EXPERIMENTAL WORK ON COCKSFOOT SEED PRODUCTION

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Over the 6 years 1946 to 1951 an average annual area of 9330 acres has been harvested for cocksfoot seed in New Zealand, mainly in Ashburton and Southland Counties. The average yield of dressed seed over these 6 harvests has been 170lbs. per acre. The average annual total yield was a little over 1½ million pounds of seed.

Evidence. from overseas and from within New Zealand is conflicting in regard to manurial and other cultural practices. Some examples of opinion from various sources are presented below.

On manuring, Wallace (1), in 1936, stated that, in Ashburton county, only about one grower in ten used any manure other than that applied in the original sowing, usually 1 cwt. superphosphate. Without presenting data, he mentions that good results had been obtained from the use of nitrogenous fertilisers. Schwanbom and Froier (2) reported that in Denmark and Sweden an increase in seed yield followed application of nitrogenous fertilisers, the largest amount used (equivalent to about 4 cwt. sulphate of ammonia per acre) giving the largest increase. It was considered better with large doses to give half in autumn and half in spring. Andersen (3), in Denmark, found increasing yields from increasing amounts of nitrate of soda. He stated that experiments had shown that there is no advantage in applying part in the autumn and part in the spring. He summarises numerous trials by saying that the use of potassium and phosphate does not, as a rule, increase the yield of grass seed. The Welsh Plant Breeding Station (4) advises autumn and spring dressings of nitrogenous fertilisers. Fulkerson (5), in Canada, obtained increases of about 30 per cent in yield following the use of nitro-

genous fertilisers at a rate equivalent to 2001bs. sulphate of ammonia per acre.

Of grazing, Wallace (1) concluded that judicious grazing might do some good, but obviously was in some doubt, as he says that though grazing was common practice on Banks Peninsula it is "probably wiser for the Plains grower to not graze at all." McPherson (6), in 1948, attributed much of the reason for decline in Banks Peninsula production to uncontrolled grazing. He considered, however, that light and controlled grazing might have a beneficial effect on both yield and quality of seed. Regarding burning, he stated that contradictory results had been obtained. Nash (7) simply stated that "Management of the established paddocks is simple, because there is nothing to do, and the secret is to keep all stock off the cocksfoot all the year round." Schwanbom and Froier (2) state that Danish experiments show that grazing the aftermath reduces seed yield considerably. Andersen (3) stated that grazing at the end of summer reduces seed yield, but the application of the equivalent of 60 to 90lbs. of sulphate of ammonia per acre would overcome the injury done by the grazing. Evans (8) found that grazing in December, in England, had no adverse effect on seed yield. Whyte (9) in discussing work in England and Wales, states that flower primordia are not laid down until February or March (N.Z. August and September).

This paper presents results from experiments carried out by Grasslands over the past 10 years.

YIELDS FROM COCKSFOOT STRAINS

There are two strains of cocksfoot which produce a large proportion of the seed harvest in New Zealand. These are the pedigree C.23 and the Akaroa strains. At present at the stage of harvest for Government Stock seed is a new strain bred by Grasslands. It is important to know how the new strain compares with the older strains for seed production, particularly as some of the experiments to be discussed have been carried out on the Grasslands strain. In the following table yield data from the three strains are presented.

TABLE 1.

Average annual production in lb. per acre of pure germinating seed of three strains of cocksfoot at Gore and Lincoln, 1949 to 1952 harvests.

Strains	Yields		
	Gore	Lincoln	Average
C.23	348	308	328
Grassland's	356	336	346
Akaroa	394	358	376

Though statistical analyses are not available for this 4 year period, the trend toward the highest production from Akaroa and the lowest from C.23 is seen. An analysis on the Gore data for the first 3 years gave a significantly higher yield from Akaroa compared with the other two, which were not significantly different. An analysis on the second harvest at Gore showed no significant differences.

EIFFELTON TRIAL

This experiment has been fully described by Sears (10) in 1950, and only a brief discussion is possible in this paper. The trial was designed in the first place to investigate the effects on seed yield of recommended methods of control of stem borer moth *(Glyphipteryx achyloessa)* by means of eliminating stubble in the field

The methods used were (1) Burning the stubble after harvest (March-April), (2) Cutting the stubble with the mower followed by harrowing and raking to remove the debris. (3). Burning in the spring (September) , (4) Control.

