Barley Grass Distribution
Influence of the Physical Environment

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The general pattern of barley grass infestations in New Zealand can be related to climatic factors.

Climate

The important factors seem to be rainfall (especially over the summer) and temperature. Where summer rainfall is fairly reliable, barley grass tends to be restricted to stock camps. However, in areas with low summer rainfall and higher temperatures, pastures dry out in summer. Overgrazing is common and barley grass can spread out from stock camps to become an important component of the pasture. The problem is, apparently, particularly bad where soil fertility is high, pastures are of improved species and stocking rates are high. Thus, Hawke's Bay, Marlborough, Canterbury and parts of Otago are very vulnerable to barley grass invasion.

The general impression is that warm, dry summers favour barley grass. This is probably largely due to the effect of such conditions on other pasture species, and will be discussed in more detail later.

Soils

Soil moisture: Popay and Sanders (1976) demonstrated a positive correlation between depth of water table and vegetative growth of barley grass and ryegrass. The growth of barley grass was strongly inhibited in wet soil. It grows slowly in soils with a high, winter water table and its growth is likely to be strongly affected by the growth of more moisture-tolerant species.

pH: According to Moore (1971) *Critesion murinum* subsp. *leporinum* became the dominant grass on both neutral and alkaline soils and replaced Wimmera ryegrass, *Lolium rigidum*, on acid soils in eastern Australia. Davison (1971) found that the soils from sites of *C. murinum* in north-west England had high pH values, with a majority having values of around 7.5. Davison also grew barley grass in pots on a range of soils and found that early vegetative growth was best on soils from barley grass sites, and on fertile garden and arable soils. Growth was poor on nutrient-deficient fixed dune sand of pH 6.8.

In New Zealand, Grant and Ball (1970) found that the soil of *C. murinum* sites tended to have a slightly lower pH (about 5.8) than that of nearby pasture sites (about 6.1). Metson *et al.* (1971) observed virtually no differences between pH values for soils from heavy and light barley grass infestations on stock camps.

The overall evidence suggests that pH itself does not affect the distribution of barley grass although in some circumstances there may be indirect relationships.

Fertility: Barley grass, as a weed in New Zealand, has only come into prominence since the 1940s. Allan (1933) observed that barley grass was widespread in waste places. Not until the late 1940s and 1950s was it recognised as a threat to pastures and to stock (Levy 1948; Madden 1953; Collin 1955; Saxby 1956; Glue and Matthews 1958; Allo 1959; Merry 1959). Its apparently abrupt spread into pastures coincided with the post-war development of topdressing with superphosphate.

This suggests that barley grass likes fertile soils and its occurrence as a coloniser of stock camps confirms its affinity for high fertility conditions.

Similar observations have been made in Australia. Tiver and Crocker (1951) commented that superphosphate converted perennial pasture into one dominated by barley grass and other annual species. Myers and Moore (1952) examined the occurrence of barley grass on the plots of a citrus fertiliser experiment, and found that barley grass had become particularly abundant on plots receiving both nitrogen and phosphorus. Rossiter (1964, 1966) and Moore (1965) reported that barley grass increased with increased phosphate levels.

In New Zealand, Grant and Ball (1970) measured higher available soil nitrogen levels on barley grass sites than in the surrounding pastures and established a positive correlation between frequency of occurrence of barley grass and available soil nitrogen.

Fertility responses

Cocks (1974a), working with *C. murinum* subsp. *leporinum* in Australia, came to the surprising conclusion that Wimmera ryegrass gave a better response to applied nitrogen than did barley grass, although the response depended on plant density. Barley grass accumulated more nitrogen in its foliage than did ryegrass and its advantage in this respect was greatest at high density and with no added nitrogen. This suggests that barley grass is more capable than ryegrass of exploiting the resources of its environment quickly and efficiently.

Additional work by Cocks (1974b) furthered this suggestion when he found that where nitrogen was not limiting, Wimmera ryegrass was a better competitor than barley grass. But, when soil nitrogen status was low, barley grass became the better competitor.

Salinity

High levels of soluble salts in soils are typically associated with semi-arid regions or coastal and estuarine conditions. Soil salinity of this kind has long been associated with the distribution of *C. jubatum* (Wilson 1967), *C. geniculatum* and *C. marinum* (Szwarcbaum and Waisel, 1973).

Metson *et al.* (1971), suggested that soil salinity may affect the distribution of *H. murinum*. It was found that as barley grass density increased, so did soil salinity. The soluble salts mainly responsible for the high salinity were (in decreasing order of importance) the cations K^{+}, Ca^{2+}, Mg^{2+} and the anions $HC03^{-}$, $N03^{-}$, Cl^{-} and $SO4^{2-}$.

