THE USE OF SMALL PLOTS AND A SMALL HARVESTER IN THE EVALUATION OF BARLEY CULTIVARS.

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SUMMARY

A comparison barley grain yields obtained from simulated breeders 3-row plots and 9-row drill strips showed significant yield differences in favour of the drill strips. The accuracy of the experiment as measured by the CV ranked drill strips first. The drill strips ranked varieties in a different order to that obtained from the simulated breeders 3-row plots. The efficiency of a commercial header was considerably better than that of the small experimental header which threshed less efficiently and favoured the easier threshing cultivars. Plot size x barley cultivar interaction and a header type x barley cultivar interactions were apparent but at low levels of significance. Results from the breeders 3-row plot similation when applied as in practice failed to isolate the high yielding commercial variety Zephyr.

INTRODUCTION

Cereal breeders in New Zealand use small plots each of three 5 m rows at 19 cm spacings to test promising cereal cultivars. These 3-row plots are separated by 0.75 m gaps which are cultivated to keep down weeds. The size and layout of the 3-row plots is determined largely by the availability of seed and the area required to operate a small tractor mounted header harvester. The fact that successful wheats such as Aotea and Kopara have been produced under these conditions has satisfied cereal breeders that there is nothing seriously wrong with this initial screening system. Promising selections arising out of this screening process are grown in full scale drill trials at Lincoln and the best resulting from these are offered for regional evaluation.

The apparent success of this system prompted the suggestion that these 3-row plots could be effectively used in regional evaluation trials in which currently replicated randomized blocks of drill strips, each of 9 row at 18 cm spacings are used. The drill strips are harvested by a commercial header harvester. The drill strip/commercial header harvester technique is generally accepted as a satisfactory simulation of practical farm conditions. Accordingly, a field trial was laid down to test the cereal breeders 3-row plots/small header system against the usual drill strip method. In the field trial it was intended to examine the following:-

1. The relative grain yields obtained from drill strips and 3 row plots to determine whether the yield obtained from a dense competitive stand of plants differs from that obtained from 3-row plots.

2. To compare the accuracy of each system as measured by their co-efficients of variation.

3. To compare the efficiency of commercial header harvester with that of a small tractor mounted experimental header.

4. To evaluate the effect of each system on the ranking of selections.

5. To examine plot size x cultivar interactions if any.

6. To select cultivars for further crop evaluation on the basis of yields obtained from 3 row plots and drill strip plots and judge these against known results.

MATERIALS AND METHODS

A randomised block trial of six replicates and containing four barleys, Research, Zephyr, CRD 48.01 and CRD 152.01, was sown on an area of Templeton silt loam previously cropped with lucerne. The barleys were sown in the main plots. Each main plot consisted of 2 randomised sub-plots 55 cm apart. One subplot contained a drill strip of 9 rows at 18 cm spacings and the other was subdivided into two sub-sub plots each of 18 cm rows. The sub-sub plots were 65cm apart. The sub-sub plots were obtained by blocking off the middle three coulters of the 9 coulter drill and were considered to simulate cereal

breeders' 3 row plots although they were only 65 cm and 55 cm apart as compared with the 75 cm gap used in practice. All plots were seeded at same rate per row. At harvest one of the two sub-sub plots was harvested with a commercial header and the other with the small tractor mounted experimental header. The drill strips were harvested with the commercial header. The harvested grain yields were reduced to 15% moisture and calculated on a per hectare basis.

RESULTS AND DISCUSSION

Under the moist soil conditions which prevailed a good even germination of seed occurred. The crops on 3-row plots and in the outside rows of drill strips made lush growth typical of the border row effect phenomenon. The yields of grains obtained are given in Table 1.

In terms of per hectare yields the drill strips - although markedly affected by border row effect on the outer rows - yielded significantly (P 0.01) more grain than the breeders' 3 row plots. Disregarding possible plot x cultivar interaction it appears that dense evenly spaced populations yield more per unit area than small clumped populations of the 3-row plots. In view of this finding it is reasonable to conclude, that as a general rule, drill strips give a conservative estimate of yield, even though the outside rows tend to be heavier yielding and are similar to small clumped populations especially where unnecessarily large gaps occur between the drill strips. Also because the 3-row plots are wider spaced - in practice 65 cm - it is likely that the real yield differences between the two systems are greater than those obtained.

The accuracy of the trial as measured by the CV indicate that the drill strips - CV 10% - had less variance than the comparable 3-row plots - CV 16% - the mean value of the two sub-sub plots CVs 14% v and 17%. These indicate that the 3-row plots harvested by the small header had higher variance, but possibly not to the degree that it could be said that header size was the sole cause. Because, the CV (14%) of the sub-sub plot harvested with the commercial header is greater than that of the drill strip (CV 10%) harvested with the commercial header the higher CV it may not be entirely due to smaller sample size. It is possible that the lower yielding