Manurial treatments, in addition, were applied. These were: —

1. Sulphate of ammonia, 1cwt. per acre in autumn plus 2cwt. in the spring.
2. Superphosphate, 2cwt. per acre in the autumn.
3. A combination of (1) and (2), and
4. Control.

The trial was carried out on a 10 year-old stand from which seed had been harvested each year and which had deteriorated considerably in yield. Yields over 5 years of treatment were obtained, and these are presented in the following table.

TABLE 2.

Average annual yields in lb. per acre of cocksfoot seed over 5-year period at Eiffelton.

	Treatment	Sulphate of Ammonia	Super-phosphate	Sulp. ammon. + Super-phosphate	Control No Fertiliser
Weight of pure germinating seed lb. per acre	Autumn burn	196	97	208	81
	Autumn clean-up	192	95	218	74
	Spring burn	221	130	241	110
	Control-no treatment	256	129	246	137
Pure germinating seed as percentage of dressed seed	Autumn burn	80	73	82	75
	Autumn clean-up	79	73	81	73
	Spring burn	82	72	82	74
	Control—no treatment	80	74	81	74

The outstanding results here are the increases where sulphate of ammonia has been applied. Burning and removing the stubble in the autumn caused an opening of the sward and a considerable quantity of tares established. Spring burning weakened the plants visibly, but at the same time checked tares. Super-phosphate has not given any reliable increase, The use of nitrogen has in all cases given a higher percentage of viable seed in the dressed seed. Space does not allow of presentation of complete data, but reference to the original article will show that when nitrogen was used average dressing losses were 35 per cent, and where not used the losses were 43 per cent.

NITROGEN TRIALS

Preliminary trials at Lincoln had indicated that spring and autumn dressings of nitrogenous fertiliser were better than single applications, but to test this more accurately further trials were begun at Gore and Lincoln.

At Lincoln a trial was begun in the autumn of 1950 on a 4-year-old stand of C.23 cocksfoot. This trial has 4 replications of ‘7 treatments. The treatments and yields from two harvests are as follows:—

TABLE 3.

Yields of dressed cocksfoot seed at Lincoln in lb. per acre 1951 and 1952 harvests.

Rate of application of sulphate of ammonia	Time of Application	Yields		
		1951	1952	Average
Nil	Nil	243	275	259
1½ cwt per acre	Autumn	347	306	327
1½ „ „ „	Spring	339	292	316
3 { 1½ cwt per acre / 1½ cwt per acre	Autumn / Spring	426	319	373
3 cwt per acre	Autumn	454	297	376
3 „ „ „	Spring	466	356	411
6 { 3 cwt per acre / 3 cwt per acre	Autumn / Spring	627	310	469

1950 Autumn treatments May 10; Spring treatments October 3.
1951 Antumn treatments May 11; Spring treatments October 9.

Seed from the 1951 harvest was of very similar purity and germination in all treatments, and in the absence of these data for the 1952 harvest machine-dressed yields are compared in both years.

In 1951 all nitrogen treatments yielded significantly higher than no nitrogen at the 5 per cent level of significance. The heaviest application, 3cwt. in autumn plus 3cwt. in spring, resulted in significantly higher yields than any other treatment. In the 1½cwt. plots no significant difference is found between autumn and spring applications. In the 3cwt. plots no significant difference exists between times of application,' Both the 3cwt. autumn and 3cwt. spring treatments have significantly higher yields than the 1½cwt. treatments. The autumn-treated plots were about two days earlier in ripening than no treatment or spring treatments.

Results from the 1952 harvest are not so clear. Only two treatments-3cwt. applied half in autumn and half in spring, and 3cwt. in spring-were significantly better than control. No differences in ripening were noticed. Considerable straw and leaf had been left from the previous harvest, and it is felt that this has had a marked effect on the 1952 yields. To test this, plots have been. split and roughage removed

from one half. Any results from this modification will be seen in the next and subsequent harvests.

At Gore an area of Grasslands nucleus strain was available from which one harvest had been taken. This area is in 24in. rows. Nitrogen treatments were applied in 1951 with 4 replications and the first post-treatment harvest taken in 1952. Measurements here included yields and numbers of panicles per 20ft. of row. By calculation from these, weight per 1000 seeds, and purity and germination analyses it has been possible to estimate the number of viable seed per panicle. These data are presented in the table.

TABLE 4.

