OBSERVATIONS ON IDENTIFICATION AND DISTRIBUTION OF BARLEY GRASS SPECIES

F. C. ALLEN

Ministry of Agriculture and Fisheries, Christchurch

Summary

The identification and distribution of the 5 barley grass species (*Hordeum* spp) recorded for New Zealand is discussed.

INTRODUCTION

THE barley grass species present in New Zealand, are generally regarded as weeds interfering with the quantity and quality of animal production; they have differing fairly specialised ecological requirements, and are adventive in a land undergoing drastic change in vegetative cover and in soil characters. Knowledge of their present distribution is thus of practical importance and considerable scientific interest. This paper reports information on distribution obtained from field inspections throughout the South Island and parts of the North Island and the examination of specimens sent through courtesy of many people in both islands.

The species fall into three readily distinguishable groups but species or varieties within groups are remarkably similar in appearance and difficult to distinguish other than by 'seed' characters. The species recorded for New Zealand (Healy, 1969) are discussed under these group headings, and a key for identification of these species in the field, is appended.

THE JUBATUM GROUP

Only one species, squirrel tail grass (*Hordeum jubatum* L.) is present in New Zealand. It is a perennial plant restricted to the low rainfall zone of Central Otago. It is usually in situations which do not dry out rapidly in summer. There is no mistaking the attractive, large, somewhat fluffy inflorescences, the spikelets of which have long soft reddish-tinged awns.

THE MARINUM GROUP

Two species are recognised in New Zealand, salt barley grass, (*H. marinum* Huds.) and Mediterranean barley grass (*H. hystrix* Roth). The short, rigid, somewhat spreading awns give the smallish inflorescence a "bottle brush" appearance when mature while the leaves have no auricles. The species have limited distribution occupying low lying saline coastal flats in Canterbury, Marlborough and Hawke's Bay. They also occur in the low rainfall zone of Central Otago, while *H. hystrix* is present in a few inland situations in North Canterbury.

THE MURINUM GROUP

Three species have been recorded for New Zealand, *H. murinum* L., *H. leporinum* Link., and *H. glaucum* Steud. (Healy, 1969). As a group they are readily recognised, in the vegetative stage, by the large auricles, leaves rolled in the bud, and non-shiny leaf and sheath with scattered soft hairs, and, once the heads emerge by the barley-like spikes with long, scabrid awns. As species they cannot be easily distinguished in the field by casual inspection, a fact acknowledged by the collective common name, "barley grass".

All specimens of *H. glaucum* examined have been remarkably uniform both in overall appearance and in the diagnostic characters. This species can be separated reliably from *H. murinum* and *H. leporinum* by the small stamens of the fertile floret and by the shape and colour of the rachilla of the lateral florets. The identity of the New Zealand specimens has been further substantiated by chromosome counts made by Mrs Barbara Groves of the Botany Division DSIR, Lincoln. Root tip smears of seedlings grown from specimens collected at Gimmerburn had 14 chromosomes in contrast to the 28 found in typical *H. murinum* and *H. leporinum* from Palmerston and Lincoln.

H. murinum and *H. leporinum*, though superficially uniform in appearance, show considerable variation in inheritance characters such as colour of awns and the diagnostic characters, while the progeny of single plant selections indicate variation in vegetative characters and time of flowering. Variation also occurs in the degree of expression of characters and in the combination in which they occur. As a consequence, though typical *H. murinum* and *H. leporinum* are readily distinguishable, ascribing a specific name on the basis of all of the several diagnostic characters is in some cases difficult or impossible. Since Rajhathy and Morrison (1962) showed that the hybrid between *H. murinum* and *H. leporinum* is fully viable, this recombination of characters probably indicates some cross fertilisation.

Distribution of *H. murinum* and *H. leporinum*

Specimens have been examined from localities throughout the country, the notable exceptions being Taranaki and the West Coast. Only *H. murinum* has been seen in South Otago and Southland and this species predominates in the dairy pastures of North Canterbury, the western border of the Canterbury Plains and the Kaikoura flats. Both species have been collected in all other districts from which specimens have been seen. The proportions of the forms present in populations have not been measured.

Distribution of *H. glaucum*

H. glaucum is present in the dry climate portions of the Clutha, Taieri and Waitaki river basins, areas which are contiguous, and in the Amuri Basin some 200 miles further north. In the Central Otago area it is most plentiful in lucerne stands or pasture derived from lucerne stands (F. A. Meeklah pers. com.). In the Waitaki basin it is about sheep yards (e.g. Simon's Pass, Glenburn) and sheep camps (under willows and matagouri, Tara Hills) and also in lucerne and pasture above Ikawai on the North bank and Waitaki on the south bank of the river. At Culverden and Rotherham it is in pasture and lucerne and, as scattered plants, in roadside gravel.

