Problems of amenity grass seed production in New Zealand

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ABSTRACT. The problems of seed production of amenity grasses in New Zealand are considered from two aspects — (a) increasing seed potential by breeding; (b) achieving that potential by good management as practised in the Netherlands,

(a) In terms of breeding, the strategies to increase seed yield depended to some degree on the species concerned. With browntop it was necessary to discard about two-thirds of the most promising genotypes because of poor heading, but the remaining genotypes flowered freely and in unison, and gave good seed yields. With fescue even the best original plants were sparsely heading, so direct selection for prolificacy has been needed. This was also carried out for perennial ryegrass, as well as selection of early-heading genotypes to avoid infection by stem rust.

(b) It is suggested that areas for seed of amenity grasses in New Zealand should be used for seed production only rather than for both forage and seed as is the usual practice. Techniques used in the Netherlands could serve as guidelines to procedures. The implications of low seeding rates, good weed control. high fertilizer applications and minimum cutting or grazing in promoting strong individual plants capable of high seed yields arc discussed.

Key words: Amenity grass, seed production, New Zealand, breeding, management. Netherlands, *Agrostis tenuis, Festuca rubra, Lolium perenne.*

INTRODUCTION

A quarter of a century ago New Zealand exported considerable quantities of seed of the amenity grasses browntop (*Agrostis* ***tenuis*** Sibth.) and Chewings fescue (***Fesfuca*** *rubra* spp. *commutata*) In 1954, 487 000 kg of browntop and 972 000 kg of Chewings fescue seed were harvested, most of which was exported. Two years later, however, the quantity harvested had fallen to 66 000 kg of browntop and 317 000 kg of Chewings fescue. Since then, production has never reached earlier levels, and by 1973 the harvest was only 63 000 kg of browntop and 74 000 kg of fescue (New Zealand Department of Statistics) .

This fall in seed production can be attributed to a number of causes. A significant factor was the conversion of low-fertility seed-producing areas into improved pasture by the use of lime and fertilizers and the sowing of high-production pasture species. Greater returns were obtained from meat and wool than from seed.

There was also increasing competition from specialized seed growers overseas, particularly in Oregon where seed was produced more cheaply than in New Zealand.

Then, in the 1960s, European and American plant breeders released new amenity cultivars better suited to their conditions than the New Zealand equivalents, and the demand for New Zealand seed largely disappeared. Some of these cultivars have proved to be suitable for New Zealand conditions. They have accordingly been placed on the New Zealand List of Acceptable Amenity Grass Cultivars and seed may now be produced in New Zealand. Those on the list are cultivars of the species browntop, creeping red fescue (*Festuca* ***rubra*** ssp. *trichophylla*) , Chewings fescue and Kentucky bluegrass (*Poa pratensis* L.) .

Instead of relying wholly upon overseas cultivars, however, it has been decided to breed New Zealand ones as well, for both internal use and perhaps export sales. If this is to succeed it is important that such cultivars have high seed yields. This can be encouraged in two ways: (a) by breeding for higher potential yields; (b) by better management to achieve that potential. These will now be discussed in turn.

BREEDING APPROACH

The breeding of amenity cultivars at Grasslands Division of DSIR has given much attention lo aspects of seed yield, as high seed rates are used when sowing turf. All cultivar parent plants should produce about the same amounts of pollen and seed, so that the cultivar will remain constant in type, whenever and wherever seed is produced. If plants produce too little seed, the resulting high prices may lead to buyer resistance. Conversely, if plants produce too much seed, it may be at the expense of general vegetative vigour and aesthetic appearance in summer.

BROWNTOP

This species is highly variable from plant to plant, and even a collection by New Zealand golf greenkeepers of subjectively desirable plants from their golf courses in 1973-4 showed a large range in colour, density, fineness, vigour, etc. At DSIR about 24 plants that had the best vegetative characteristics were selected and then allowed to grow out to form seedheads. However, the reproductive variation was very high also, and some plants had to be eliminated because:

(1) They flowered 2 to 3 weeks later than the rest (these late ones usually had fewer heads as well, or none at all).
(2) The flowering stalks were too short.
(3) Some had prostrate stalks and presented harvesting difficulties.
(4) Some had frayed stalk tips.
(5) Some dropped their seed too readily.

Even when these variants were removed there was still a range in seed yield per plant from 0 to 0.72 g (mean = 0.2 1) in one browntop selection and 0 to 2.0 g (mean = 0.38) in the second selection. Finally, however, 7 to 12 unrelated plants which had similar appearance and good seed-producing qualities were selected as the basis of a new cultivar.

