RESEARCH NOTES ON BARLEY GRASS CONTROL AT INVERMAY

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Summary

An account of past and current barley grass (*Hordeum murinum*) research at Invermay is given. The bulk of the work relates to actual control of the weed by herbicides, noting that TCA, paraquat and dichloropropionic acid all give adequate control while several other materials are either inadequate or need further study. Various aspects of control through influencing seed viability are reported: only maleic hydrazide and paraquat appear reliable if applied after the flower primordia have developed and before the developing seed kernel has reached the soft dough stage. A preliminary survey of seed viability from two sites indicated that viable seed may be present up to September or October under normal field conditions. The implications of results so far are discussed and comments on past and future research work are also included.

INTRODUCTION

IN SPITE OF the introduction of herbicides specific for grass control throughout the last few years, barley grass (*Hordeum murinum*), a free-seeding annual grass, appears to be increasing in many areas throughout both islands. Many farm advisory officers are of the opinion that increasing fertility on sheep properties is raising the incidence of this weed, and it seems likely that its increase is a secondary effect of higher fertility. As a result of increased stocking, areas such as shelterbelts, fence-lines, and stock camps received such a concentration of hooves that the pasture is thinned out, or even annihilated, allowing barley grass to establish and thrive.

The most common species is *Hordeum murinum*, though *H. marinum*, *H. hystris* and the perennial *H. jubatum* occur occasionally: little information is available as to whether the seed-heads of these other species cause stock problems similar to those of *H. murinum*. At Invermay, field experimental work commenced in 1955 and has been confined to *H. murinum*: early trials showed that, under certain conditions, good control could be obtained with the following minimum quantities of herbicides (all rates given in lb active ingredient per acre): TCA 7.9 lb dichloropropionic acid 1.4 lb and chlorpropham 4 lb. More critical work later indicated that dichloropropionic acid gave as good control in winter as in spring but the highest rate examined (1.4 lb) was barely enough. With TCA, winter application was better than spring and 7.9 lb was adequate while sward damage was somewhat less than with dichloropropionic acid.

Following this work in 1959, an experimental eradication programme was carried out at Invermay for several seasons: this experience elicited the following seven factors:

- (1) The best equipment was an offset nozzle spraying a 6 ft swath in addition to an orthodox boom spraying 4 to 8 ft.

- (2) Infested areas were best located in the summer (seed-head stage).
- (3) Winter application was favoured because that was when time was found to do the job; spring-time was too busy.
- (4) Both TCA and dichloropropionic acid gave good control.
- (5) Cleared fence-lines became infested with thistles, hemlock (*Conium maculatum*), docks (*Rumex* spp.), etc., thus a follow-up spray of 2,4-D or MCPA was required.
- (6) Each year small areas were missed and proved fruitful sources of reinfestation.
- (7) A weed burner proved very tedious and not very effective for clearing up these unsprayed areas in the seed-head state.

Thus it was decided to study methods of controlling barley grass delaying spraying until the seed-head had appeared, to kill the plant and reduce seed viability to nil or acceptable low levels. It was envisaged that ultimately a control programme would be developed that entailed spraying with orthodox grass-killers in winter or spring and then patching up any missed areas by spot treatment in the seed-head stage by a germination inhibitor.

CURRENT WORK

The barley grass problem at Invermay is confined to the fence-lines and stock-camps: it is assumed from general observations that in coastal areas of adequate rainfall and also adequate sward competition, barley grass is a fence-line problem, and few instances of stock management problems due to the sharp-pointed seed are reported. However, in more arid areas, the problem occurs on a paddock scale, probably because of weakened pasture competition during the main periods of barley grass germination: in these areas, too, stock problems are at times critical and whole mobs of lambs may have to be handled to remove barley grass seed from round the eyes and from the groin.

To study possibly differential effects within these two major environments, Invermay experimental work has been extended to sites on the Maniototo plain, the nearest arid area, and the remainder of this paper deals with two groups (A) trials based at or near Invermay and (B) trials based in the Maniototo.

