SUPPRESSION OF WHEAT GROWTH BY DIFFERENT TREE SPECIES

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Abstract

Change in the height of wheat away from the boles of different native tree species was measured in north western N.S.W. following conditions that gave good germination but where the crop development depended largely on stored soil water. The radial distance away from the tree bole to the point of zero reduction in wheat height varied between species, as did the relative suppression of wheat within this distance. No suppression of wheat was measurable with *Brachychiton populneus. Callitris columellaris* was the next lowest with a ratio of the width of radial suppression to tree height of 0.67. This ratio averaged around 1.5 for the other species but reached a maximum of 3 with *Eucalyptus populnea*. The suppression of wheat within this zone was high for *E. populnea* and *Geijera parviflora* and low for *E. crebra, Acacia pendula* and *E. melliodora*. The results demonstrate that species selection will affect pasture growth in and around shelter belts. Of the species sampled, those most suitable for shelter belt planting are *B. populneus* and *E. melliodora*.

Introduction

Agricultural development in Australia has been synonymous with the killing or clearing of native vegetation to enhance pasture growth or to allow for cropping. Sometimes trees were left as shelter for animals but, more typically, even steep slopes were denuded to increase grazing and eliminate refuges for 'vermin'. The recent demise of many of the remaining mature trees, some naturally but many expedited by insect attack and other factors associated with agriculture, has triggered the reversal of this trend, albeit some 50 years later than the U.S.A. Landowners are now replanting native species. However, the original reason for the removal of the native trees and shrubs, the reduction in pasture and crop yields through competition, remains valid and many landowners remain reluctant to plant trees.

This study was undertaken to investigate the range of competitive influence of some native tree species. Such information allows the selection or placement of tree species to minimise suppression and provides a basis for estimating the cost of retaining trees.

Methods

This study took advantage of conditions in the wheat belt of northern NSW during the 1975 season. Substantial early rains resulted in good crop establishment but crop development largely depended upon stored soil water. In consequence there was a marked suppression of growth but not density of wheat plants adjacent to trees.

Wheat fields adjacent to the Newell Highway between Moree (Lat. 149° 50'E, Long. 29° 28'S) and Dubbo (Lat. 148° 37'E, Long. 32° 15'S) were sampled just prior to harvest. Measurements were taken wherever mature trees were located either at the boundary or within a crop. The height of the wheat to the top of the ear was measured at regular intervals along 4 transects running radially away from the tree bole. Equal angular separation was provided between transects giving a 90° separation where trees were surrounded by the crop. Approximately 10 measurements were obtained per transect giving sampling increments along transects of

between 1 and 3 m. Transects were terminated where suppression of the wheat was estimated to be zero. The error of this estimate for any transect was observed to be much less than the variation between transects for any tree.

Use of plant height as an indicator of suppression has limitations. For example, parrots mainly feed adjacent to trees and in some locations mature seed heads were sparse around trees. However, it still provides a reasonable indicator of both the existence and level of suppression where plant establishment is uniform.

The species sampled were *Eucalyptus populnea* (poplar or bimble box), *E. crebra* (narrow leafed ironbark), *E. melliodora* (yellow box), *Casuarina cristata* (belah), *Geijera parviflora* (wilga), *Callitris columellaris* (cyprus pine), *Acacia pendula* (myall) and *Brachychiton populneus* (currajon). The opportunistic sampling provided unequal numbers of replicates for the different species. The trees were blocked into four replicates per species and this produced two blocks each for *C. columellaris* and *G. parviflora* obtained from different areas.

All measured variables were analysed separately for species differences using analysis of variance. Also analysed were the derived variables of ratio of radial distance to zero suppression and tree height, the ratio of lowest to highest wheat height measured along the transect and the slope of the linear regression relating the proportional reduction in wheat height to log distance from the tree.

Results

Results of the analysis of variance are given in Table 1 with the species being sequenced in order of decreasing radial extent of suppression. Results for *B. populneus* were omitted as no suppression could be detected with this species. The radial extent of suppression with *E. populnea* is approximately twice that of any other species. *A. pendula* had least radial effect but the plant size was small compared with the other species. Of the large trees, *C. columellaris* and *E. melliodora* had least radial effect.

E. crebra and *C. cristata* had substantial effects and, considering tree height, so did *G. parviflora*. The ratio of radial distance to zero suppression to tree height was around 1.5 for most species but was just under 3 for *E. populnea* while being only 0.67 for *C. columellaris*.

