SOIL MOISTURE AND BARLEY GRASS

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Summary

In experiments in which barley grass (*Hordeum* spp) and ryegrass (*Lolium* spp) were grown in a soil-filled tank in which the depth of water table ranged from 0.8 m to soil surface it was found that while both species were, at some times of the year, sensitive to differences in water table depth, barley grass growth was much more reduced than that of ryegrass when the water table was close to the soil surface. The possible implications of this discovery on the natural distribution of the two species are discussed.

INTRODUCTION

There is certainly a general relationship between the distribution of barley grass (*Hordeum* spp) and seasonal drought. Davison (1970) in a study of the distribution of *Hordeum murinum* in Britain, concluded that it was more widespread in areas of low rainfall. In Australia barley grass is a common component of Mediterranean-type annual pastures. In New Zealand it is much more widespread east of the main ranges, where summers are dry and warm. West of the main ranges barley grass usually only becomes common in pastures on sandy or gravelly soils which are susceptible to drought. Within a paddock it is often concentrated on the tops of ridges or under shelter belts, both of which are often drier than the rest of the paddock. Grant and Ball (1970), investigating some factors influencing barley grass distribution, found a hint of a negative correlation between soil moisture and the frequency of occurrence of barley grass. On very fertile stock camps, the classic locus of barley grass infestations, high levels of soluble salts impose a physiological drought on the plants growing on them.

This may mean that barley grass itself is more competitive than other pasture species in a dry environment and less competitive in a wetter one. It may be that animals tend to congregate in the drier parts of a paddock and thus enrich the soil, disturb the vegetation, and make conditions favourable for barley grass. It is possible that in drier areas other pasture species die or become dormant over the summer so that barley grass has no effective competition for the first few days or weeks of its life. Accumulation of soluble salts in the surface layers of the soil over a hot, dry summer may give barley grass an advantage in the early autumn. Certainly barley grass is designed as a drought evader. It flowers and sets seed early in the summer and survives the dry summer months as a seed which is well adapted to respond promptly to autumn rains. At the same time its occurrence on saline stock camps does suggest that perhaps it is better able than other pasture species to extract water against a high soil water osmotic pressure.

The experiments described here were designed to study the growth of ryegrass (*Lolium* spp) and barley grass, both in monoculture, at a range of soil moisture conditions during the autumn, winter, and spring.

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METHOD

A square section water-tight tank 6 m long $\times$ 0.8 m wide $\times$ 0.8 m deep was made from galvanised iron. One end of the tank was sunk into the ground so that the top of this end was at ground level: the bottom of the tank at the other end was at ground level so that the tank sloped downwards towards the north-east at an angle of about $7^{\circ} 40'$ from the horizontal. Pipes were installed to allow water to be introduced into the bottom of the top end of the tank and the whole tank was then filled with topsoil to within about 20 mm of the edge. Three vertical partitions of galvanised iron were installed along the length of the tank: these were pushed into the soil to a depth of about 25 mm and stood about 120 mm above the soil level. The soil surface was thus divided into four strips 6 m long and 200 mm wide. Plots 0.5 m long and separated from each other by a distance of 100 mm were marked out along the length of each strip. Each plot was sown with ryegrass or barley grass (*Hordeum murinum*) at the rate of 750 seeds per plot in such a way that at each position along the tank there were two plots of ryegrass and two of barley grass, arranged at random. There were 10 plots, or sites, along the length of the tank.

In the 1974 experiment 'Grasslands Manawa' ryegrass (*Lolium multiflorum x perenne*) and barley grass were sown on 4 April. The soil surface was not protected from rain and water was kept moving, at a slow rate, through the tank throughout the experiment. In 1975, when the experiment was repeated, 'Grasslands Nui' ryegrass (*Lolium perenne*) and barley grass were sown on 15 April. A cover of transparent polythene sheet was used to exclude rainfall and the water in the tank was allowed to stagnate, fresh water only being introduced if the water table at the lower end of the tank fell below the soil surface.

In both experiments, soil moisture of the top 50 mm of soil was measured gravimetrically at 11 evenly spaced points along the length of the tank at regular time intervals. At approximately monthly intervals the whole of each plot was cut to a height of 10 mm and the vegetation removed was oven-dried and weighed.