(A) INVERMAY

Effect of Common Herbicides on Seed Viability

Dichloropropionic acid at 2.2 and 3.7 lb prevented seed-head production if applied in the vegetative stages when flower primordia of the unemerged seed-head at the base of the leaf sheath were only 10 to 15 mm long. Similar applications 4 and 6 weeks later when seed-heads had emerged, and were at the late anthesis and soft dough stages, failed to affect seed production or viability. A further trial comparing ethyl ester of 2,4-D, dichloropropionic acid and diquat at three stages of seed development (early and late anthesis, and the soft dough stage) failed to reduce seed viability.

Effect of Maleic Hydrazide and Paraquat on Seed Viability

Experiments over three years showed that maleic hydrazide at 1 lb or paraquat at ½ lb applied during all but the final stages of the reproductive phase reduced barley grass seed viability to

10% and often less. The application of this original work to field practice means that the spraying season for barley grass control can be extended right up to the soft dough stage in seed kernel development. As Harris (1959) has shown that there is no carry-over of viable seed from season to season, then the life-cycle can be broken and this weed eradicated.

Paraquat gave apparently complete kill of barley grass at all times and no seed was produced if the weed was sprayed early enough when flowers were in the primordial stage. Application of maleic hydrazide at a similar stage disrupts the reproductive process and no seeds are produced.

Paraquat and Maleic Hydrazide for Control during the Vegetative Stages

A specific study of maleic hydrazide at $\frac{1}{2}$ lb and 1 lb with and without 0.1% wetting agent, applied once a month from June to October inclusive, indicated that only application in June gave a marked reduction in barley grass numbers, giving almost complete control of a fence-line infestation with subsequently a good take-over by perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*). Response to application at other times was poor. All seed eventually produced was of normal viability.

Paraquat has been included in other general trials studying the activity of several herbicides: at rates of 4 to 6 oz the results have been erratic. It was concluded that, in coastal areas with adequate rainfall, special conditions are necessary for maximum kill, possibly application during low light intensity, using high volume and high pressure for maximum coverage.

The Effect of Grazing plus Herbicides on Barley Grass Control

These studies commenced initially as a technique trial in an effort to find out what was causing the immense variability that occurred between barley grass control trials that often included many common factors such as the herbicide used, rate per acre, and volume. It was considered that a study of the effect of grazing following application of herbicides might throw some light on the subject.

In general, this work has confirmed that grazing increases the degree of control, but only through the degree of trampling that occurs; the area of bare ground also is increased. Even these studies raise more problems. Of two identical trials on two different properties, reduced control through grazing occurred on one, while the other behaved as expected and grazing improved control. One can only contemplate further trials to study the reason for this.

Two further trends evident from these investigations are that (a) spring application may give better control than winter application, and (b) TCA applied in spring and grazed is the best treatment yet examined.

Screening Programme

New materials are examined if they are considered promising. Thiocyanate activated amitrole is poor. Atrazine is not sufficiently selective. Dichlorobutyric acid is not as efficient as dichloropropionic acid though pasture damage is less. A proprietary formulation of dichloropropionic acid plus extra wetting agent improved the efficiency of a 2.22 lb rate. A rate of 3.7 lb of dichloropropionic acid still gives the best control of barley grass.

(B) MANIOTOTO

Screening Programme

Two large trials examined three compounds under code numbers MB 8882, MB 9057, MB 9555, all at rates of 1, 2 and 4 lb each. Dichlorobutyric acid 4 lb and dichloropropionic acid 2.96 lb were included, and all were compared in winter and spring applications. The trials were laid down on heavily infested lucerne.

Dichloropropionic acid was the most efficient material — only MB 9555 could be described as promising. Dichlorobutyric acid was slightly poorer than dichloropropionic acid but lucerne tolerance was poor.