All of these salts were derived from animal wastes and their concentration was due to the transfer of fertility from pasture to stock camps. The authors suggested that these conditions gave barley grass some undefined advantage over ryegrass.

Grant and Ball (1970) also measured soil salinity in barley grass communities and found that this was higher than in the surrounding pasture although there was no correlation between salinity and the frequency of occurrence of barley grass in tiller plugs.

Popay and Sanders (1982) measured, at approximately monthly intervals, soil salinities on stock camps in pastures infested with barley grass and in adjacent, non-infested pastures (Fig. 1). In all cases there was a tendency towards increased salinity during the summer and this was most marked in soils on which barley grass grew.

Popay (unpublished) grew barley grass and ryegrass, in both mixtures and monocultures, at different levels of salinity on a stock camp (Table 1). When grown alone, both species grew better on the least saline soils but the growth of ryegrass tended to more strongly inhibited than that of barley grass at high salinities. When the two species were grown together the growth of ryegrass was strongly suppressed at all salinity levels.

Since the same chemical substances are responsible for high soil fertility and salinity, there can be no clearly drawn line between the two.

The levels of soluble salts in the soil on a stock camp depend on a number of factors including stock numbers and management, rainfall and temperatures, but in general patterns are similar to those shown in Fig 1.

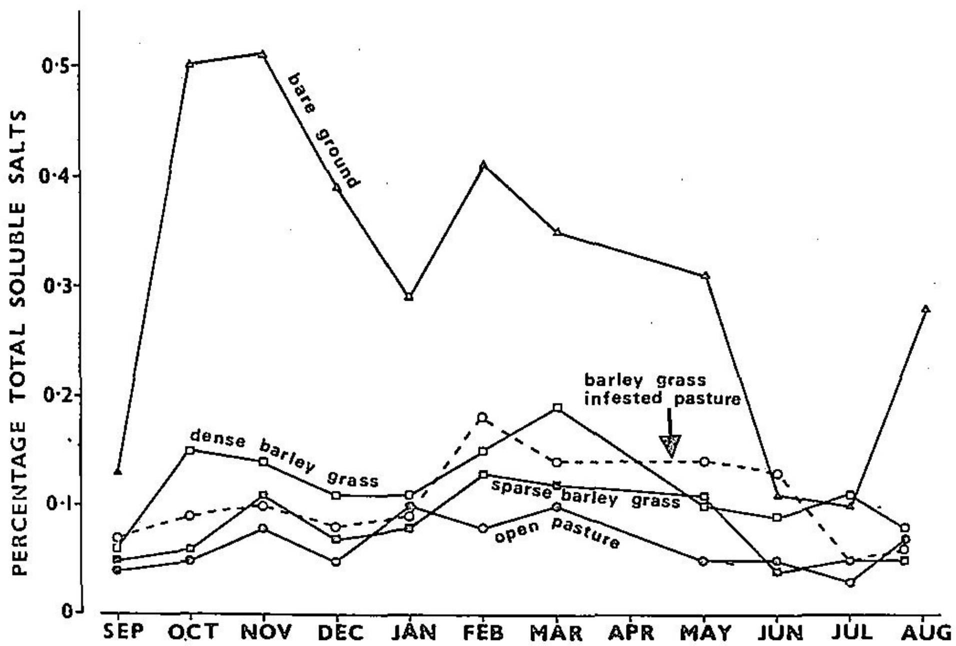

Fig. 1: Percentage total soluble salts in the top 25 mm of soil samples from 4 zones of a stock camp on a farm near SH 2 between Norsewood and Waipukurau in Hawke's Bay and from a barley grass infested pasture on a farm at Maraekakaho, Hawke's Bay.

Table 1: Growth of monocultures and mixtures of barley grass, *Hordeum murinum*, and ‘Grasslands Manawa’ short rotation ryegrass on a stock camp. Yields in g DM / m^2.

