Research Note

Time of Harvest in Tall Oatgrass (*Arrhenatherum elatius* (L.) J. and C. Presl.)

K.Reddy and M.P. Rolston[1]

ABSTRACT

Studies on tall oatgrass (*Arrhenatherum elatius* (L.) J. and C. Presl.) seed production were conducted to determine the optimum time of harvest for seed yield and quality. Seed yield, shattering losses, thousand seed weight, seed moisture content and germination were recorded at 3 day intervals from 21 days after peak anthesis (DAA) to 36 DAA. The optimum time to harvest tall oatgrass for maximum yield of quality seed was 27 DAA, when the seed moisture content was 43%, thousand seed weight 2.7 g and losses due to shattering were minimal.

Additional index words: **apex, *Arrhenatherum elatius*, seed yield, tall oatgrass, time of harvest.**

EXPERIMENTAL AND DISCUSSION

Tall oatgrass (*Arrhenatherum elatius* (L.) J. and C. Presl.) is a tall, usually erect, tussock-forming, perennial grass. In New Zealand it has been used for grazing since the 1800s (MacKay, 1887), and is considered a potentially important pasture grass in drought prone areas with moderately fertile soils (Wills and Begg, 1994).

Seed shattering is a major problem in tall oatgrass due to the unevenness with which seed ripens, and the ease with which it shatters prior to maturity (Voight and MacLauchlan, 1985). The optimum time of harvesting for seed is a compromise between allowing sufficient time for the maximum number of seeds to mature, and avoiding heavy losses due to over ripening. Attempts have been made to find the optimum time of harvesting in other grasses which readily shatter seeds (McWilliam and Schroeder, 1974; Reddy, Scott and Lucas, 1993; Rowarth, Rolston and Archie, 1993) by comparing yield at sequential harvesting dates. The effects of time of harvest have not been reported for tall oatgrass. Hence the objective of this study was to determine the effect of harvest time on seed yield and quality in tall oatgrass.

The experiment was conducted on a Templeton silt loam at Lincoln, New Zealand (43°S) in the 1995/96 season. Seed was sown in autumn 1993 at a sowing rate of 8 kg ha^{-1} with a 30 cm row spacing. The seeds used for sowing were from selected breeding lines grown in the South Island high country (David Scott, pers.comm.).

The site was spray irrigated once in September and twice in October with 30mm water, to maintain the soil above 50% available water, and received 80 kg N ha^{-1} split between autumn and spring applications. The crop was sprayed in early spring with Salvo (ai = 107 g l^{-1} MCPA, 210 g l^{-1} mecoprop, 233 g l^{-1} dichlorprop and 17 g l^{-1} dicamba, as the dimethyl amine salt in the form of a soluble concentrate) at 4 l ha^{-1} to control broadleaf weeds. The area was divided into 28 plots for seven harvest dates replicated four times.

Anthesis was defined as having occurred when anthers were exerted on 50% of the seed heads. This was achieved by randomly selecting 0.5m row lengths, and counting and marking all shoots at anthesis on a daily basis until 50% of the shoots had reached anthesis. Harvesting commenced on the 21st day after anthesis (DAA) using a sample size of 1m x 0.6m. Plots were harvested at the same time of the day, starting at 10am, by cutting the stems 10 cm above ground level and storing the cut material in hessian bags to prevent seed loss. Samples were air dried for 21 days, hand threshed and cleaned. The air-dried seed was weighed for yield and the thousand seed weight (TSW) determined from the air dried sample from each harvest.

The seed moisture content at each harvest was measured by cutting additional seed heads at random, and extracting fresh seeds by gently shaking and rubbing. The fresh seeds were weighed and dried with an infra-red lamp to constant weight. Germination tests were then conducted using standardised methodology (ISTA, 1993). Seed shattering was determined by placing trays (0.5m x 0.25m) at random sites between plant rows in the field. Seed from these trays was collected before each harvest, cleaned and weighed to determine seed loss from shattering.

The seed moisture at 21 DAA was 55%. There was a gradual reduction in seed moisture after that of 1.2 % per

[1] *AgResearch, P.O. Box 60, Lincoln, New Zealand.* *Accepted for publication 13 November, 1997.*

day, reaching 37 % at 36 DAA (Fig. 2). Seed weight increased rapidly between 21-27 DAA, and afterwards remained almost constant at 2.7 g (Fig. 1). Seed germination increased rapidly from 33% on 21 DAA to 66% on 30 DAA, but declined after 33 DAA (Fig. 1).

Seed shattering first began after 24 DAA. Between 24 DAA and 30 DAA (6 days), average losses of 37 kg ha^{-1} day^{-1} were recorded. Maximum shattering occurred between 30 DAA and 36 DAA(6 days) at the rate of 78 kg ha^{-1} day^{-1} . Shattering declined to 23 kg ha^{-1} day^{-1} from 36 DAA(3 days) to 39 DAA. (Fig. 2).

Seed yield was greatly influenced by the stage of maturity of the crop and the rate of seed shattering. Seed yield reached a maximum of 622 kg ha^{-1} at 27 DAA. The seed yield declined thereafter due to severe loss of seeds from shattering (Fig. 2).

Differences in tiller age, time of ear emergence and the maturity of panicle components within a seed head population result in differences in the date of maturity (Anslow, 1964) creating difficulties in deciding the optimum harvest time. In grass seed crops like phalaris (*Phalaris aquatica* L.) the difference in maturity of seeds within an inflorescence spans a period of two weeks or more (Lutz and Morant, 1983), whereas an individual seed takes about 30 days from anthesis to full maturity (McWilliam and Wardlaw, 1965) depending on prevailing weather conditions. Harvesting the crop before most seeds reach physiological maturity results in lighter seeds with reduced germination because of immaturity of most of the seed. These effects were observed in tall oatgrass when harvests were made before 27 DAA, and became more pronounced with earlier harvest times. Delaying the harvest beyond 27 DAA had no detrimental effect on seed weight and germination but resulted in a sharp reduction in seed yield because of progressive loss of seed from shattering.

