METHOD OF SEEDBED PREPARATION – EFFECTS ON MAIZE *(Zea mays L.)* AND BARLEY *(Hordeum sativum Jess)* YIELDS

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SUMMARY

Grain yields from maize and barley sown in seed beds prepared by a range of cultivation techniques were measured.

With both crops late cultivation without either a pre-cultivation application of paraquat or a post-sowing application of nitrogenous fertiliser gave lower yields.

Early cultivation gave higher grain yields which were not increased by either a pre-cultivation application of paraquat or a post application of nitrogenous fertiliser. Application of paraquat and nitrogen increased yields of late cultivation treatments.

INTRODUCTION

Paraquat has been applied to pasture by several maize and barley growers in the Manawatu and Waikato districts as a pre-cultivation spray treatment prior to normal cultivations for spring-sown cereals. The technique involves the application of paraquat 0.56 kg ai to the sward 4-10 days prior to ploughing. When the fallow period has been short, i.e., from 7-14 days, grain yield increases from pre-cultivation spraying have been claimed.

Some work on this technique has been reported by Blackmore (1967) who demonstrated yield increases and pointed out that pre-cultivation spraying enabled fallowing to proceed under conditions when it would be impossible to cultivate.

It was considered that further work was necessary to quantify the conditions under which a benefit from pre-cultivation spraying might be expected. Trials were therefore initiated on spring-

sown maize and barley in the Waikato and Manawatu and included such factors as type of cultivation, length of fallow, pre-cultivation spraying with paraquat, 0.56 kg ai/ha, and the application of a nitrogenous fertiliser.

METHODS AND MATERIALS

Hamilton Maize Trial:

This field trial was laid down on a 30 year old pasture which was predominantly perennial ryegrass and white clover. The soil was a Maeroa ash. The treatments were:-

1. "Early-ploughing" without paraquat.

   Ploughed 28 September 1970.

2. "Early-ploughing" with paraquat.

   Ploughed 28 September 1970 preceded by paraquat 0.56 kg ai/ha, applied 22 September 1970.

3. "Late-ploughing" without paraquat.

   Ploughed 16 October 1970.

4. "Late-ploughing" with paraquat.

   Ploughed 16 October 1970 preceded by paraquat 0.56 kg ai/ha, applied 8 October 1970.

5. Rotary-hoed without paraquat.

   Rotary-hoed 15 October 1970.

6. Rotary-hoed with paraquat.

   Rotary-hoed 15 October 1970 preceded by paraquat 0.56 kg ai/ha applied 8 October 1970.

On 16 October 1970 all treated areas were disced, rolled and harrowed prior to precision planting the hybrid maize PX610 in 75 cm rows on 23 October 1970. The trial design was a randomised block with four replications. The plot size was 6 m x 18 m. Rotary-hoeing consisted of two cuts to a depth of 12.5 cm - 15 cm.

A visual assessment of weed infestation was made on 3 December 1970. The score was based on a 1-10 scale where 10 represented no weeds present. Plant numbers were assessed on 7 December 1970 by counting plants in the two centre rows of each plot. Grain yields were determined by harvesting a 9 m length of 2 rows. Grain yields were calculated at 14% moisture.

Manawatu Barley Trial:

This trial was located on a drained Kairanga silt loam soil. The area had been in pasture for about four years and, at the time of treatment, was a predominantly ryegrass-white clover sward.

The trial was a randomised block design with four replications. Nitrogen was broadcast post-sowing on a random split plot basis. The plots were large - 10 m wide by 18 m long - to facilitate header harvesting. The cultivation treatments were:

1. "Early-ploughing" with paraquat ± nitrogen 22.5 kg/ha. Ploughed 14 October 1971 preceded by paraquat 0.56 kg ai/ha applied 2 October 1971.

2. "Early-ploughing" without paraquat ± nitrogen 22.5 kg/ha. Ploughed 14 October 1971.

3. "Late-ploughing" with paraquat ± nitrogen 22.5 kg/ha. Ploughed 3 November 1971 preceded by paraquat 0.56 kg ai/ha applied 27 October 1971.

4. "Late-ploughing" without paraquat ± nitrogen. 22.5 kg/ha. Ploughed 3 November 1971.

