canopy. Thus more of the radiation penetrating through the pod canopy was intercepted by leaf in the prochloraz treatment compared with the control. Assimilates mostly move acropetally (Major & Charnetski, 1976) and it seems likely that photosynthesis by leaves at the base of the pod canopy promoted pod and seed survival in the treated crop. Prochloraz resulted in fewer seeds per pod being aborted in the lower layers of the canopy. However, the effect on seed number per pod was responsible for only a small proportion of the yield response, the majority of which was attributable to the production and retention of more pods in the upper and middle regions of the pod canopy.

In summary, prochloraz increased yield by improving leaf retention and radiation capture leading to improved assimilate supply during seed filling which favoured greater retention of both pods and seeds per pod.

ACKNOWLEDGEMENTS

The authors are grateful to AgrEvo UK Limited (formerly Schering Agrochemicals Limited) for funding the studentship held by J.A. Stafford.

REFERENCES

Bilsborrow, P.E. & Norton, G. (1988). Physiological factors affecting the yield of oilseed rape. *Proceedings of the 7th International Rapeseed Congress, Poznan,* 794 - 797.

Bock, C.H., Doughty, K.J., Fieldsend, J.K., Spink, J., Bilsborrow, P.E., Rawlinson, C.J. & Milford, G.J.F. (1991). Effects of fungicides and disease on growth parameters and seed glucosinolate concentration of oilseed rape. *Proceedings of the 8th International Rapeseed Congress, Saskatoon,* 1737-1742.

Major, D.J. & Charnetski, W.A. (1976) Distribution of ^{14}C- labeled assimilates in rape plants. *Crop Science*, **16**, 530-532.

Mendham, N.J., Shipway, P.A. & Scott, R.K. (1981). The effects of delayed sowing and weather on growth, development and yield of winter oilseed rape (*Brassica napus*). *Journal of Agricultural Science, Cambridge,* **96**, 389-416.