The distance to zero suppression of wheat away from trees can be difficult to accurately determine because of spatial variations in the growth of crops. In an attempt to avoid this error a variable was derived by graphically obtaining the slope of the linear regression between the height of wheat and the log of the distance away from the tree. Lower slopes are indicative of greater suppression. Results for the measured and derived variables are similar but significance levels for the latter were poor. The derived measure is confounded by differences between sites in the growth of wheat; the derived variable depends as much on the difference between maximum and minimum wheat heights as to the radial distance to zero suppression.

The ratio of minimum and maximum wheat heights measured along transects is a normalised estimate of the degree of suppression within the radial extent of influence of the tree. In this regard, *E. populnea* and *G. parviflora* reduce plant growth within their zone of influence much more than do the other species. However, results for the two blocks of *C. columellaris* differ indicating site differences may affect this estimate. With the other measures used to indicate suppression, differences between blocks for Geijera and Callitris were insignificant despite differences in the growth of wheat (Table 1).

Discussion

The suppression of wheat was analysed here in relation to tree species but the response reflects the interaction between the plants and their environment. The trees sampled in this study were large, mature specimens which had recruited naturally. They were all growing in 'natural' environments and so the different species tended to occur on different soils. For example, *B. populneus* only occurs on deep, fertile soils. Moreover, conditions for wheat were most favourable to the south of the sampling area. Conditions around *E. melliodora,* which only occurred to the south, were therefore more favourable than with *E. populnea* and *A. pendula* which only occurred to the north. However, given the magnitude of differences between species and the consistency of the results it is likely that the ratings between species given in Table 1 are valid for a range of conditions.

The marked suppressive effect of *E. populnea* provides an explanation for the strong relationship between tree density and pasture growth with that species (Walker et al. 1972) but opens to question the use of small plots in experiments with trees. It may be, however, that trees growing in isolation have different rooting patterns than those in communities.

The suppressive effects of *E. populnea* make it an undesirable species to have adjacent to crops and pastures. Conversely, B. populneus and *C. columellaris* are most suitable. However, the spread of the canopy makes *G. parviflora* and *E. melliodora* most suitable for shelter. Of these, *E. melliodora* has the lower level of suppression within the radius of influence and the lower radius of suppression relative to the canopy diameter.

The number of species sampled was limited and they are only representative of one region of NSW, but the results indicate that species selection can have a marked bearing on grass production in an around shelter belts and trees.

References

Walker, J., Moore, R.M., and Robertson, J.A. (1972). Herbage response to tree and shrub thinning in Eucalyptus populnea shrub woodlands. Aust. J.. Agric. Res. 23, 405-10.

Table 1. Analysis of variance of species effects in relation to the measured variables of radial distance to zero suppression (a), the maximum, (b) and minimum wheat heights away from trees (c), and the height (d). girth (e) and canopy diameter (f) of trees and for the derived variables of relative reduction in wheat height (g), the ratio of the radial distance to zero suppression and tree height (h), and the slope of the linear regression relating wheat height to log distance from the tree bole (i). Distances in metres.

	Species	Eucalyptus populnea	Eucalyptus crebra	Casuarina cristata	Geliera parviflora	Geiiera parviflora	SE
a	Radial distance	31.6	17.2	16.0	11.2	14.4	1.71
b	Maximum wheat height	0.22	0.30	0.30	0.21	0.25	0.02
c	Minimum wheat height	0.56	0.16	0.11	0.05	0.05	0.015
d	Tree height	11.0	13.0	9.5	7.4	8.5	1.5
e	Tree girth	2.8	2.1	1.6	1.4	1.4	0.24
f	Tree canopy diameter	15.3	14.0	5.0	7.5	8.6	0.013
g	Ratio of min. to max. wheat height	0.25	0.54	0.38	0.22	0.20	0.02
h	Ratio: radial distance and tree height	2.87	1.32	1.68	1.51	1.69	0.25
i	Slope: regression height vs. log distance	0.13	0.12	0.14	0.30	0.23	0.05
	Species	Eucalyptus melliodora	Callitris columellaris	Callitris columellaris	Acaia pendula		
a	Radial distance	11.5	8.3	9.4	6.1		1.71
b	Maximum wheat height	0.39	0.29	0.31	0.23		0.02
c	Minimum wheat height	0.21	0.07	0.15	0.12		0.015
d	Tree height	10.5	13.3	13.3	5.0		1.5
e	Tree girth	2.0	1.5	1.6	0.7		0.24
f	Tree canopy diameter	14.0	9.5	7.1	4.5		0.013
g	Ratio of min. to max. wheat height	0.54	0.24	0.48	0.53		0.02
h	Ratio: radial distance and tree height	1.09	0.63	0.71	1.22		0.25
i	Slope: regression height vs. log distance	0.13	0.32	0.22	0.30		0.05