Nitrogen treatments, panicle counts, yields of viable seed in lb. per acre, weight per 1000 seeds, weight and number of viable seeds per panicle. 1952 harvest at Gore.

Applications		Measurements (nearest whole number)					
Rates, cwt. per acre	Times	Panicles per 20ft. of row		lb. viable seed per acre	Weight of 1000 seeds Mgms.	Mgms. viable seed per panicle.	Weight No. viable seed per panicle
		Emerged 16/11/51	Harvested 22/1/52				
Nil	Nil	134	1235	466	I/	775	203
2	autumn	187	1406	647	796	192	240
1	autumn						
2		149	1428	629	778	183	237
1	spring						
2	spring	99	1304	633	816	200	243
4	autumn	276	1619	665	799	171	214
2	autumn						
4		205	1517	673	808	185	229
2	spring						
4	spring	97	1392	760	831	227	274
6	autumn	378	1696	772	762	190	251
6	autumn	222	1421	693	804	203	253
3	spring spring	169	1217	618	839	212	254
Difference required at 5 per cent level of significance.		71.8	187.2	124.5		49.7	41.4

Autumn applications 2/4/51, spring 17/9/51.

In the counts. of panicles emerged in November none of the spring applications differs significantly from no nitrogen. Applications of 2cwt. in autumn or divided into autumn and spring dressings do not

differ significantly from the control. All other autumn treatments, whether alone or followed by a spring application, have significantly more heads emerged at this date. If the means for times and rates of application are taken (these are not shown) it is found that autumn nitrogen gave higher counts than divided applications at the same rates and the divided applications gave higher counts than spring applications. Six hundredweight. of sulphate of ammonia gave higher mean counts than 4cwt., and the latter higher than 2cwt.

In the January harvest counts all the autumn and autumn/spring applications gave significantly higher panicle numbers than control ; the spring applications did not produce significant differences from control, In the means for times and rates of application, autumn applications gave higher counts than autumn/spring, and this split application gave higher counts than the spring applications.

In yields of viable seed all treatments have yielded significantly more than control. No significant differences occurred between the means for either time or rate of application. There is an indication that an increase from 4 to 6cwt. in autumn application has been beneficial and that the same increase in spring has reduced yield.

The weight per 1000 seeds is lower in the mean for no nitrogen than in any other, but not significantly so, except for the 4cwt. and 6cwt. spring application, which are significantly heavier than control. In the means for times and rates of application the spring applications, on the average, are higher than for autumn or autumn/spring applications, and these latter two do not differ significantly.

No statistical analysis has been made on the weight of viable seed per panicle, but there appears to be a definite increase in weight at any rate or time of application of sulphate of ammonia, and this is especially marked in the spring applications.

The number of viable seed per panicle shows the same trend as the weights. Control has significantly fewer seeds than any of the spring treatments or any of the 6cwt. treatments, though there are no significant differences between treatments.

These results are from one harvest only, but to sum up it may be said that the increase in grain weight and numbers of seeds per panicle in spring treatments has made up for the smaller number of panicles.

No significant differences were found in either purity or germination percentage of pure seed, though a trend is noticeable. In purity the lighter rates and autumn applications tend to be better than control. In germination percentage the lighter rates and autumn applications are similar to control, i.e.;, higher than the heavier rates or spring applications. The percentages of pure germinating or viable seed-the product of purity and germination percentage-show some significant differences. The mean of 2cwt. rates is higher than the means of 4cwt. or 6cwt.; the latter do not differ significantly. The mean for autumn treatments is significantly higher than the mean for spring applications. High rates in spring have given significantly lower results than control, and light rates in autumn gave significantly higher results than control.

GRAZING TRIALS

At Lincoln in 1950 four plots of cocksfoot similar to that used in the nitrogen trial were subjected to grazing management. Two of these were grazed and two were not grazed. In 1950 there were two grazing periods, 7 to 10 April and 25 to 26 July. In 1951, with greater growth, the grazing periods were 9 to 15 March, 26 April to 2 May, 27 June to 2 July and 27 to 30 July. In each case growth was eaten down to .a. height of 2in. ,to 3in. All plots received autumn and spring applications of, 1½cwt. of sulphate of, am-, , monia per acre. In this trial 'germination results are not available for the second year and dressed seed yields are -presented.

TABLE 5.

Yields of dressed seed in lb. per acre from grazed and not-grazed plots at Lincoln.. 1951 and 1952 harvests.

