PERFORMANCE OF THE WHEAT CULTIVAR KOPARA IN SOUTH ISLAND FIELD TRIALS

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SUMMARY

Kopara, the bulk line of 1020,01, gave higher grain yields than Aotea when autumn sown in Marlborough, Canterbury and South Canterbury and spring sown in Canterbury. Where spring sown in districts south of Canterbury the advantage of Kopara over Aotea was less and in Southland its performance appeared to be affected by its place in the rotation.

Kopara was more responsive to superphosphate than Aotea on Canterbury soils of low phosphate status.

Kopara was more susceptible to lodging caused by eyespot *Cercosporella herpotrichoides* and damage from grain aphid (*Macrosiphum miscanthi* Tak.) than Aotea but was more resistant to sprouting.

INTRODUCTION

A promising multiple cross Selection Number 1020,01 bred by Mr L.G.L. Copp at Crop Research Division, D.S.I.R., Lincoln was included in Field Research Section field trials in 1966 after initial testing had been carried out by the Crop Research Division, D.S.I.R. Recently it was released to farmers by the Crop Research Division as the bulk selection of the cross 1020,01 with the name Kopara.

In the last four years 159 experiments comparing Kopara with the standard wheat Aotea, were sown by the Field Research Section in South Island districts from Marlborough to Southland. Of these 150 trials were harvested, and 132 statistically analysed. Eighteen trials were excluded because of either severe bird or insect damage, or unsuitable designs for over-all analysis, or grain yields below 2,000 kg/ha. Results from six trials conducted in the Hawkes Bay were also excluded from this overall analysis. In these North Island trials Kopara outyielded Aotea by six percent.

Quality aspects of Kopara wheat are not discussed in this paper.

METHODS

The field experiments were normally sown in farmers' wheat paddocks using ramdomized block lay-outs with individual plots being one drill run of either 7 or 9 coulters by 40-60 metres. In the more recent trials factorial designs were used to add fertiliser, plant growth regulator and fungicide treatments to the basic comparison of the wheat selections.

Once sown the experimental crops were normally treated as part of the farmers' wheat crop with weed and insect pest control being carried out as necessary. All trials were header harvested except ten which were sampled by hand using the methods described by Lynch (1960). Grain samples were taken for moisture and baking tests.

The experiments were divided by the arbitrary date 1 August into two groups, those sown in the later autumn-winter period (autumn sown) and those sown in the spring. Autumn sown trials were mainly drilled in the latter half of May and early June and the spring crops in the period from mid August to early October.

Grain yields obtained from the trial crops were analysed on a district basis, firstly examining the simple cultivar comparison and then taking subsets of these trials to study the effects of superphosphate and nitrogen fertiliser on the cultivar grain yields. In South Otago and Southland the effects of chlormequat and nitrogen fertiliser were examined. The data were tested by logarithmic transformation to determine whether the yield difference between the cultivars was proportional to individual trial yields. No such relationship was found.

RESULTS AND DISCUSSION

Grain Yield

The mean grain yields of Kopara and Aotea for provincial districts are given in Table 1.

Kopara significantly outyielded Aotea in Marlborough, Canterbury and South Canterbury but not in the more southern districts. Only in Canterbury was spring sown Kopara superior to Aotea and here the yield difference was less than half that of the autumn sown crop.

TABLE 1 : Mean Grain Yield of Aotea and Kopara kg/ha, 15% Moisture)

District	No. of Trials	Aotea	Kopara	Diff.	C.V.%
Autumn Sown:					
Marlborough	15	4480bB	5290aA	810	8.3
Canterbury	26	4460bB	5160aA	700	7.1
South Canterbury	25	5380bB	5840aA	460	8.1
North Otago	12	3860a	4010a	150	6.9
Spring Sown:					
Canterbury	9	3740bB	4070aA	330	4.9
South Canterbury	7	4440a	4600a	160	2.8
South Otago	13	5470a	5820a	350	10.5
Southland	17	5520a	5710a	190	8.3
South Otago-Southland	8	5390a	5090a	-300	7.0

In Southland the performance of Kopara was affected by its position in the cropping rotation.

TABLE 2 : Mean Grain Yields (kg/ha, 15% moisture) of Aotea and Kopara as Affected by Position in Crop Rotation in Southland.

Rotation Position	Number of Trials	Aotea	Kopara	Diff.
1st Wheat Crop	9	6240	6870	+630
2nd Wheat Crop	4	4740	4670	- 70
3rd or more Wheat	8	5370	4870	-500

As a first wheat crop Kopara considerably out-yielded Aotea but as successive wheat crops were grown, Kopara became inferior to Aotea. The suscept-ibility of Kopara to eyespot disease which is discussed in a separate section, is the probably reason for this effect. The cultivar x year inter-action was not significant, indicating that the two cultivars behaved similarly in the different years.

Recently the use of benomyl has been shown to prevent almost completely, lodging due to eyespot (Witchalls and Close 1971).