Economics of Barley Grass

Its distribution appears to be circumscribed by soil and climatic conditions. It requires the fertility supplied by high concentrations of stock but may not require the same level as *H. murinum* since at the sheep yards mentioned above, *H. murinum* is the principal species close to the sheds and *H. glaucum* in the outer holding yards. As this zonation also occurs in camps under trees and bushes, soil moisture retention could also be involved.

The species appears to be restricted to areas with rainfall about or less than 550 mm per annum. The areas also have more than 6 months of the year in which evapotranspiration exceeds mean monthly rainfall. Several gradients have been examined (Table 1). *H. glaucum* is present at Roxburgh but not evident at Miller's Flat, abundant on the Maniototo Plain from Gimmerburn to Ranfurly but not seen in lucerne near Naseby or within 30 miles of Palmerston (Stockdill, pers com.) while it extends from Omarama to the sea along the banks of the Waitaki but not south of the Kurov road on the lower Waitaki Plains. Though the rainfall figure for Culverden is somewhat high, rainfall gradients are steep and the centre of the plain is in a rainshadow from encircling hills. The Grassmere area of Blenheim fits these postulated requirements for *H. glaucum* but to date only *H. murinum* and *H. leporinum* have been found.

TABLE 1: DISTRIBUTION OF *HORDEUM GLAUCUM* IN RELATION TO MEAN RAINFALL AND EVAPOTRANSPIRATION

Locality and survey line	Mean Annual rainfall mm	Months in which evapotranspiration exceeds mean monthly rainfall	<i>H. glaucum</i> present
<i>Down Clutha River</i>			
Cromwell	391	8.5 Aug-mid April	Yes
Alexandra	335	9 Aug-April	Yes
Roxburgh Hydro	508	8 Aug-March	Yes
Miller's Flat	617	—	No
<i>Maniototo North and East</i>			
Waipiata	439	7.5 late Aug-March	Yes
Naseby State Forest	619	5.5 Oct-mid March	No
Palmerston	648	—	No
<i>Down Waitaki River</i>			
Tara Hills	575	7 Sept-March	Yes
Otematata	409	—	Yes
Oamaru Airport	533	—	Yes
<i>Amuri Basin</i>			
Culverden	610	—	Yes
Balmoral Forest	688	5.5 mid Oct-March	No
<i>Potential sites</i>			
Lake Grassmere	559	6.5 mid Sept-March	No
Timaru	597	6.5 mid Sept-March	—

Climate data from "Climatographs Part 3: Cool zone of the South Island" (Gerlach, 1972).

DISCUSSION

The present distribution of a species depends on the availability and accessibility of suitable sites. Absence may indicate unfavourable conditions or merely that the species has not reached the site. Spread or recession within an area depends on changes in environment which may represent continuing trends or be intermittent events. With these points in mind some inferences may be drawn from this survey in conjunction with present knowledge of the ecology of the species.

Hordeum jubatum and *H. glaucum* appear to have the similar climatic requirement of long periods with evapotranspiration exceeding precipitation. However, being a fibrous rooted perennial, *H. jubatum* cannot tolerate long periods with soil moisture below wilting point. Furthermore it is a poor competitor with other perennial pasture species (Cords, 1960). Thus it is likely to remain restricted, as at present, mainly to irrigated pastures and lucerne, not intensively watered, in the dry zone of the Clutha, Taieri and Waitaki catchments. It could establish in the Amuri Basin but here, as in the lower Waitaki, irrigation schemes will require intensive competition-inducing use of water.

Though *H. jubatum* has a limited weed potential, eradication should be feasible in view of its limited distribution, low seed survival in soils frozen in winter (Cords, 1960) and its Noxious Weed rating.

The distribution of *H. glaucum* may indicate a slow spread from Central Otago but the sharp boundaries suggest ecological limiting factors. The early flowering and strict annual habit may, in the absence of a strong seed dormancy mechanism place the species at a disadvantage where summer drought conditions are intermittent.

With pasture improvement programmes throughout the area *H. glaucum* is likely to become more widespread. A programme to eradicate the weed around yards could delay or prevent this spread on run country.

The *marinum* group are either more widespread in or will spread to more estuarine localities than recorded here. They could increase in company with *H. glaucum* in like manner to the association of *H. hystrix* with *H. leporinum* in Australia.

H. murinum and *H. leporinum* considered as an entity appear to occupy all suitable sites throughout the country. Further spread within districts depends on the build up of fertility as indicated by soluble salt level (Metson, Saunders and Nott, 1971; Grant and Ball, 1970).

Davison (1971) states that the key morphological characters overlap and are modified by the environment with, in Europe, the *murinum* type being of northern and cooler climates and the *leporinum* type more restricted to Mediterranean climates. Only the *murinum* type is present in England and is largely confined to ruderal habitats in the lowlands and rarely occurs where the rainfall exceeds 850 mm a year (Davison, 1970). In contrast only the *leporinum* type has been found in continental Australia where it is a prominent element of annual type pastures in Victoria. This sharp habitat and climatic separation of the 2 species or forms and the fact that *H. murinum* has been reported as the pasture invading species in New Zealand has been noted by Smith (1972).