TABLE I : Barley Grain Yields t/ha

Cultivar	Research	Zephyr	CRD 48.01	CRD 152.01	C.V.	L.S.D. 5%	L.S.D. 1%	
Overall	12.89	14.63	15.52	16.63	14.0%	0.96	1.33	
Means	cC	bB	bAB	aA				
Drill Strip	13.89	16.66	16.37	17.96	10%	1.33	1.81	
Means	cB	abA	bA	aA				
All Breeders 3-row plot	11.89	12.59	14.66	15.26	16%	1.70	2.37	9-row drill strip v 3-row plot**
Means	bC	bBC	aAB	aA				
Small Experimental Header	11.26	11.26	12.52	13.59	17%			
Means	-	-	-	-				
Commercial Header	12.52	13.89	16.81	16.96	14%	2.56	3.55	commercial v small**
Means	cB	bcAB	abA	aA				

and 3-row plots are intrinsically more variable in yield than drill strip plots. In practice, the 3-row plots are 5 m long and cover less than one-third of the area covered by the drill strip plots. They are also further apart and under these conditions are likely to be more variable than drill strips. The inefficiency of the small header tended to make matters worse as comparison of the two header yields shows.

In the analysis of yields from 3-row plots the difference in yields obtained from the large commercial header and the small experimental header was highly significant. The variability of yields (CV 17%) harvested by the small header was such that no significant differences between barleys were obtained. The small header failed to separate the lower yielding varieties and considerably reduced the yields of the best varieties in the comparison with the yields obtained from the larger commercial machine. The evidence suggests also that the small header favoured the easier threshing varieties. The large header (CV14%) produced yield differences that were significant at the 1% level and separated all four varieties.

In ranking the four varieties in order of yield the 3-row plot series separated CRD 152.01 and Research at the 1% level of significance and CRD 48.01 from Zephyr and Research at the 5% level of significance. No significant separation was made between Zephyr and Research. However, the order of yield: CRD 152.01, CRD 48.01, Zephyr and Research was similar but with different levels of statistical significance except in the drill strip and small header plots. In the case of the latter the cause may be ascribed to mechanical inefficiency of the small header but in the case of drill strip results other reasons must be sought since these were harvested efficiently. The drill strip order of yield was CRD 152.01, Zephyr, CRD 48.01 and Research. The first three barleys were separated from the Research at the 1% level of significance. Zephyr was separated from Research and CRD 48.01 from CRD 152.01 at the 5% level of significance. Zephyr was included in the highest yielding group in the drill strip plots but occurred in the lowest yielding group in the 3-row plots. Since population density was the chief difference between the two types of plots it may be argued that Zephyr, since its ranking changed, is a type which yields well under dense population conditions. The opposite may be argued for CRD 48.01. Possibly Zephyr would have performed better relatively if the pronounced border

effect of drill strips was reduced by smaller inter-drill strip spacings.

None of the potential interactions was significant at the 5% level. However, an examination of the cultivar differences, (Table II), between 3-row plots and drill strip plots on one hand and the small header and the large header on the other, suggest that drill strip v 3-row x variety and commercial v small header x varieties interactions may occur at lower levels of significance.

TABLE II: Various Interplot Cultivar Differences

	Research	Zephyr	CRD 48.01	CRD 152.01	Approx. LSD 5%
Difference Drill Strip v 3-row	1.99	4.07	1.70	2.70	2.59
Difference Commercial v Small Header	1.26	2.63	4.29	3.37	-

Table II shows the higher yield of Zephyr in drill strips compared with 3-row plots tended to be greater than that of CRD 48.01. This difference approaches the 5% level significance using the LSD test. The cultivar differences in the commercial v small header comparison are of the same magnitude and it is difficult to offer any explanation for this other than a header x cultivar interaction.

Mr I. Lancaster (pers. comm.) used the results of this trial to test the system used to select cultivars for inclusion in regional evaluation trials. Zephyr and Research were eliminated and CRD 152.01 and CRD 48.01 were promoted to a CRD drill trial for increase on the basis of yields obtained from 3-row plots harvested by the small header. The drill trial - because Zephyr and Research were previously eliminated - would have promoted CRD 152.01 and CRD 48.01 to regional evaluation trials. This would not cause concern if the cultivars were unknown but Zephyr which was eliminated on the basis of yields from 3-row

plots is the highest yielding variety in current use.

Selection CRD 152.01 was the top yielder in the experiment and would have been promoted to regional testing but in fact it has been discarded from the crop evaluation trials because its yields have been about 25% below that of Zephyr. It is considered CRD 152.01 showed a combined adaptive response to the 3-row plots x local conditions and that this tendency was exaggerated by the small 3-row plot system. That CRD 152.01 was significantly superior at the 1% level to Zephyr in the 3-row plots and in the same group in the drill strip tends to support this point. The difference between the two would have probably been less had the drill strips been closer together.

CONCLUSION

The use of small 3-row plots and the small tractor mounted header harvester for evaluation of barleys tended to favour easier thrashing cultivars more suited to small clumped population conditions and therefore lower yielding under commercial conditions.

Higher yielding cultivars such as Zephyr may not perform well in small 3-row plots and may well miss selection for commercial use. The small 3-row plot exaggerates the difference between a locally adapted cultivar and a more desirable widely adapted cultivar. The small 3-row plot and the small header are thus not suitable for the yield evaluation of barleys having a commercial potential, though they are well suited for the increase of small stocks of seed, the evaluation of disease resistance, grain quality and some other agronomic factors.

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