Aphid susceptibility

The grain aphid (Macrosiphum miscanthi Tak.) infected four trial crops and in all cases Kopara was observed to be more susceptible to infestation than Aotea. This is in agreement with the experience of Sanderson and Mulholland (1969) and Burnett (1970) who indicated that from aphid counts Kopara was the most susceptible of seven cultivars tested. Arawa was the least affected with Aotea being half way between these two in degree of susceptibility.

Kopara, like Aotea, appeared to be affected by barley yellow dwarf virus transmitted mainly by the cereal aphid (Rhopalosiphum padi L.)

Sprouting

In six trials where sprouting occurred Aotea was more severely sprouted than Kopara. The results of two trials where the cultivars were scored for sprouting are given in Table 4.

TABLE 4: Sprouting Score for Aotea, Kopara and Hilgendorf 61 at Two Sites Near Balclutha, South Otago. (0, no sprout - 5, severe sprout).

Cultivar	Site 1	Site 2
Hilgendorf 61	0	0
Kopara	1	0-1 (trace)
Aotea	4	3

DISCUSSION

As a bulk line Kopara includes a range of plant material varying in straw height and maturity. Further improvement in agronomic performance can be expected by reselection. In the breeding of Aotea Copp (1959) gained a further five percent in grain yield by reselecting from its bulk line. Reselections from the 1020,01 bulk have already given higher yields than the bulk, and some improvements in milling and baking quality (L.G.L. Copp pers.comm.)

It is noteworthy that Kopara responded more to superphosphate than Aotea on Canterbury soils of low phosphate status. It is of considerable interest that response to applied phosphate status was related to the soil test figures of the trial sites. The association between the response of Kopara to applied phosphate relative to that of Aotea, and the calcium soil test on the recent soils of Canterbury and South Canterbury is new to the authors, and inexplicable.

Fertilisers and Grain Yield

Ninety-one trials were conducted in which superphosphate treatments were superimposed on the cultivar comparison. In twelve trials significant cultivar x fertiliser interactions occurred, in eleven of which Kopara gave an average of 590 kg/ha more grain than Aotea when superphosphate was applied. It was apparent that Kopara was more responsive to superphosphate in some situations (Douglas, 1970). However, this could not be demonstrated by analysis of results on a district basis even though most of the significant fertiliser interactions occurred in Canterbury and South Canterbury.

Regression analyses of grain yields in these districts were conducted looking at the cultivar x phosphate interaction as the dependent variable Y = (Kopara + superphosphate - Kopara) - (Aotea + superphosphate - Aotea) and the soil quick test, pH, calcium, potassium and phosphate figures of each site as the independent variables (x). Significant (P 0.05) negative regressions were established for the response to superphosphate of the two cultivars only in relation to the Truog* phosphate level on Canterbury soils, excluding the recent soils (Cutler, 1968) and with the calcium** level on the recent soils of Canterbury and South Canterbury. The regression equations for the graphs given in Fig. 1 are:

(a) Relationship to Troug phosphate level on Canterbury soils (excluding recent soils)

$$Y = 35\ (\pm\ 15)\ X + 500\ (\pm\ 130).$$

(b) Relationship to calcium level on Canterbury recent soils

$$Y = 61\ (\pm\ 17)\ X + 470\ (\pm\ 119).$$

(c) Relationship to Calcium level on South Canterbury recent soils.

$$Y = 61 (\pm\ 17)\ X + 470\ (\pm\ 119).$$

Kopara was more responsive to phosphate application than Aotea at calcium figures of below 7 on the recent soils and below 12 for Truog phosphate levels on the Yellow Grey earth soils of Canterbury.

In the 55 trials in which nitrogen fertiliser was applied only three cultivar x fertiliser interactions occurred, in each case Kopara gave a greater response to nitrogen application than Aotea.

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* parts per 50 million of extract. Extractant - Truog Reagent.