Location *	Harvest 1: 20/6		Harvest 2: 18/7		Harvest 3: 27/8		Harvest 4: 29/10	
	monoculture	mixture	monoculture	mixture	monoculture	mixture	monoculture	mixture
A								
barley grass	15.0	11.2	2.4	2.1	12.1	10.1	166.2	97.5
ryegrass	1.2	0.5	0.4	0.2	3.7	1.9	131.0	36.8
total		11.7		2.3		12.0		134.3
B								
barley grass	17.9	13.2	2.8	4.0	14.5	13.9	166.6	114.6
ryegrass	3.6	0.4	0.9	0.3	8.8	1.7	192.3	39.6
total		13.6		4.3		15.6		154.2
C								
barley grass	15.3	14.3	4.0	3.8.	18.2	11.0	152.6	125.3
ryegrass	2.9	0.7	1.0	0.3	8.0	1.3	192.9	31.6
total		15.0		4.1		12.3		156.9
D								
barley grass	37.1	18.0	5.8	4.8	26.5	18.6	149.8	184.7
ryegrass	5.6	1.5	1.1	0.5	7.1	1.9	229.	1 47.3
total		19.5		5.3		20.5		232.0

*A: at highest salinity level, D: at lowest.
Experiment sown 18/4/75 at Flock House Field Research Area. Sowing rate 2500 seeds/m^2. Mixtures sown at 1250 seeds/ m^2 of each species.

References:

Allan, H.H. (1933): Notes on recently observed exotic weeds. IV. The barley grass. N.Z. Journal of Agriculture 47: 182 - 4.

Allo, A.V. (1959): Weed problems of the Bay of Plenty. Proc. 12th N.Z. Weed and Pest Control Conf.: 17 - 23

Cocks, P.S. (1974a): Response to nitrogen of three annual grasses. Australian Journal of Experimental Agriculture and Animal Husbandry 14: 167 - 72.

Cocks, P.S. (1974b): The influence of density and nitrogen on the outcome of competition between two annual pasture grasses, *Hordeum leporinum* Link) and *Lolium rigidum* Gaud.: Australian Journal of Agricultural Research 25: 247 - 258.

Collin, F.H. (1955): Control of barley grass in Hawke’s Bay. Proc. 8th N.Z. Weed Control Conference: 23 - 7.

Davison, A.W. (1971): The ecology of *Hordeum murinum* L. II. The ruderal habit. Journal of Ecology 59: 493 - 506.

Glue, D.I. and Matthews, L.J. (1958): Weed identification and control: barley grass. N.Z. Journal of Agriculture 97: 313.

Grant, D.A. and Ball, P.R. (1970): Synecology of some barley grass communities in the central Manawatu. Proc. 23rd N.Z. Weed and Pest Control Conf.: 83 - 9.

Levy, F.B. (1948): Sheepfarming Annual. Massey College’ 69 - 79.

Madden, F.A. (1953): Ecology of barley grass. Proc. 6th N.Z. Weed Control Conference: 85 - 8.

Merry, D.M.E. (1959): Barley grass control. Proc. 12th N.Z. Weed Control Conf.: 77 - 81.

Metson, A.J., Saunders, W.M.H. and Nott, J.H. (1971): Some chemical properties of barley grass, .1-fordeum murinum L., infestations. N.Z. Journal of Agricultural Research 14: 334 - 51.

Moore, R.M. (1965) Man as a factor in the dynamics of plant communities. Proc. Ecological Society of Australia 1: 106.

Moore, R.M. (1971): Morphogenesis and management of annual plants in Australia. In “Plant morphogenesis as the basis for scientific management of range resources”. USDA Misc. Pub. 1271: 99 - 110.

Myers, L.F. and Moore (1952): The effect of fertilisers on a winter weed population. Journal of the Australian Institute of Agricultural Science 18: 152 - 5.

Popay, A.l. and Sanders, P. (1976): Soil moisture and barley grass. Proc. 29th N.Z. Weed and Pest Control Conf.: 72 - 5.

Popay, A.l. and Sanders, P. (1982): Seasonal variation in salinity of soils supportingdifferent levels of barley grass (Hordeum murinum). New Zealand Journal of Agricultural Research 25: 223-227.

Rossiter, R.C. (1964): The effect of phosphate supply on the growth and botanical composition of annual-type pasture. Australian Journal of Agricultural Research 15: 61 - 76.

Rossiter, R.C. (1966): Ecology of the Mediterranean annual-type pasture. Advances in Agronomy 18: 1 - 56.

Saxby, S.H. (1956): Pasture production New Zealand. N.Z. Dept. of Agric. Bulletin 250.

Szwarcbaum, I. and Waisel, V. (1973): Inter-relationships between halophytes and glycophytes grown on saline and non-saline media. J. Ecol. 61: 775 - 86.

Tiver, N.S. and Crocker, R.W. (1951): The grasslands of S.E. South Australian in relation to climate, soils and developmental history. Journal of the British Grassland Society 6: 29 - 80.

Wilson, D.G. (1967): Growth of *Hordeum jubatum* under various soil conditions and degrees of plant competition. Canadian Journal of Plant Science 47: 405 - 12.

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