From 10 November 1971 all treatments received the same management, viz., one rolling on 10 November, 3 discings and harrowings on 13 November, followed by planting on 14 November with barley c.v. Zephyr 200 kg/ha. The barley was sown with a 6:6:4 NPK fertiliser 250 kg/ha using a conventional hoe coulter drill. Additional nitrogen 22.5 kg/ha was broadcast on 17 November 1971 as sulphate of ammonia.

On 20 December 1971, four sites within each plot were chosen at random and the number of plants in the rows on either side of a one metre marker counted. On 24 December 1971, within a 40 m area in the centre of the trial, five plants per plot were chosen at random and their height measured. The number of plants and tillers were counted on one block on 7 February 1972 by selecting five 2.7 m row lengths at random. The crop was harvested 1 March 1972 using a combine harvester which took a 4.3 m swath down the length of each sub-plot. At the end of each sub-plot, the barley in the header was emptied into sacks, weighed, and a sample taken for moisture determination. Barley grain yields were subsequently adjusted to a 14.5% moisture level.

RESULTS

Hamilton Maize Trial:

The results of the weed infestation assessment are given in Table I.

TABLE I : WEED INFESTATION AT 3 DECEMBER 1970

Treatment:	Score Mean of 4 Replicates
"Early-ploughing" without paraquat	7.3 ab A
"Early-ploughing" with paraquat	7.8 a A
"Late-ploughing" without paraquat	6.0 b A
"Late-ploughing" with paraquat	8.5 a A
Rotary-hoed without paraquat	2.8 c B
Rotary-hoed with paraquat	3.3 c B

10 = no weeds.

A wide range of weeds was present at this assessment on all treatments, only the degree of infestation was effected by the treatments. Both early and late ploughing treatments had a highly significant lower weed infestations than did rotary hoeing. The length of fallow had no significant effect on weed infestation. Paraquat significantly reduced weed infestation with late ploughing but not with either early ploughing or rotary-hoeing treatments.

The results of plant counts are given in Table 2.

TABLE 2 : NUMBER OF PLANTS AT 7 DECEMBER 1970.

Treatment:			Plants/ha		
"Early-ploughing"	without	paraquat	65,900	a	A
"Early-ploughing"	with	paraquat	65,700	a	AB
"Late-ploughing	without	paraquat	52,360	c	C
"Late-ploughing"	with	paraquat	60,520	ab	ABC
Rotary-hoed	without	paraquat	53,350	bc	BC
Rotary-hoed	with	paraquat	57,800	abc	ABC

The late ploughing and rotary-hoed treatments were similar, and both had a highly significantly fewer plants than did early ploughing. Paraquat significantly increased the number of plants in late ploughing but not in early ploughing or rotary-hoed.

The grain yields from the trial are given in Table 3.

TABLE 3 : GRAIN YIELDS KG/HA (14.0% MOISTURE) AT 24 APRIL 1971

Treatment:			Yield kg/ha		
"Early-ploughing"	without	paraquat	12,770	a	A
"Early-ploughing"	with	paraquat	13,300	a	A
"Late-ploughing"	without	paraquat	11,020	bc	AB
"Late-ploughing"	with	paraquat	13,040	a	A
Rotary-hoed	without	paraquat	9,880	c	B
Rotary-hoed	with	paraquat	12,430	ab	A

In the absence of paraquat, the late ploughing and rotary-hoed treatments gave significantly lower yields than did early ploughing either with or without paraquat. The lowest yielding was the rotary-hoed without paraquat treatment. Paraquat increased yields up to those obtained from early ploughing. No yield increase was obtained from paraquat when it was applied prior to early ploughing.

Manawatu Barley Trial:

The results from the germination counts and the height measurements are shown in Table 4.

TABLE 4 : GERMINATION COUNTS AND HEIGHT MEASUREMENTS

Treatment	Number of Plants per metre row 20.12.71	Crop Height Plot Mean 24.12.71 cm
"Early-ploughing" with paraquat without 20 lb N	51	
"Early-ploughing" with paraquat with 20 lb N	52	210 a A
"Early-ploughing" without paraquat without 20 lb N	53	
"Early-ploughing" with paraquat with 20 lb N	46	207 a A
"Late-ploughing" with paraquat without 20 lb N	53	
"Late-ploughing" with paraquat with 20 lb N	48	179 b B
"Late-ploughing" without paraquat without 20 lb N	49	
"Late-ploughing" without paraquat with 20 lb N	49	145 c C

There were no differences in germination counts between treatments. With regard to height, analysis of the data showed there were no differences due to nitrogen. Late ploughing with and without paraquat had highly significantly shorter plants than did early ploughing. Paraquat did not effect height with early ploughing but caused a highly significant increase with late ploughing.