FESCUES

In this species the problems were similar, but not quite so easy to solve. The creeping fescues appeared on the whole to be better for turf than the tufted Chewings type, but in general they produced less seed. However, it was possible by two generations of between- and within-family selection to eliminate the non-flowering genotypes and greatly increase the average seedhead number on the remaining genotypes. There does not appear to be much scope for improving features of the seedhead itself, either by increasing the number of seeds formed per head or by reducing losses by shedding.

PERENNIAL RYEGRASS (*Lolium perenne* L.)

In this species it was possible to breed either late- or early-heading cultivars, which looked equally attractive in turf plots mown at a height and frequency suitable for sportsfields. The late-heading selection produced considerably fewer seedheads — a feature that could be an advantage on roadsides and other less frequently mown sites. However, its flowering and seed development coincided with infection by stem rust (*Puccinia graminis* Pers.) at Palmerston North, which further reduced its seed yield. In the short term it appears better to release an early-heading cultivar, to avoid seed-production problems.

OTHER SPECIES

There are other less important amenity grasses where breeding is less likely to help the problems of seed production, and which therefore are not a major part of the breeding programme at DSIR. For example, Kentucky bluegrass seed is not usually derived from interpollination between plants, and therefore offers far less genetic variation to the breeder. Many of the commercial cultivars available are simply seed increases of single plants — rare variants found existing naturally or created by artificial mutagens. Even more extreme, some of the creeping bents produce no seed-like propagules at all, and must be "sown" by removing and chopping short stem sections from a nursery bed and then discing them into cultivated ground. This is a specialized industry which does not exist in New Zealand.

Finally, it should be noted that the genetic aspects of seed production cannot be forgotten once the cultivar has been bred and released for seed increase. It is the breeder's responsi-

bility to produce a cultivar that is genetically fairly stable, and phenotypically fairly uniform and distinguishable. It is the job of the certification authority and the seed grower to protect that stability by avoiding contamination during seed increase. All three main species discussed above are cross-pollinated, and seed paddocks must be isolated by distance from outside pollen. Perennial ryegrass particularly is widespread through New Zealand, and special care should be taken with the choice and preparation of paddocks for seed increase, to avoid pollen contamination by pasture cultivars.

MANAGEMENT APPROACH

As we have little experience in New Zealand of seed production of overseas amenity grasses, in particular Kentucky bluegrass and red fescue, it is now proposed to discuss methods of seed production used in the Netherlands where many of these cultivars were bred and seed is produced. Although procedures used there may not be wholly applicable to New Zealand conditions, their methods can serve as guidelines to practice in this country.

In considering Dutch methods it should be noted that seed production of amenity grasses is usually carried out on arable land with no grazing and only occasional cutting. Seed areas are not required to fulfil a dual purpose function as is the common practice in New Zealand.

The following discussion will be confined to seed production of the amenity grasses, Kentucky bluegrass, browntop, and Chewings and creeping red fescues. For comparison, data on pasture-type perennial ryegrass are also presented in Table 1.

SOWING

The soils used for seed production in the Netherlands are normally uniform clay loams. Deficiency of soil moisture is not usually a problem as the water table in the flat polder country is maintained at the rooting zone of the crop.

Seed is drilled in rows 25 cm apart, or, in the case of perennial ryegrass and Kentucky bluegass, up to 37.5 cm. Sowing may be in the spring or early summer or, with the fescues, browntop and Kentucky bluegrass, in the autumn under a cover crop, usually winter wheat. Sowing rates are low so that seedling plants are not overcrowded in the drills. Emphasis is placed on very shallow drilling of the small-seeded Kentucky bluegrass and browntop.

Establishment of browntop, the fescues and Kentucky bluegrass is slow, so that in New Zealand, particularly in Canterbury, spring sowing is probably preferable to autumn sowing. With early autumn sowing there is the danger that the slowly establishing seedlings may be destroyed by drought, and on the other hand, if sowing is delayed until late autumn, low temperatures will inhibit germination.

TABLE 1: SEED PRODUCTION OF AMENITY GRASSES IN THE NETHERLANDS'

Species	*Drill Width* (*cm.*)	*Sowing Rate* (*kg/ha*)	*N in Spring Before* Harvest (*kg/ha*)	*Method of Harvesting*	*Normal Yield* (*kg/ha*)	*Shedding*	*No.* of *Harvests*
Perennial ryegrass (late-flowering)	25-37.5	6-10	120	DH,W[2]	1100-1 500	S[3]	1-2
Kentucky bluegrass	25-37.5	5-8	100	W.DH	1000-1500	—	2 or more
Browntop	25	2-4	100	W	200-500	—	2 or more
Chewings fescue	25	8-10	70	DH,W	700-1200	S	2 or more
Red fescue	25	6-8	40	DH,W	700-t 200	S	2 or more

'Extracted from *Descriptive List of Varieties of Agricultural Crops,* published by Government Institute for Research on Varieties of Cultivated Plants, The Netherlands.
[2] DH = direct: W = windrow.
[3] S = susceptible.