Proofing of Lucerne Stands and Comparison of Paraquat and Dichloropropionic Acid

In the Maniototo plain, the barley grass problem is acute, and, because of the almost universal occurrence of this weed on extensive grazing properties, it is found that control in a lucerne paddock is soon followed by re-infestation from seed. It has been suggested that residual soil sterilants used at low rates could proof the stand against re-infestation in this arid area for 1 year or more without any effect on the deep rooted lucerne.

In a preliminary study, paraquat 4, 8 and 12 oz was compared with dichloropropionic acid 2.22, 2.96 and 3.70 lb, all with simazine included at 3 rates, 0, 1 and 2 lb applied in July and September. This trial is still in progress, but so far simazine has prevented re-infestation although the 2 lb rate has caused some lucerne damage. An assessment of barley grass control in November showed that, in the winter treatments, those containing simazine were superior to those with paraquat alone, which in turn were superior to the dichloropropionic acid treatments. In the spring treatments, the pattern was broadly similar although not so clearly shown. Most treatments appear better than their winter counterparts except for the dichloropropionic acid/simazine mixture which was significantly poorer in spring than in winter. One yield cut has been taken so far and paraquat treatments are in general heavier than the corresponding dichloropropionic acid treatment.

Seed Viability Studies

Various phases of the barley grass research project have pointed to the need for more information on seed viability. In particular, it is necessary to pinpoint the date about which barley grass seed loses its viability as this may then give a better guide as to the optimum time to spray for control.

Preliminary studies have been carried out on seed from two sites on the Taieri plain and in the Maniototo. Over the winter period from April to October, it was found that the germination capacity of the Maniototo seed never exceeded 10%, while the Taieri seed averaged 40 to 60% throughout the season. Taieri seed did not fall in viability at the end of winter, and Maniototo seed was still viable though germination fell as low as 2%.

However, the striking difference between the two sites over a long sampling period was that the Taieri site had about 40 seeds per square foot whereas the Maniototo held about 4,000.

Sampling ceased when no further seed could be found at the Taieri site (late September) and in the Maniototo when the area was ploughed (mid-October).

CONCLUSIONS

There appears little doubt that dichloropropionic acid and TCA, the two materials commonly used for barley grass control, are not ideal. At rates high enough to give reliable control under most conditions they lack selectivity, and obviously the converse has been found true, that at "selective" doses they lack reliability to cover the wide range of ecological and environmental conditions that occur in the field. There is no evidence to suggest that paraquat will be any better. Thus there is need for a considerable screening programme to identify a selective material for control of barley grass, and in this some of the old established materials such as chlorpropham should not be neglected, and possibly propham and certainly maleic hydrazide need more study.

Initial trial work showed good results with dichloropropionic acid and TCA at low rates but in recent years poorer results have made it necessary for higher rates — dichloropropionic acid at 3.7 lb and TCA 10.7 lb — to be recommended. Paraquat is erratic in coastal trials, allowing unacceptable amounts of regrowth, though the ease of penetration and coverage on the sparse foliage in more arid areas suggests that the 8 oz dosage normally recommended may be reduced to 6 oz with quite good results.

The grazing of treated areas increases the degree of control; it also increases the amount of pasture damage by killing some of the weakened components, and thus the percentage of bare ground is increased.

Application is probably best delayed until early spring, particularly in arid areas, though this does not appear to be so important in coastal Otago. For example, initial seed viability studies show viable seed present in September both in central and coastal Otago. However, re-infestation from seed after a July spraying is rarely seen in coastal Otago though it has been known to occur in central Otago. A study of "breakdown" factors in a long series of Invermay trials revealed that, where application occurred before the end of June, then seedlings were noted later: application in July or later was not followed by seedling re-infestation, though control may have been poor through other reasons.

Three years' good results with maleic hydrazide and paraquat show that the spraying season can be extended to cover application during the seed-head stage, provided it is carried out before the developing seed kernel has reached the soft dough stage.

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REFERENCE

Harris, G. S., 1959: *Proc. 12th N.Z. Weed Control Conf.*, 85-92.