CHEMICAL ESTABLISHMENT OF WHEAT

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Summary

Yields of wheat established by drilling on pasture previously sprayed with paraquat were compared with those from drilling on cultivated land.

Yields on chemically treated plots were significantly higher than those from cultivation provided clover growth was suppressed by 2,4,5-T or a bipyrindyl compound and the benefits of fallowing were obtained by prior chemical treatment or by adding nitrogen fertilizer to the crop.

INTRODUCTION

ELEVEN YEARS have passed since the first crop was drilled into a chemically prepared seedbed in this country (Blackmore, 1957). Results from this trial were encouraging enough to take the method further. Since then a variety of crops, including maize, choumoellier, swedes, turnips, rape, garden peas, millet and the cereals have been established in this way (F. B. Thompson, A. Thompson, L. J. Matthews, P. Bramley, L. W. Blackmore, and others). Results have been extremely variable. In the main they have been mediocre to poor with some outstanding exceptions. In recent years, with a better understanding of the principles involved, improved techniques for placing the seed and fertilizer in the soil, and with a greater variety of chemicals, results have been more encouraging.

Promising results from a trial carried out in the Manawātū district are discussed in this paper.

The specific aims of this trial were:

- (1) To find out more about the technique of drilling in the crop as this has been one of the major stumbling-blocks in the past.
- (2) To get a measure of the importance of clover suppression on yields.
- (3) To investigate the effects of various methods (including chemical as well as cultivation) of seedbed preparation involving spraying at different times, spraying followed by cultivation, and cultivation only, on yields.

EXPERIMENTAL

DETAILS OF TREATMENTS

The soil selected for this trial was Kairanga silt loam, a deep silt overlying sand and shingle. Drainage was fairly good. The area had been in pasture for five years.

The variety of wheat was Gamanya which was sown at 3 bushels with 2 cwt superphosphate per acre. The trial was drilled in on September 16, 1966.

There were 5 replications of 10 treatments. The plot size was 132 ft by 4 ft (8 drills, 6 in. apart).

All rates of chemicals in this paper are given in oz active ingredient per acre unless otherwise stated.

The effect of cultivation was compared with drilling on plots treated with paraquat, with or without 2,4,5-T or a bipyridyl compound to eliminate or suppress clover growth. Nitrogen fertilizer was also added in some treatments. All plots other than those cultivated received a basal treatment of 8 oz paraquat immediately prior to drilling, plus another 4 oz paraquat on September 21, 1966, prior to emergence of the wheat. Where bipyridyl compound was used, it was mixed with the paraquat applied on September 21, 1966. Treatments were:

- (1) Cultivation only. Rotary hoed 5/9/66 and 14/9/66.
- (2) 2 oz paraquat on 27/4/66; 3 lb a.i. per acre 2,4,5-T 28/7/66; plus basal paraquat treatment.
- (3) As for Treatment 4 plus 6 oz bipyridyl compound on 21/9/66.
- (4) 2 oz paraquat on 27/4/66 plus basal paraquat treatment.
- (5) 4 oz paraquat on 15/6/66; basal paraquat treatment; plus 6 oz bipyridyl compound.
- (6) 4 oz paraquat on 15/6/66 plus cultivation as in Treatment 1.
- (7) As for Treatment 8 plus $\frac{1}{2}$ cwt 20% nitrogen with the seed and 2 cwt 20% nitrogen broadcast on the crop 10/10/66.
- (8) 8 oz paraquat on 27/4/66; basal paraquat treatment; plus 6 oz bipyridyl compound.
- (9) As for Treatment 10 plus nitrogen as for Treatment 7.
- (10) Basal paraquat treatment plus 6 oz bipyridyl compound.

DRILLING TECHNIQUE

The seed and fertilizer in the chemically prepared seedbeds were drilled in with a disc and coulter assembly which proved to be very efficient. It consisted of a flat rolling disc in front followed by a hoe coulter fitted with a laterally compressed point designed by R. Taylor. Additional tubes to lead the seed and fertilizer right down into the soil were fitted. The cultivated plots were drilled with hoe coulters with standard points. The seed in the chemically treated plots was "covered" by rolling the entire surface with a heavy self-propelled Dennis mower. This operation brought the two sides of the drill slits together again so efficiently that the drill incisions almost entirely disappeared.

ASSESSMENT OF CLOVER GROWTH

Six weeks after drilling, clover growth was assessed by eye estimations of height, density and vigour for each plot. The following scoring method was adopted.

Height: Recorded in inches.

Density: 0 = 100% bare ground; 10 = a complete clover cover.

Vigour: 1 = very poor; 10 = extremely vigorous.

The relative aggressiveness or "clover rating" was then assessed by multiplying together the average scores (treatment averages) for height, density and vigour. These figures were then adjusted, the highest figure being given the value of "100" while the others were scaled down proportionately.

