VARIATIONS IN WHEAT YIELDS BEHIND WINDBREAKS IN SOUTHERN QUEENSLAND

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Abstract

How do windbreaks affect crop growth and yield and what are the economic consequences of windbreaks in cropping systems? A national project is providing some of the necessary base data and has developed a methodology suitable to answer this question. Progress has been made in gaining some understanding of windbreak effects through experimental work and also through the application and adaptation of models. To add credence to the current experimental and modelling work where some selected windbreaks are assessed in great detail, a regional survey was conducted for wheat grown on the southern Darling Downs in 1997. As part of this survey, the relative performance of wheat crops along transects behind existing windbreaks were assessed on one property on the Darling Downs. This showed that in 1997, wheat yield increases in the wake zone behind shelters protecting the crop from southerly and easterly winds were sufficient to elevate the normal yield decreases in the competition zone. Wheat crops growing behind windbreaks giving shelter to northerly or westerly winds had no beneficial impact.

Keywords - windbreak, shelterbelt, wheat, yield

Introduction

Many experiments investigating the effects of windbreaks on crops show a general decrease in growth and yield within a competition zone (1 to 3 H; multiples of tree heights) behind a windbreak but an increase in crop production in the wake zone of a break, usually between 3 to 18 H. At 20+ H no effect is generally observed (1). However, the position of the break, environmental conditions and generally high spatial and temporal variability of prevailing wind direction and soil type make it impossible to derive generalised conclusions from the investigation of a single break. Thus, this survey investigated the effects of many windbreaks differing in orientation on wheat crops grown near Goondiwindi during winter and spring of 1997.

Material and methods

The survey was conducted on a large wheat property near Goondiwindi, Queensland (28^{o}S, 149^{o}E). On this property part of the remnant vegetation was left as treelines for stock shade around most of the paddocks in north-south and east-west direction. Sixteen transects where sampled involving eleven different windbreaks (five breaks had wheat growing on either site). Each break was characterised by measuring tree height, orientation, length and width of the break and by determining the tree species. Tree height varied from 8 to 12 m and windbreak length varied from 380 to 1,100 m. Measurements were taken along transects starting at the centre of each break and far enough away from any other shelter to avoid potentially confounding effects. At maturity yield measurements were taken at seven set distances from the windbreak. Using an experimental plot harvester two samples were taken at 1, 3, 6, 9, 12, 18 and 24 H behind each break, respectively (1.8 x 10 m for each sample). To assess the impact of wind shelter on the entire paddock yield, weighted yield averages from each height interval were integrated to calculate an overall paddock yield. Yield at each hight interval was expressed relative to the yield measured at 24 H (open field conditions).

Results and discussion

An ANOVA indicated significant effects of windbreak orientation on wheat yields ($P<0.05$). However, within each orientation, no statistically significant effects were found due to the high spatial variability, except for the strong yield depression in the competition zone. However, preliminary geo-statistical analysis indicates some significant differences in the co-variance structure of the data. This is currently being further investigated. Protection from southerly winds increased wheat yields in the wake zone (3 to 18 H) by an average of 18% with overall paddock yields increasing by 8% (Fig. 1). In contrast, protection from northerly winds reduced paddock yields by 10% due to a stronger competition effect and no apparent beneficial effect in the wake zone of the break. Likewise, easterly protection increased yields in the wake zone by 13% and paddock yields by 3%. Westerly protection increased yields in the wake zone by 2% resulting in an overall paddock yield reduction of 7%. Across all windbreak orientations there was a 1% (but statistically not significant) reduction in paddock yields due to windbreaks.

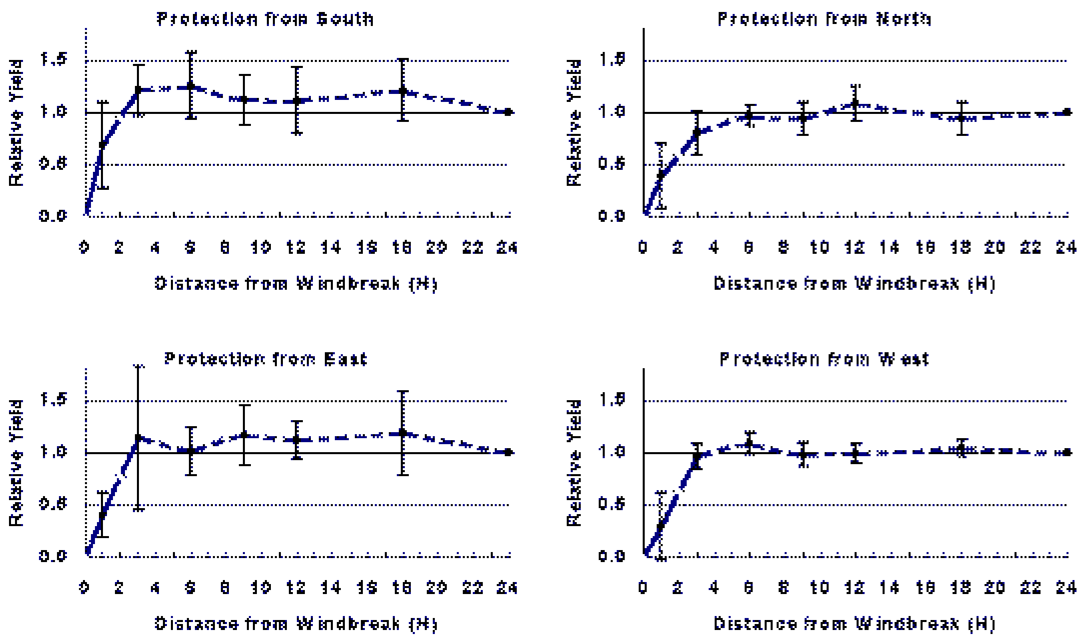

Figure 1: Wheat yields (relative to open field conditions at 24 H) behind natural windbreaks differing in orientation. Error bars indicate +/- one standard deviation.

The results show for one season and for one environment that wheat yield increases in the wake zone of a windbreak can compensate for yield losses in the competition zone. Protection from presumably cool, southerly and easterly winds resulted in up to 18% yield increases in the wake zone. No such increases were apparent behind windbreaks located to the north or west of the crops. While these findings add credence to similar findings behind artificial shelters and to results from simulation models, they have to be supplemented with data from other regions and seasons before general conclusions can be drawn.

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References

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