FERTILIZER

It is common practice to have periodic soil tests to determine the nutrient status of the soils.

Heavy rates of N, P, K are applied at sowing, particularly of nitrogen fertilizer, as the heavily cropped arable soils are often low in this element. The nomal application of nitrogen at the time of sowing is 75 kg N/ha, equivalent to about 375 kg of sulphate of ammonia. Following spring sowing a further 30 to 60 kg/ha of nitrogen is normally applied in the autumn, or, if sowing is in the autumn, this quantity is applied after harvesting the cover crop. This application is to promote vigorous growth and tillering so that the maximum number of strong fertile tillers will be produced by the following spring.

Heavy rates of nitrogen are used in the early spring before harvest, usually about 100 kg N/ha for browntop and Kentucky bluegrass, and 40 to 70 kg for the fescues. The aim is twofold: to promote strong fertile tillers and to have the crop growing vigorously enough to be lodged at the time of harvesting. The use of the correct amount of nitrogen in the spring application is a delicate operation as the crop should be lodged at harvest but not at flowering, because maximum pollination in the crop is not obtained if it is lodged at that time.

WEED CONTROL

In the Netherlands, where seeding is usually with a cover crop, no pre- or post-emergence spraying to control weeds is carried out, but it is usual to spray with a herbicide after the cover crop is harvested. Many of the weeds there are also common in New Zealand and can easily be controlled by herbicides. Here, however, if seed production is to be carried out on medium-fertility soils, and if fertility is to be maintained by application of high rates of fertilizer, white clover arising from hard seeds can become a serious weed. This problem did not occur under the old system of producing seed of browntop and Chewings fescue, as the seed crops were usually on low-fertility soils and little or no fertilizer was used. But on more fertile soils white clover will grow more vigorously than Chewings fescue, browntop and Kentucky bluegrass. If competition from the clover is severe it should be restricted by spraying. It is probably wise to forgo nitrogen fixation by the clover in favour of eliminating competition.

HARVESTING

Browntop and Kentucky bluegrass are normally windrowed. Fescues may be direct headed but, as the seed sheds easily,. time of harvesting is critical. Harvesting too late results in loss of seed, and if it is too'early there are problems of immaturity and heating. As the climate in the Netherlands is usually not favourable for drying in the field, it is customary to dry the seed artificially.

Kentucky bluegrass seed is difficult to dress because the hairiness of the seed glumes causes the seed to clump. Special dressing machinery is used to overcome this problem.

SEED YIELDS

Seed yields are high in the Netherlands compared with those obtained in the past in New Zealand. For instance, the normal yield of browntop in the Netherlands is 200 to 500 kg/ha whereas Richards (1957) states that in New Zealand yields up to 100 kg/ha have been obtained from small areas but the average was only about one-third of that. With Chewings fescue the normal Dutch yield is 700 to 1200 kg/ha, while Faithful (1948) reports the average yield in New Zealand in the decade 1936-46 was about 160 kg/ha.

After two or three harvests, seed areas of Kentucky bluegrass, browntop and fescues tend to become sod-bound with consequent reduction in seed yields. Skim ploughing, with the furrows laid in a weatherboard fashion, is used as a method of renovation to produce a new stand from the plants which emerge in rows along the line where the furrows meet. The method has also been used in New Zealand to renovate Chewings fescue seed stands, even up to three or four times until weed invasion becomes excessive (Stuart, 1955).

CONCLUSION

The significant practices which contribute to the high seed yields obtained by the Dutch seed producers are:

(1) Seed-growing fields are for seed production only and are not required to fill a dual function as is the common feature in New Zealand.

(2) The arable soils are uniform and well suited to the growing of seed crops, and have adequate soil moisture.

(3) Sowing rates are low so that there is no overcrowding of seedling plants in the drills and strong plant development is encouraged.

(4) Fertilizer is kept to a high level that ensures vigorous plant growth and strong fertile tillers.

(5) Full development of the maximum number of seedheads is encouraged by not cutting or grazing in the harvest years.

(6) Harvesting is carried out at the optimum time to ensure minimum seed loss along with good seed development.

Seed production of amenity grasses in New Zealand could no doubt be improved by using some of the Dutch techniques, probably with modifications appropriate to our conditions. Most important is to treat seed production as a specialized practice rather than to consider it as a subsidiary to feed production. The use of high levels of fertilizer, particularly nitrogen, should be directed towards stimulating vigorous plant growth and the development of maximum number of strong fertile tillers. Cutting or grazing should be used only for this purpose.

New Zealand has a climate much more suited to seed production than that of the Netherlands. With this advantage the New Zealand seed grower should be able to compete with his Dutch counterpart in the production of high yields of good-quality amenity grass seed.

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