Treatment	Mean Yields		
	1951	1952	Average
Grazed	593	477	535
Not grazed	596	374	485

The evidence from this trial to date is that grazing has increased rather than decreased yield. No deterioration of the stand 'or ingress of other species has so far occurred under grazing. A trend toward

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a-lower percentage of pure germinating seed was seen in 1951 from the ungrazed plots.

At Gore an area of Grasslands nucleus cocksfoot in 24in. rows was available for a grazing trial. This area had had three harvests previously. In this trial three treatments were possible-grazing in autumn, grazing in autumn and again in winter, and no grazing. The treatments were begun in 1951, with 9 replications. As in the Gore nitrogen trial, counts of panicles were made. The following table presents data from the first harvest of this trial., No statistical analyses are available except for panicle counts.

TABLE 6.

Number of panicles per 28ft. of row, yield of viable seed in lb. per acre, weight of 1000 seeds, weight and number of viable seeds per panicle in grazing trial at Gore 1952 harvest

Grazing Treatment	No. of panicles per 28ft. of row	lb. viable seed per acre	Weight per 1000 seeds Mgms.	Weight viable seed per panicle Mgms.	No. viable seed per panicle
Autumn	1618	479	741	308	229
Autumn + Winter	1725	424	738	256	189
Nil	1418	455	761	338	258

Autumn grazing 23-26/3/51, winter. 12/7/51.

The increases in 'the number of panicles in both grazed treatments are significant at the 5. per cent level, a difference of 184 being required. The double grazing has not produced a significant increase over the autumn grazing.

The yield of viable seed is highest in the autumn treatment and lowest in the double grazed treatment, but differences are small.

Grain weight, as shown by weight per 1000 seeds; is highest in the ungrazed treatment and lowest in the double grazed treatment.

Weight and number of viable seeds per panicle are highest in the ungrazed, lowest in the grazed, and intermediate in the autumn-grazed treatment.

Though the ungrazed treatment has the lowest number of panicles, the greater number of seeds per panicle and bigger grain weight have compensated. In the grazed treatments little difference in grain weight is seen, but the low number of seeds per panicle in the double grazing is not compensated for by the increase in number of panicles.

A trend toward a lower percentage of pure germ-

inating seed is seen in this harvest in seed from the ungrazed plots, as at Lincoln.

This trial has had uniform applications of nitrogen applied in both autumn and spring. For the next harvest the plots have been split so that half receive autumn nitrogen only and half spring nitrogen only. By this means some further information is expected on the nutrition of the extra panicles produced by autumn nitrogen or autumn grazing.

CONCLUSION

It has been shown in the trials reviewed that nitrogen has increased yield of seed consistently. The Eiffelton trial. ran for 5 years, but those at Lincoln and Gore are to run for several years yet before conclusive evidence on rates and times of application or the effects of grazing are obtained. Rates of application will depend on the nitrogen status of the soil in which the crop grows, and most striking results will be apparent on crops already starved for nitrogen. Field observation suggests that such is the case in most of the cocksfoot seed areas in the country.

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DISCUSSION

Q. In view of the long-term nature of this project and the large amounts of sulphate of ammonia being used, are any steps being taken to check increase in acidity ?

A. (Lambert) : No, not so far, but there is no evidence that acid conditions will affect cocksfoot seed yields. Similarly there is no evidence that potash increases yields, but we are investigating that question with small pilot trials.

Q. Is white clover sown with the cocksfoot in these trials ?

A. (Thurston) : Not as a rule. In a small trial at Lincoln white clover gave increased seed production for the first 2 years, but after that it smothered the cocksfoot.

Prof. A. H. Flay: I must congratulate the speakers on their careful and accurate work, but unfortunately at the moment no one wants to grow. cocksfoot for seed. However, it is possible that with a change in market demand this work may be of very great, importance soon,

G. A. Nutt: I -agree with Professor Flay. I have recently returned from England and there cocksfoot seed yields average about 6cwt. per acre. Individual fields have reached yields of 14cwt. of clean seed per acre. If artificial nitrogen drops in price, that is the key to cheaper cocksfoot production in New Zealand.

Q. Would there be any difference in results of applications of nitrogen between cocksfoot broadcast and cocksfoot drilled in 28in. rows?

A. (Lambert) : There may be differences in the way they react to grazing, but there are no differences with regard to the effects of nitrogen.