THE EFFECTS OF TIME OF APPLICATION OF NITROGEN ON SEED YIELD OF 'GRASSLANDS RUANUI' RYEGRASS *(Lolium perenne L.)*

M.J. Hill

Advisory Services Division,

Ministry of Agriculture and Fisheries

INTRODUCTION

The place of grasslands in the economy of New Zealand is paramount. Consequently grassland seeds must and do play a vital role in the agricultural industry.

On many farms seed production is considered as only secondary to the production of meat and milk. It is only in seasons when stock feed is abundant that many areas are closed for the production of seed. It would be to the advantage of the seed industry if grass seed production was viewed more as a primary consideration with controlled management being employed to assist in producing high yields of quality seed rather than as a 'catch' crop as it is presently considered on many farms.

Despite the fact that ryegrass pastures are often required to perform a dual role, providing herbage for stock as well as seed in the same farming year, considerable attempts have been made to evolve a management system which allows maximum utilisation of grass for grazing without impairing seed yield. In this regard particular attention has been paid to the effects of nitrogen application on ryegrass seed production.

A number of workers have suggested the need for a more morphological and physiological approach to the problems of management of grass seed crops (Cooper and Saeed, 1949; Langer, 1956; Hill, 1970). This paper presents the results of a trial carried out to test this aspect.

METHODS

An area of silt loam was sown with Basic "Grasslands Ruanui" perennial ryegrass seed (23 kg/ha) at Flock House (Bulls) on 20 March 1970. Potassic superphosphate, 260 kg/ha, was drilled with the seed. A split plot design was employed, with four replicates. Plots were 9.23 m^2.

Treatments were:-

1. No nitrogen applied.

2. Autumn nitrogen only. Urea 195 kg/ha, 5 April 1970.

3. Early spring nitrogen only. Urea 195 kg/ha. 15 August 1970.

4. Split nitrogen application autumn plus early spring. Urea 98 kg/ha, 5 April 1970. Urea 98 kg/ha 15 August 1970.

Grazing was with sheep at approximately monthly intervals and was discontinued at the onset of floral initiation (determined by tiller dissection) in mid August 1970.

A single application of 'Disyston' granules was applied to control aphids in the late spring and gave apparently complete control.

At seed maturity two 1 m^2 areas were hand cut from each plot, the intact spikes were removed and air dried at room temperature for approximately one month.

Counts of heads per m^2 and floret numbers per head were made. Seed yields were also obtained.

RESULTS

The results in Table 1 indicate that increased seed yields are obtainable following split applications of nitrogen (autumn and early spring) compared with either no nitrogen or with single applications of nitrogen in autumn or early spring.

TABLE 1 : EFFECT OF TIME OF NITROGEN APPLICATION ON INDIVIDUAL COMPONENTS OF SEED YIELD AND SEED YIELD.

Time of N Application	Head Number per Metre	Floret Number per Head	Seed Weight (mg/100)	Seed Yield kg/ha
Nil	2181 cB	247 cB	176 bB	542 dC
Autumn	3025 aA	263 cB	167 bB	776 cB
Spring	2293 cB	392 aA	198 aA	913 bB
Autumn & Spring	2873 aA	358 bA	213 aA	1236 aA

Compared with the nil treatment a single autumn application of urea resulted in a 43% increase in seed yield. This occurred principally as a result of the marked increase in head number per unit area (+39%).

Early spring application of urea significantly increased seed yield compared with autumn nitrogen and with no nitrogen. While head number was not significantly increased both floret number per head (+59%) and seed weight (+13%) increases resulted in an overall seed yield increase of 371 kg/ha (+69%) compared with no nitrogen.

Split application of nitrogen (autumn plus spring) increased all three yield components in the following order - floret number (+45%), head number (+32%) and seed weight (+21%) with overall seed yield being increased by 694 kg/ha (+126%) compared with no nitrogen.