ASSESSMENT OF NITROGEN AVAILABILITY

It was desirable to get some measure of the rate of breakdown of organic matter for the different trial treatments. This was discussed with Dr W. M. H. Saunders, Ruakura Agricultural Research Centre. It was considered that measurements of soil nitrate levels would not be sufficiently reliable. An indirect approach was therefore adopted. All plots were sampled at successive stages and the plants analysed by nitrogen content. This, however, did not reveal any definite pattern. It was finally decided to score all plots for "colour" using a "0 to 10" range of points, because the differences in colour were very marked throughout the growing period. It was assumed that there was a direct relationship between colour in the crop and nitrogen availability in the soil.

RESULTS

The strike of wheat in the chemically prepared plots was remarkably even, while that in the cultivated plots was rather uneven, owing to some bird and hare damage. It was also felt that consolidation was not as good as it should have been in the cultivated plots although these had been Cambridge rolled prior to drilling. Subsequently all plots remained very even throughout the remainder of the season. However, differences between treatments both in height and especially in colour showed up at an early stage. By December the average height of the wheat was 48 in.

The results of wheat yields harvested on 13/2/67, the clover rating and colour ratings for wheat are given in Table 1.

TABLE 1: YIELDS OF WHEAT, CLOVER RATING, AND COLOUR RATINGS OF WHEAT

Treatment No.	Yield (bu/acre)	Clover Rating	Colour Rating of Wheat*			
			17/10/66	31/10/66	18/11/66	30/11/66
1	 74.0 cC	Nil	5.4	8.4	9.8	9.4
2	 88.1 aA	0.3	7.2	8.0	8.0	6.0
3	 85.1 AbAB	24	8.2	6.2	6.8	4.8
4	 77.1 cBC	100	8.2	5.4	6.0	4.4
5	 88.8 aA	31	8.6	7.8	8.0	5.6
6	 86.8 abAB	Nil	4.8	9.4	9.8	9.4
7	 85.4 abAB	44	8.3	9.5	8.6	7.8
8	 84.4 abAB	37	8.4	6.6	7.2	5.4
9	 87.1 abAB	20	8.4	10.0	8.2	6.6
10	 80.4 bcABC	20	8.0	5.8	5.8	4.0

* Colour Ratings: 1 = yellow green; 10 = very dark green.

DISCUSSION

COMMENT ON DRILL SLITS

By drill slits is meant the slits which were cut in the surface during the drilling operation by the disc and hoe coulter assembly. As previously pointed out, these slits were closed by the rolling operation after drilling to the extent that they could scarcely be discerned. However, as a result of a dry spell about one month after sowing, these slits began to re-open

and it was felt that, if the process had continued, it might well have become a problem. It was noticed that the slits in some treatments opened up wider than in others. The following observations were made.

- (1) Wherever pre-spraying had been done, and this included the use of 2,4,5-T, the slits were much narrower. In Treatment 5 where paraquat had been applied in mid-June they had opened very little. However, in Treatment 10 where paraquat had been applied immediately prior to drilling, the slits were the widest. This result is probably associated in some measure with the elastic nature of the turf. With chemical treatment this elasticity largely disappeared.
- (2) The amount of cover growth was an important factor. Cover provided shade and reduced drying out and therefore shrinkage. Where the slits were directly exposed to the sun and wind, they were widely open.
- (3) The distance between the rows had an effect. In a separate area where the plots were drilled in at 3 in. spacings, the slits were only half as wide open as for the 6 in. spacings.

COMPETITION FROM CLOVERS

It had previously been demonstrated by C. Düring and the writer in 1960 that clovers could offer serious competition to crops during their establishment stages and that they would either have to be suppressed or eliminated if a satisfactory crop was to be obtained. It can be seen in the following tabulation that an increase of 8.0 bu/acre resulted from the use of the bipyridyl suppressant, while an increase of 11.0 bu/acre was obtained where the clovers were removed with 2,4,5-T.

<i>Treatment</i>	<i>Yield (bu/acre)</i>	<i>Difference from Treatment (4)</i>
4: No clover suppression	77.1 cBC	
3: Clover suppression	85.1 abAB	+ 8.0
2: Clover removal	88.1 aA	+11.0

With regard to Treatment 2, it is considered that at least part of the increase in yield was due to nutrients released by the breakdown of clovers killed by the 2,4,5-T, as well as some possible effect on the grasses as these were observed to suffer a check.

SOIL PREPARATION FOR SOWING

Fallowing the land is of special importance where the initial fertility is low and has particular advantages for dry climates where the leaching of nitrates is low.

It was demonstrated (Blackmore, 1961) that the fallow was just as important with the chemical method of seedbed preparation as it was for cultivation. The current trial has shown that the "chemical fallow" is important even on high fertility soils.

Basically the object of fallowing is to mobilize a sufficient quantity of plant nutrients from organic matter breakdown to allow a quick establishment of the crop.

With the current trial, several approaches have been made to the problem. These are based on the principle that the land should be out

of production for the least possible time. Four approaches have been tried.