In practice a compromise must be made, with the crop being harvested at a particular period. By combining the optimum parameters shown in Fig. 1 and 2, the maximum yield and quality of tall oatgrass seed at this site could be expected at 27 DAA. During this period, germination was 60%, seed moisture content 43 %, thousand seed weight 2.7 g and losses due to shattering minimal.

Seed shattering commenced much earlier from the uppermost florets of the early formed tillers. This small loss must be accepted to attain high seed quality. Delaying the harvest to 33 DAA resulted in more than 50% loss of total yield, but had no adverse effect on germination and seed weight.

These results suggest that the optimum time to harvest tall oatgrass is probably 27 DAA. Harvesting prior to full maturity to reduce seed shattering had a detrimental effect on seed quality, while delaying the harvest after 27 DAA reduced seed yield due to shattering.

Cutting early and stooking or cutting and drying in windrows may increase the germination, seed weight and seed yield through more seeds becoming mature, as McWilliam and Wardlaw (1965) have shown that translocation of assimilate continues in detached culms of phalaris. But there is also the risk of seeds getting detached through additional handling and the maturing process, resulting in reduced seed yield through seed loss.

A long-term solution to the shattering problem will require breeding for non-shattering. In the mean time, harvesting tall oatgrass crops in windrows at an optimum time based on measurement of seed moisture is probably the best method of maximising the seed yield and quality.

REFERENCES

1. Anslow, R. C. 1964. Seed formation in perennial ryegrass. II. Maturation of seed. *Journal of the British Grassland Society* 19: 349-353.
2. ISTA. 1993. International rules for seed testing. *Seed Science and Technology* 21: 75-186.
3. Lutz, E. E. and Morant, A.E. 1983. Influence of harvest date on the yield and quality of Phalaris (*Phalaris aquatica* L.)cv. Stenoptera. *IDIA. Mayo-Agosto*: 65-69.
4. MacKay, T. 1887. A manual of the grasses and forage-plants useful to New Zealand. Government Printer, Wellington.
5. McWilliam, J. R. and Schroeder, H. E. 1974. The yield and quality of Phalaris seed harvested prior to

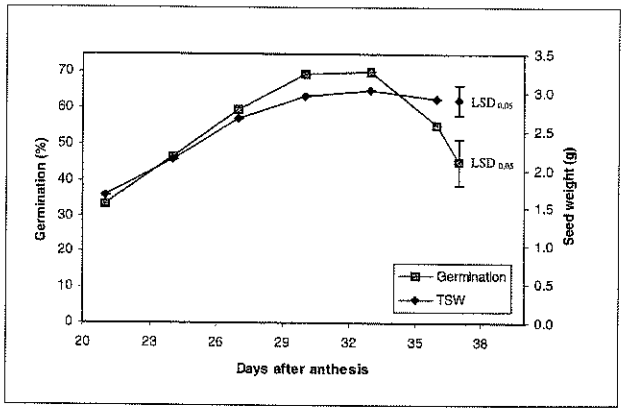

Fig 1. Germination and thousand seed weight in tall oatgrass harvested sequentially at three day intervals.

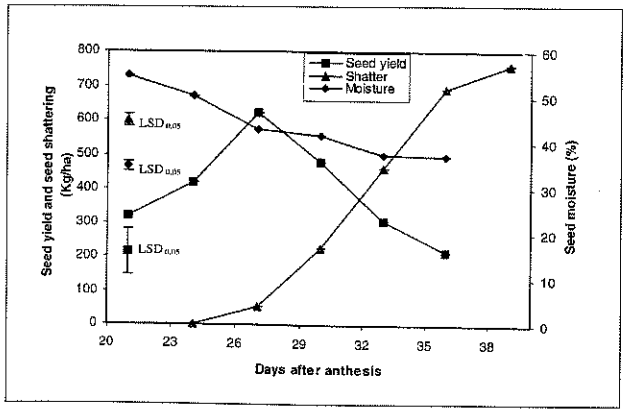

Fig 2. Seed yield, seed shattering and seed moisture content of tall oatgrass harvested at three day intervals.

maturity. *Australian Journal of Agricultural Research* 25: 259-264.

6. McWilliam, J. R. and Wardlaw, I. F. 1965. Effects of detaching culms on seed development in Phalaris. *Australian Journal of Agricultural Science* 18: 283-294.
7. Reddy, K., Scott, W. R. and Lucas, R. J. 1993. Influence of harvest date on the yield and quality of seed of phalaris. *Proceedings of the XVII International Grassland Congress*: 1685-1686.
8. Rowarth, J. S., Rolston, M. P. and Archie, W. J. 1993. Seed production of plantain (*Plantago lanceolata* L.). *Proceedings of the XVII International Grassland Congress*: 1675-1676.
9. Voight, P. W. and MacLauchlan, R. S. 1985. Native and other western grasses. In: Forages. The Science of Grassland Agriculture (ed. M.E. Heath, R.F. Barnes, and D.S. Matcalfe), 117-187, Iowa State University Press.
10. Wills, B. J. and Begg J. S. C. 1994. *Arrhenatherum elatius* (L.) Beauv.- A review, and evaluation of tall oatgrass for dryland and hawkweed-affected country in the South Island. *Proceedings of the New Zealand Grassland Association* 56: 121- 126.