DISCUSSION

For many years ryegrass seed production in New Zealand has been based on the traditional system of management involving a single application of nitrogenous fertiliser at the time of closing(October). This has resulted, in the Manawatu district, in a mean average seed yield of approximately 580 kg/ha. The

results reported above have shown that a departure from this traditional management system can markedly increase seed yields.

The timing of nitrogen application in relation to the morphological development of the plant at two specific periods of the year (autumn and spring) has a marked effect. Application of nitrogen in the autumn (April) promoted vegetative growth of plants, markedly increasing the number of tillers formed prior to the winter. The possible explanation of the effect of autumn nitrogen application is based on the important contribution of the oldest tillers in a crop to total seedhead number, an effect previously reported in ryegrass. (Wilson, 1959, Lambert and Jewiss, 1970, Hill, 1971a).

Spring nitrogen application (mid August) had a major effect on reproductive development (floret number and ultimately seed number per head). This effect might be explained in terms of Ryle's (1964, 1967) work with ryegrass, floret formation occuring during head development when the ear is undergoing exponential growth and therefore has a high demand for substrates. In addition spring nitrogen application resulted in a significant increase in seed weight.

It should be stressed that the results were obtained under Manawatu conditions. Any comparison between the results obtained here and responses in other districts should therefore take this into account. It would be of interest to be able to compare results obtained from similar trials in other areas of New Zealand where dry autumn conditions may make the benefits from autumn nitrogen application less consistent and reliable.

The application of early spring nitrogen alone resulted in significantly higher yields than autumn application alone. Nevertheless the results stress that the management of ryegrass seed crops should begin right from the time of sowing and that significantly higher seed yields can be obtained when nitrogen is applied as a split application. Early spring application should therefore not be carried out at the expense of an autumn application.

Since seed weight was significantly increased following spring application it could be suggested that a third application at closing or at ear emergence (November) would have an even more marked influence on this component of seed yield. In preliminary studies nitrogen application at ear emergence following two previous applications (autumn and early spring)

has induced severe crop lodging prior to anthesis, stimulated strong vegetative growth and resulted in a heavy bulk of leaf which must be handled at harvest. (Hill, unpublished). This may not be advantageous.

It is important that ryegrass seed crops receive careful management through correct closing date (Hill, 1971b) and attention to cutting and harvesting operations in order that the increased seeding potential of the crop induced by split applications of nitrogen can be fully exploited.

ACKNOWLEDGEMENT

The staff of the Seed Testing Station, Palmerston North for floret counts and seed weight determinations.

REFERENCES

Cooper, J.P., Saeed, S.W., 1949:

Studies of growth and development in Lolium. 1. Relation between the annual habit and head production under various systems of cutting. Journal Ecology 37: 233-259.

Hill, M.J., 1970:

Ryegrass seed crop management. New Zealand Journal of Agriculture 121: 52-54.

———— 1971a:

A study of seed production in perennial ryegrass, timothy and prairie grass. Ph.D. Thesis, Massey University, New Zealand.

———— 1971b:

Closing ryegrass crops for seed production. New Zealand Journal of Agriculture 123: 43.

Lambert, D.A., Jewiss, O.R., 1970:

The position in the plant and the date of origin of tillers which produce inflorescences. Journal of British Grassland Society : 25: 107-112.

Langer, R.H.M., 1956:

Growth and nutrition of timothy (Phleum pratense L.) 1. The life history of individual tillers. Annual of Applied Biology 44 : 166-187.

Ryle, G.J.A., 1964:

The influence of date of origin of the shoot and level of nitrogen on ear size in three perennial grasses. Annual of Applied Biology 53 :311-323.

———— 1967:

Effects of shading on inflorescence size and development in temperate perennial grasses. Annual of Applied Biology 59 : 297-308.

Wilson, J.R., 1959:

Influence of time of tiller origin and of nitrogen level on floral initiation and ear emergence of four pasture species - New Zealand Journal of Agricultural Research 2 : 915-932.