LABORATORY GERMINATION OF BARLEY GRASS

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Summary

Tests at a range of constant temperatures were conducted on freshly collected seed. Innate dormancy was most pronounced in *Hordeum glaucum* and in other species decreased in the order *H. leporinum*, *H. hystrix*, *H. marinum*, *H. murinum*. Dormancy was gradually lost with dry storage at 20°C. In *H. glaucum* dormancy was broken by removing the palea and lemma from the grain. Dormancy was not induced in any of these five species by exposing moistened seeds to 35°C for several weeks before transferring them to 15°C. *H. jubatum* required alternating temperatures in order to germinate. *H. secalinum* is probably similar to *H. hystrix* in its behaviour.

INTRODUCTION

Detailed laboratory studies of germination behaviour have been carried out on *Hordeum jubatum* in Canada (Ungar 1974), on *H. murinum* in Britain (Davison 1971), on *H. hystrix* and *H. leporinum* in Italy (Onnis and Bellettato 1972) and on *H. leporinum* in Australia (Smith 1968; Piggin *et al.* 1973; Cocks and Donald 1973). Germination studies in New Zealand have been less detailed. Harris (1959; 1961) found that fresh seed (probably *H. murinum*) sown in soil gave close to 90% germination within a few weeks and no more after this. Rumball (1971) found that artificially buried seed germinated readily in most situations but that in the dry conditions of Central Otago an appreciable number of seeds remained dormant for several months. Popay and Sanders (1975) buried seed of *H. murinum* in soil at different depths and found that seed germinated equally well at all depths although deeply buried seed did not produce seedlings.

The experiments described here were therefore established to examine and compare, under laboratory conditions, the germination behaviour of the several species of barley grass occurring in New Zealand.

MATERIALS AND METHODS

Seed of the different species was collected at different times during the early summer of 1974-1975 either from the field (*H. glaucum*, *H. hystrix*, *H. jubatum*, *H. secalinum*) or from experimental plots at the Milson Field Research Area, Palmerston North (*H. leporinum*, *H. marinum*, *H. murinum*). Within a few days of collection samples of seeds were tested as described below and the rest were air dried at room temperature for about two weeks before being placed in preserving jars and stored at constant 20°C. In the case of *H. jubatum* and *H. secalinum* tests were less detailed, the seed being stored at room temperature and tested a few weeks after collection.

Germination tests were conducted in the Seed Testing Station at Palmerston North using glass fronted incubators set at 5°C, 15°C, 20°C, 25°C, 30°C, 35°C and an unlit incubator set at 10°C. Immed-

Note: *H. hystrix* is now called *H. geniculatum*.

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Barley Grass

TEMPERATURE (°C) OF GERMINATION TEST

○ - fresh seed △ - stored 70 days
 ◻ - stored 35 days ▲ - stored 100 days

Fig. 1: Percentage germination of seed tested for 14 days at different constant temperatures, when fresh and after dry storage at 20°C.

iately before testing the awns of the seeds were trimmed off with scissors, just above the top of the central spikelet. For each test at each temperature 100 seeds were placed on filter paper on a wet towel. Twice a week the seeds were examined and germinated seeds counted and removed. Tests normally continued for about 30 days, but the results presented here are of germination after 14 days.

RESULTS

A summary of the results of germination tests on five of the species is shown in Fig. 1. Fresh seed of all five species showed some dormancy at all temperatures. Very few seeds of *H. glaucum* germinated and a large proportion of the seeds of *H. leporinum* remained dormant. *H. hystrix* and *H. marinum* seeds germinated fairly well at 10°C and 15°C. *H. marinum* seeds showed least dormancy, with over 90% germination at 10°C although at other temperatures rather fewer seeds germinated.

Dry storage at 20°C led to a progressive reduction in seed dormancy so that germination in subsequent tests was greater at all temperatures and became more rapid. This effect of storage was not very marked in *H. glaucum* but after three months storage the germination of *H. marinum* approached 100% at 10°C and 15°C whilst that of the other three species reached or approached 100% at 5°C, 10°C, 15°C and 20°C.

No germination was ever observed at 35°C in any of the five species. When seeds which had been tested at this temperature for 30 days were transferred to 15°C all species gave over 90% germination except for *H. marinum* which gave only 83%. The appearance of the ungerminated seeds suggested that they had been adversely affected by treatment at 35°C rather than that dormancy had been induced.

On one occasion the palea and lemma were removed from the grain of *H. glaucum* and germination tested at 15°C. Within one week 97% of these seeds had germinated.

When separated central florets of *H. glaucum* were tested at 15°C for 16 hours and 20°C for 8 hours each day germination reached 51% after 14 days, as compared with 29% at 15°C and 17% at 20°C.

H. secalinum, tested at 10°C, 15°C and 20°C five weeks after collection, showed over 90% germination at all three temperatures. *H. jubatum* tested six weeks after collection gave no germination at all at constant temperatures of between 5°C and 30°C, but when exposed to temperatures alternating daily between 15°C (16 hours) and 25°C (8 hours) gave 71% germination.

DISCUSSION AND CONCLUSIONS

The results obtained agree closely with those for those species tested in other countries. Except for *H. jubatum* and *H. glaucum*, alternating temperatures were not tested here but with *H. leporinum* Piggin *et al.* (1973) showed that alternating temperatures only reduced germination where the higher temperature was 27°C or higher. Cocks and Donald (1973), working with the same species, found that temperature alternations hardly affected germination.

Although the effect of alternating temperatures on *H. glaucum* was not fully investigated it does seem as if the seed of this species was more dormant than that of *H. marinum* and *H. leporinum*. This agrees well with the observations of Meeklah (1966) who found that barley grass seed from Central Otago (now known to be *H. glaucum*, Meeklah, personal communication) survived in greater numbers for a much longer period than did *H. marinum* seed from coastal Otago.

Barley Grass

However, the four most widespread species of barley grass — *H. leporinum*, *H. murinum*, *H. marinum* and *H. hystrix* — although showing various degrees of innate dormancy, gave complete or near-complete germination after storage for two or more months when tested at 10°C or 15°C. *H. murinum*, which is the commonest species, showed least dormancy of all and after two months storage gave 100% germination at 10°C, 15°C, 20°C and over 90% at 5°C.

These results strongly suggest that barley grass seeds (except those of *H. glaucum*) produced during the main season of December and January would lose their innate dormancy during the summer and that all seeds would be capable of germinating readily in the autumn. There is no evidence that dormancy can be induced by high temperatures or by burial in the soil. However, there is good evidence that a few barley grass seeds can germinate as late as October under field conditions. There are three possible explanations for this:

1. Seeds produced late in the season could have more dormancy than that found in earlier seeds but the limited evidence available (personal observations) suggests that dormancy of seeds produced in April is not much different from that of seeds produced in December.
2. Late seeds may lose their innate dormancy slowly during the cold winter months so that some of these seeds may only become capable of germination with the onset of warmer spring weather. Higher temperatures would, however, lead to rapid dormancy loss again and it is unlikely that such seeds would remain dormant until the summer.
3. Seed surviving to germinate in the spring may not previously have been in a position to germinate. Such seeds could have been caught up in litter or vegetation (barley grass seed being admirably suited for this) and would not be able to absorb sufficient moisture to enable them to germinate.

If this third explanation has any validity then there is no reason why some barley grass seed should not survive for a year or more. But at least in *H. murinum*, *H. leporinum*, *H. hystrix*, *H. marinum* and probably *H. secalinum* there is no physiological reason why barley grass seed should survive from one year to the next.

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Barley Grass

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