In the block counted on 7 February 1972, there were, between treatments, no differences in tiller counts and plant numbers.

The grain yields from the trial are given in Table 5.

TABLE 5 : BARLEY YIELDS KG/HA (14.5% MOISTURE) 1 MARCH 1972

Treatment	Yield kg/ha
"Early-ploughing" with paraquat without 20 lb N	4850
"Early-ploughing" with paraquat with 20 lb N	4940
"Early-ploughing" without paraquat without 20 lb N	4900
"Early-ploughing" without paraquat with 20 lb N	4940
"Late-ploughing" with paraquat without 20 lb N	4690
"Late-ploughing" with paraquat with 20 lb N	4680
"Late-ploughing" without paraquat without 20 lb N	3190
"Late-ploughing" without paraquat with 20 lb N	3860

C.V. Main plots 5.3%

C.V. Sub plots 3.1%

The grain from the late ploughing without paraquat treatments was graded poor quality, due to pinching and shortness of grain. Grain from all other treatments was acceptable. The significance of the main effects was as follows:

Paraquat:

"Early-ploughing" No N. - 406

"Early-ploughing" with N 0

"Late-ploughing" No N. +1500**

"Late-ploughing" with N. +820**

Paraquat had no significant effect either with or without nitrogen with early ploughing, but had a highly significant effect especially without nitrogen with late ploughing. Paraquat almost brought the yields from late ploughing up to those obtained from early ploughing.

Nitrogen:

"Early-ploughing" No paraquat + 40

"Early-ploughing" with paraquat + 80

"Late-ploughing" No paraquat +670**

"Late-ploughing" with paraquat - 10

Nitrogen had a significant effect only when applied to the late ploughing no paraquat treatment.

Time of Ploughing:

The main effect of time of ploughing was highly significant. Late ploughing seriously depressed yield. This was partly overcome by applying nitrogen, but to a greater extend was overcome by applying paraquat. No additional benefit was obtained from nitrogen where paraquat had been applied.

DISCUSSION

In the Hamilton and Manawatu trials, significant depressions in grain yields were caused by a reduction in the fallow period from approximately four weeks to one week. This result demonstrated the advantage in terms of crop yields of early ploughing in the spring as soon as the stock demands and ground conditions permit. Neither pre-cultivation spraying with paraquat nor post-sowing application of nitrogenous fertiliser was beneficial when ploughing was early.

In both trials, however, a pre-cultivation application of paraquat 0.56 kg/ha significantly increased yields from late ploughing and rotary-hoeing. The yields resulting from pre-cultivation spraying and late ploughing or rotary-hoeing were nearly equivalent to that obtained from early ploughing.

Whether the paraquat effect is due to the chemical fallow per se, or due to a more rapid breakdown of organic matter following ploughing, or a combination of both, has not been resolved and further trials are necessary to separate these factors.

In the Manawatu barley trial, the yield differences were due to higher yielding individual plants. There was no significant relationship between yields and germination counts, final plant numbers or tiller counts. In the Hamilton maize trial, differences in plant numbers and weed infestation occurred as a result of pre-cultivation spraying prior to late ploughing or rotary-hoeing. These were similar to the early ploughing treatments.

The results from these trials support the view that yield responses may be obtained from pre-cultivation spraying if ploughing is late and the fallow period is reduced to 7 days. The application of nitrogen with late ploughing, whilst providing significant yield increases in the absence of paraquat, does not appear to fully compensate for the yield losses caused by a reduction in the fallow period.

The pre-cultivation spraying technique appears to have some practical value to growers who are unable to plough sufficiently early to allow a four week fallow. Under these conditions the use of a pre-cultivation spray treatment offers the prospect of obtaining yields very similar to those obtained from the longer fallow and of avoiding the significant yield depressions of the kind recorded in these trials.

Further work is necessary to measure more critically the soil factors involved to ascertain over a wider range of conditions the length of time required for an "adequate fallow", and to extend the technique to other crops.

REFERENCES

Blackmore, L., 1967. Chemical Establishment of Wheat. Proceedings Twentieth New Zealand Weed and Pest Control Conference: 67 - 73.