** parts per 40,000 of extract. Extractant - Neutral normal ammonium acetate.

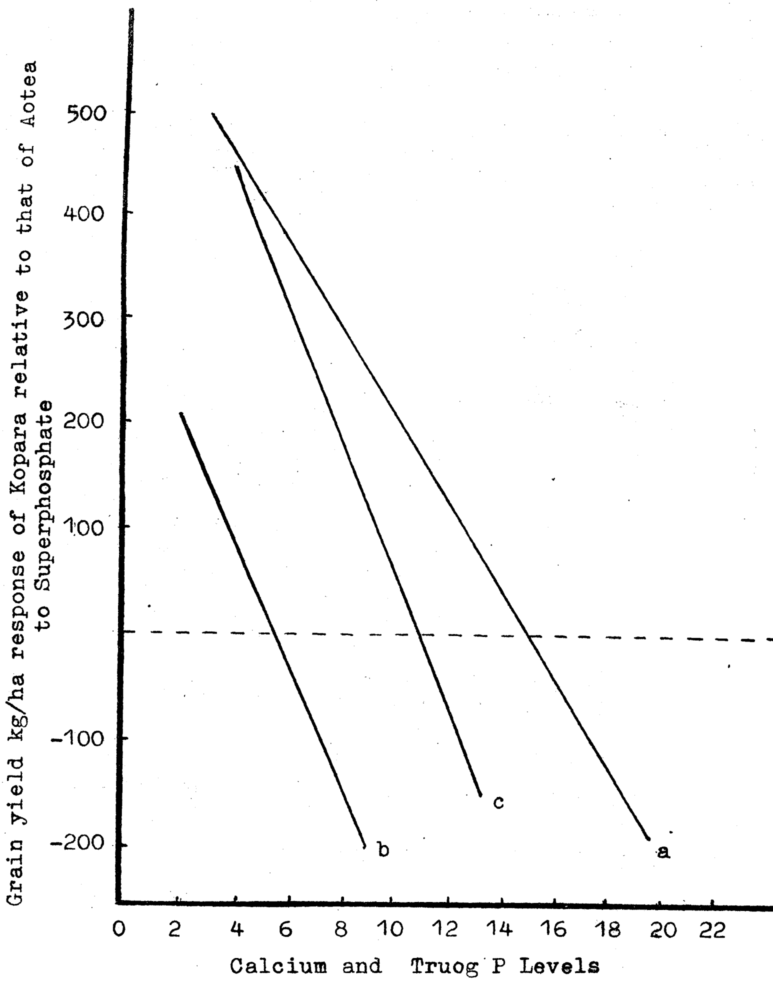

Fig. 1. Relationship of cultivar x superphosphate interaction to Calcium and Truog P soil levels

a. Troug phosphate level on Canterbury soils

b. Calcium level on Canterbury recent soils

c. Calcium level on South Canterbury recent soils.

Diseases:

Rusts (Puccinia spp)

No marked differences were observed in the field trials between the susceptibility of Kopara and Aotea to leaf rust. (P. rubigo-vera tritica Eriks.) and stem rust (P. graminis Pers.). Both were susceptibile but resistant to stem rust.

Mildew (Erysiphe graminis D.C.)

Research by Smith and Smith (1970) rated Aotea as very susceptible and Kopara resistant to mildew. This result was borne out at Invermay Agricultural Research Centre where mean mildew infection ratings on an 0-5 scale of increasing infection levels for seven field experiments was 3.4 and 2.3 respectively for Aotea and Kopara. However, in other experiments Aotea and Kopara were considered to have a similar incidence of mildew.

In the case of Footrot (Fusarium spp) and Take-all (Ophiobolus graminis) (Sacc.) infection. Kopara, like Aotea, appeared susceptible. In the case of Eyespot (Cercosporella herpotrichoides Fron.) infection which occured only in Southland, Kopara lodged more readily than Aotea after infection (Witchalls 1970, Witchalls and Hawke 1970). Fertiliser has been shown to modify this effect (Douglas 1970).

The use of the straw strengthening chemical chlormequat (CCC) to lessen lodging gave no overall beneficial effect in eight trials in South Otago and Southland. However, on two sites where an intentional build-up of eyespot disease was affected chlormequat markedly reduced the lodging of Kopara and gave improved grain yields. However, this still did not make Kopara superior to Aotea (Table 3).

TABLE 3 : Mean Grain Yields kg/ha of Aotea and Kopara Treated With and Without Chlormequat (CCC) on Two Eyespot Infected Sites.

	SITE A		SITE B	
	Grain Yield (kg/ha)	% Lodge	Grain Yield	% Lodge
Aotea	6280aA	5aA	5910aA	3aA
Aotea + CCC	6500aA	0aA	6240aA	0aA
Kopara	5490bB	25bB	4670bB	56bB
Kopara + CCC	6270aA	10aA	5960aA	1aA
C.V. %	4.3	42.0	7.2	

Kopara has not proved to be a replacement for Aotea throughout its range but only in specific areas. Kopara's place is for autumn sowing in Marlborough, Canterbury and South Canterbury. It can perhaps be looked upon as the first of a number of regionally adapted cultivars, as some unreleased Crop Research Division selections are proving superior to it and Aotea in certain districts. For instance, the selection 1169,01 is superior in South Canterbury and North Otago and the selection 790,01 superior in South Otago and Southland (L.G.L. Copp pers. comm.).

When spring sown, Kopara only outyielded Aotea in Canterbury. However, both were surpassed by the Australian wheat cultivars Gamenya and Raven.

Spring sowing of wheat should take a new lease of life with the use of the Australian cultivars and the projected use of the high yielding Mexican cultivars. In this situation the autumn sown wheats, such as Kopara, may cease to have an advantage in grain yield over spring sown crops and consequently become less important in farm management.

ACKNOWLEDGEMENTS

The authors are grateful for the assistance and co-operation from New Zealand Department of Agriculture and Crop Research Division, D.S.I.R. staff and the generosity of co-operating farmers who made experimental sites available.

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