(1) *Preceding the Spring Sowing of Wheat by an Autumn Treatment*

Two ounces paraquat were applied to the pasture in the autumn unaccompanied by seed sowing. Portion of the original grass in the sward was removed by the paraquat and the clover substantially increased. After about four weeks the pasture recovered sufficiently to be grazed.

There were three main effects associated with the method. There was evidently a rise in fertility resulting from organic matter breakdown which was carried through to the crop; a change in the nature of the soil (softer texture); while the grazing of the pasture could be carried right through to the time of drilling in the spring.

Although the autumn treatment with paraquat gave an increase in yield of approximately 5 bu/acre (the difference between Treatments 3 and 10), this was not significant.

(2) *Winter Spraying to Remove the Grasses*

The winter application of paraquat (Treatment 5) removed virtually all the grass. Clover recovery was remarkably quick for the time of the year, and well before the winter was over clover covered most of the area. This treatment resulted in a significant 8.4 bu/acre increase over spraying in the spring immediately prior to drilling (Treatment 10).

(3) *Winter Spraying followed by Cultivation*

One of the obvious advantages of pre-spraying is that fallowing can proceed under conditions when it would be impossible to cultivate. Furthermore, when the land was subsequently ploughed, it would break down more readily. The following tabulation shows that winter spraying of paraquat followed by cultivation (Treatment 6) gave a significant increase in yield over cultivation only (Treatment 1). However, equally good results were obtained by using the basal paraquat application plus bipyridyl compound instead of cultivation (Treatment 5).

<i>Treatment</i>	<i>Yield (bu/acre)</i>
1. Cultivation	74.0 cC
6. 4 oz paraquat 15/6/66 and cultivation	86.8 abAB
5. 4 oz paraquat 15/6/66 and basal paraquat	88.8 aA

(4) *Value of Nitrogen in Replacing Pre-spraying Treatments*

In some circumstances, it may be more convenient to graze a pasture until about the time the wheat is to be drilled, spray it, and then sow immediately. If maximum yields are to be obtained under this system, some nitrogen may be necessary during the establishment stages. However, there is apparently nothing to be gained by supplying nitrogen to a wheat crop if the preceding pasture was sprayed with paraquat the previous autumn. Comparisons between Treatments 7 to 10 inclusive are of interest in this connection. These are given in the following tabulation.

<i>Treatment</i>	<i>Yield (bu/acre)</i>
10. Sprayed spring (no nitrogen)	80.4 bcABC
9. Sprayed spring (nitrogen)	87.1 abAB
8. Sprayed autumn (no nitrogen)	84.4 abAB
7. Sprayed autumn (nitrogen)	85.4 abAB

EFFECTS OF TREATMENTS ON NITROGEN AVAILABILITY

If it can be assumed that the colour ratings given in Table 1 are an indication of nitrogen availability for the different treatments, the following deductions can be made:

- (1) Treatments 7 and 9 which received artificially applied nitrogen had the highest nitrogen availability during the first 45 days after drilling but at subsequent assessments the nitrogen was higher where the land had been cultivated — *i.e.*, Treatments 1 (cultivation only) and 6 (spring spraying of paraquat followed by cultivation).
- (2) The figures for Treatments 1 and 6 are of particular interest and indicate that nitrogen availability was initially much lower than for any other treatment. This suggests that, under the conditions of the trial, organic matter breakdown with cultivation was initially slower than with the chemical treatments. Subsequent to this, however, nitrogen levels rose sharply and were subsequently higher than any of the other treatments.
- (3) A comparison of Treatment 5 (winter spraying) with Treatment 6 (winter spraying followed by cultivation) indicates that nitrogen was available to the crop much earlier where cultivation was not carried out. It appears that cultivation after spraying tended to delay nitrogen release, probably because of the admixture of the chemically fallowed top-soil with the raw underneath soil during the cultivation process.
- (4) Treatments 2 (clover removal), and 5 (winter spraying) appeared to give the highest nitrogen availability for the non-nitrogen treatments except for cultivation.
- (5) In the lowest rating group (Treatments 3, 4, 8 and 10) Treatment 4 is of interest as it was a "no clover suppression" treatment. It would appear that the clover present was a competitor for available nitrogen. This view is supported by the fact it had the highest "clover rating" for all treatments.

CONCLUSIONS

- (1) Seedbed preparation by chemical methods gave significant increases in yields of wheat over spring cultivation alone, provided that clover growth was suppressed and fertility increased by either preconditioning the soil by chemical means to obtain the equivalent of a fallow, or applying nitrogen to the crop.
- (2) The yields following cultivation were significantly increased and equalled those from the chemical method where cultivation had been preceded by a mid-winter treatment of paraquat to precondition the soil, and to obtain the benefits of a fallow.

- (3) Appropriate chemical treatments enable benefits equivalent to fallowing to be obtained, and at the same time permit grazing of the land right up to the time of drilling the crop.
- (4) Chemical methods would enable crops to be drilled in earlier in the season.

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