RESULTS

For each occasion on which soil moisture measurements were taken the regression of soil moisture on position in the tank were calculated. In 1974 every time but once (a total of 16 times between 17 May 1974 and 23 January 1975) and in 1975 on every occasion (7 times between 26 May and 16 September) there was a positive, statistically significant correlation between soil moisture content and position in the tank from which the samples were taken. Until mid-July in 1974 the moisture gradient was relatively shallow, ranging from 19-22% moisture content at the upper end to 22-27% at the lower end. After this date the gradient became steeper (10-24% at the upper end and 33-50% at the lower end). In the 1975 experiment moisture levels varied between 7 and 24% at the upper end and between 35 and 60% at the lower end.

In Table 1 are shown correlation coefficients for the relationship between dry matter yields and positions of plots in the tank for each harvest in both experiments. Position number one was at the higher and drier end of the tank and number ten at the lower and wetter end. Thus a significant negative correlation between position number and dry matter yield indicates that as the water table rose closer to the soil surface, yields decreased.

In 1974, none of the correlation coefficients for ryegrass were significantly greater than zero, but for barley grass at 3 out of 6 harvests yields were higher at the drier end of the tank.

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TABLE 1: RELATIONSHIP BETWEEN POSITION OF PLOTS IN TANK AND DRY MATTER YIELDS

<i>Date of harvest</i>	<i>Species</i>	<i>Correlation coefficient</i>	<i>Level of significance*</i>	<i>Range of yields (g/plot)</i>
15 May 1974	barley grass	0.18	NS	18 - 24
	ryegrass	0.15	NS	3 - 8
12 June 1974	barley grass	-0.59	5%	15 - 21
	ryegrass	0.26	NS	12 - 29
9 July 1974	barley grass	0.21	NS	7 - 10
	ryegrass	-0.05	NS	5 - 9
6 August 1974	barley grass	-0.73	1%	4 - 11
	ryegrass	-0.32	NS	7 - 11
5 September 1974	barley grass	-0.81	1%	6 - 20
	ryegrass	-0.24	NS	9 - 16
31 October 1974	barley grass	-0.44	NS	20 - 46
	ryegrass	-0.14	NS	13 - 42
26 November 1974	barley grass	-0.69	1%	2 - 26
	ryegrass	0.14	NS	9 - 31
TOTAL YIELD 1974	barley grass	-0.60	5%	75 - 138
	ryegrass	-0.12	NS	62 - 104
26 May 1975	barley grass	-0.45	5%	8 - 18
	ryegrass	-0.14	NS	9 - 13
25 June 1975	barley grass	-0.73	1%	3 - 8
	ryegrass	-0.73	1%	2 - 8
23 July 1975	barley grass	-0.78	1%	2 - 7
	ryegrass	-0.71	1%	2 - 6
3 September 1975	barley grass	-0.84	1%	1 - 27
	ryegrass	-0.78	1%	6 - 28
13 October 1975	barley grass	-0.94	1%	2 - 29
	ryegrass	-0.40	NS	10 - 26
TOTAL YIELD 1975	barley grass	-0.92	1%	16 - 83
	ryegrass	-0.72	1%	35 - 85

* NS = not significant.

At the first and last harvests of ryegrass in 1975 the negative correlations between ryegrass yields and position in the tank were not significant but they were highly significant for the other 3 harvests. At all harvests there was a negative, highly significant correlation between barley grass yields and position in the tank.

Although regressions of yield on position in the tank were calculated for each species at each harvest, on most occasions there were considerable deviations of actual points from fitted regression lines: these lines thus showed only a general trend rather than giving an accurate picture of what was happening. Regression lines and equations are not therefore given.

At almost all harvests, in both years, yields of barley grass declined more than did those of ryegrass along the tank, indicating that barley grass is more seriously affected by a high water table than is either 'Nui' or 'Manawa' ryegrass. At the start of each experiment barley grass yields were greater than those of ryegrass but by August in both years ryegrass was outyielding barley grass at the wet end of the tank, but not at the drier end.

DISCUSSION AND CONCLUSIONS

From the results of these experiments there is good evidence that the growth of both barley grass and ryegrass is inhibited on very wet soil over the May to November period. However, barley grass suffered much

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more than ryegrass when growing in wet conditions. This suggests that regardless of summer growth conditions barley grass would tend to be at an advantage over ryegrass on sites which are relatively dry in winter, whereas on wet soils ryegrass would have some advantage.

Since places which are drier in winter would also tend to dry out more quickly in summer, barley grass would have a double advantage, on such sites, because of the lack of early autumn competition and because of its superior growth on dry soil in autumn and winter.

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