Some separation of the species and differences in the type of infestation have been noted. The relationship is complex, involving the interaction of rainfall, water loss, aspect, soil type and farm management practices on the level of soluble salts in the soil and competition from

Economics of Barley Grass

associated species. As a rule, *H. murinum* in sharply delineated, stock camp type infestations predominates when evapotranspiration does not exceed monthly rainfall by more than about 10% during the mid November, January period. Both *H. murinum* and *H. leporinum* are present where the difference is greater and persists for a longer period. In these districts, boundaries are more diffuse, and generalised pasture invasion more common.

Since the members of the *murinum* group are so similar in appearance, continued use of one standard common name is justified until some practical reason for differentiating arises. However in view of differences in flowering time and distribution the species present should be noted in trial work.

ACKNOWLEDGEMENTS

My thanks are due to the many people who supplied specimens and in particular to Dr M. J. Hartley, F. A. Meeklah, S. M. J. Stockdill and B. A. Lauder; to Mrs Groves and Dr J. Hair for chromosome determinations and to Mr A. J. Healy for helpful discussion.

REFERENCES

- Cords, H. P., 1960. Factors affecting the competitive ability of foxtail barley (*Hordeum jubatum*). *Weeds* 8, 636-644.
- Davison, A. W., 1970: The ecology of *Hordeum murinum* L. 1. Analysis of the distribution in Britain. *J. Ecol.* 58: 453-466.
- , 1971. The ecology of *Hordeum murinum* L. 2. The ruderal habit. *J. Ecol.*, 59: 493-506.
- Gerlach, J. C., 1970-71-72. Climatographs 1. 2. 3. Ruakura Agriculture Research Centre, Hamilton.
- Grant, D. A. and Ball, P. R., 1970. Synecology of some barley grass communities in the central Manawatu. *Proc. 23rd N.Z. Weed & Pest Control Conf.*: 97-102.
- Healy, A. J. 1969. The adventive flora in Canterbury, in G. A. Knox (editor) *The natural history of Canterbury*. A. H. & A. W. Reed, Wellington. 261-333.
- Metson, A. J.; Saunders, W. M. H. and Nott, J. H., 1971. Some chemical properties of soils from areas of barley grass (*Hordeum murinum* L.) infestations. *N.Z. Jl. Agric. Res.*, 14: 334-51.
- Rajhathy, T. and Morrison, J. W., 1962. Cytogenetic studies in the genus *Hordeum*. The *murinum* complex. *Can. J. Genet. Cytol.*, 4: 240-7.
- Smith, D. F., 1972. *Hordeum* species in grassland. *Herb. Abs.*, 42: 213-223.

BARLEY GRASS IDENTIFICATION

The identification of barley grass species is based largely on floret characters. As the inflorescence ripens it breaks up into a series of triads each of which consists of a central fertile floret and 2 lateral sterile florets. The florets each have 5 segments; 2 outer glumes, the lemma covering the back of the grain, the palea over the front of the grain and the rachilla, a bristle-like projection from the base of the palea. The glumes and lemmas have long terminal projections, the awns.

Economics of Barley Grass

Floret structure can be seen readily with the naked eye or with the aid of hand lens. It is best observed in green to mature "seeds" which can be teased out with a pin if necessary. Dry ripe seeds become springy and difficult to manipulate.

KEY TO BARLEY GRASS SPECIES PRESENT IN NEW ZEALAND

1. Inflorescence feathery with long lax awns *H. jubatum*
 Inflorescence strict with rigid awns 2
2. No auricles, inflorescence seldom more than 5 cm long, lateral florets with glume awns longer than lemma awns 3
 Auricles present, inflorescence usually more than 5 cm long, lemma awns of lateral florets much longer than glume awns 4
3. Glumes of lateral florets more or less equal in width *H. hystrix*
 Glumes of lateral florets unequal in width, 1 side of inner member of each pair with a prominent wing *H. marinum*
4. Central floret of the triad stalked, paleas and lemma awns of lateral florets overtopping those of central floret, inflorescence with 4 awn ridges (square) at tip 5
 Central floret sessile or with very short stalk, central floret lemma awn overtopping lateral floret lemma awns, paleas about equal, inflorescence with 2 awn ridges (flat) at top *H. murinum*
5. Rachilla extension of the lateral florets more than $\frac{1}{3}$ rd length of palea tapering uniformly from base to tip, colour variable from bleached straw to orange, stamens of florets similar in size *H. leporinum*
 Rachilla extension of lateral florets about $\frac{1}{3}$ rd length of palea, lower third stout then tapering to tip, orange coloured, stamens of central floret much smaller than those of lateral florets *H. glaucum*

NOTE: The rachilla of *H. murinum* is usually about $\frac{1}{2}$ length of palea, narrow, bristle-like and colourless.
 The deep orange colour and swollen base of the rachilla of *H. glaucum* is diagnostic though close to the Australian form of *H. leporinum* collected in North Canterbury.