SPRING-SOWN FIELD EXPERIMENTS WITH WHEAT SELECTIONS IN CANTERBURY

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SUMMARY

Results from field experiments conducted in four seasons, 1966-67 to 1969-70; to test the adaptability of several wheat selections to spring sowing in Canterbury and to compare grain yields of spring-sown wheat and spring-sown barley are given. Carlsberg barley gave significantly higher grain yields than the wheats. Australian wheat selections were better adapted to spring-sowing and gave significantly higher grain yields than local wheats.

INTRODUCTION

Wheat is the major arable cash crop grown in Canterbury. In recent years an area of some 160,000 hectares has been cultivated annually for arable crops in Canterbury and the portion occupied by wheat has, from year to year, varied from 30% to 50%. (Anon, 1966, 1967, 1968, 1969).

Although most of the Canterbury wheat crop is drilled in the late autumn and early winter, in recent years some six to seven percent has been spring-sown (L.G. Hopp, pers.comm.) Spring-sown wheat in Canterbury tends to be confined to districts where soil and/or climatic conditions ensure satisfactory soil moisture levels are maintained well into the early summer. A major factor limiting further extension of this practice, which allows greater flexibility in cropping programmes, into other Canterbury districts, where important but more drought-prone wheat soils occur, has been the lack of suitable wheat cultivars. There has been a need for cultivars that produce when spring-sown, grain yields and cash returns as high as those obtained from either wheat drilled in late autumn and early winter or barley sown in the spring.

In the four seasons, 1966-67, 1967-68, 1968-69, 1969-70, the Field Research Section of the Research Division, Department of Agriculture, carried out eighteen field experiments to test adaptability and to measure grain yields of local and Australian wheat cultivars when spring-sown in Canterbury, and to establish relative grain yields to be obtained from spring-sown wheat and spring-sown barley.

MATERIALS AND METHODS

In eighteen field experiments which were conducted on commercial farms in North, Mid and South Canterbury, the local commercial wheat Aotea was drilled as the standard wheat with variable numbers of local and Australian wheat cultivars: viz. 946.01, Kopara, Gamenya, Raven, Gamut, Arawa, Hilgendorf 61, Triple Dirk and Falcon. The barley cultivar, Carlsberg, was included in thirteen experiments.

The cultivars were sown in early spring, usually mid September, with phosphatic fertiliser in plots each 1.25m x 50m and randomised in blocks replicated four times. At intervals throughout the spring and summer, the experimental crops were visually assessed for disease infections, pest infestations and the onset and completion of grain maturation. After ripening, crops on individual plots were harvested with a combine-harvester. Standard techniques previously described by Lynch (1960) were used.

Milling and baking quality evaluations of grain were carried out by staff of the Wheat Research Institute, D.S.I.R., Christchurch.

Statistical analyses of grain yields obtained from selections in individual experiments and grain yields of a few selections obtained from several experiments conducted in more than one season, were carried out by staff of the Biometrics Section, Research Division, Department of Agriculture.

RESULTS

Diseases and Pests:

The incidence and severity of disease and pest damage varied from year to year and in any year varied from crop to crop. Powdery mildew *Erysiphe graminis* DC., and leaf rust, *Puccinia rubigo-vera tritici* Eriks, were widely experienced in the years 1966-67, 1967-68 and 1968-69 but little was recorded in the 1969-70 season.

Wherever powdery mildew established on the standard wheat, Aotea; Hilgendorf 61, Kopara, Falcon, Triple Dirk and the barley, Carlsberg, also became infected. Raven, Gamut and 946.01 never became as heavily infected as did Aotea. Arawa and Gamenya generally remained free from powdery mildew infection.

The occurrence and severity of leaf rust infections tended to parallel those of powdery mildew. Wherever leaf rust established on Aotea; Arawa, Hilgendorf 61, 946.01, Kopara, Gamut, Triple Dirk and Falcon became equally infected. Gamenya and Raven remained virtually free from leaf rust infection. The barley, Carlsberg, tended to become less severely infected with leaf rust than Aotea.

Stem rust Puccinia graminis Pers., established in one experimental crop. Although Arawa and Hilgendorf 61 became heavily infected, Aotea and Gamenya were less severely infected and other wheats and the barley remained free from infection.

Damage caused by Argentine stem weevil, Hyperodes bonariensis Kush., occurred sporadically and although this occurred more frequently in Gamenya, it never reached economically significant levels.

Barley yellow dwarf virus damage occurred in one crop and all wheats in that experiment except Gamenya, exhibited symptoms of gross infection.

The grain aphid, Macrosiphum miscanthi Tak., caused damage to Aotea and Kopara in one crop while Gamenya, Raven and Triple Dirk were not damaged.

Maturation:

The relative onset and completion of grain ripening of individual wheats and the barley varied from year to year and in each season from crop to crop. In general, the barley Carlsberg, matured earlier than most wheats but where less favourable growing conditions were experienced some wheats, notably Gamenya and Raven matured earlier than Carlsberg. Gamenya, Raven, Gamut and Triple Dirk were the earliest maturing of the wheats. Hilgendorf 61 and 946.01 matured later than the earliest wheats but earlier than the latest wheats Aotea, Arawa and Kopara.

Grain Yields:

A summary of grain yields kg/ha is given in Table 1.

Highest yields of grain were obtained from the barley, Carlsberg. Gamenya and Raven tended to be the highest yielding and Hilgendorf 61, the lowest yielding wheats.

Grain yields of the standard wheat, Aotea, ranged from 2,500 kg/ha to 5,800 kg/ha. On all sites except one where some barley grain was lost as a result of storm damage, Aotea was significantly ($P>0.01$) outyielded by the barley, Carlsberg. On 70% of common experimental sites, Aotea was significantly ($P>0.01$) outyielded by Gamenya. The wheats 946.01, Kopara, Raven, Triple Dirk and Falcon significantly ($P>0.01$) outyielded Aotea on at least 50% of common experimental sites. Aotea was significantly ($P>0.01$) higher yielding than Arawa and Gamut on as many common experimental sites as it was significantly ($P>0.01$) lower yielding. Aotea significantly ($P>0.01$) outyielded Hilgendorf 61 on more than 50% of common sites.

Milling and Baking Qualities:

Results of milling and baking quality evaluations carried out by staff of the Wheat Research Institute, D.S.I.R., are summarised in Table 5. The data which indicate the milling and baking qualities of wheat selections relative to that of the standard wheat Aotea, have been presented in descriptive terms because it is considered that qualitative data would imply a markedly higher degree of precision in these assessments than was possible to obtain from the limited numbers of grain samples available for milling and baking tests.

TABLE 5: Milling and Baking Qualities of Wheats' Grain Relative to that of Aotea

CULTIVAR	MILLING QUALITY	BAKING QUALITY
946.01	Equal	Slightly superior
Kopara	Slightly Inferior	Equal
Gamenya	Inferior	Equal
Raven	Equal	Equal
Gamut	Slightly Inferior	Slightly superior
Arawa	Greatly Inferior	Inferior
Hilgendorf 61	Equal	Superior
Triple Dirk	Equal	Equal

DISCUSSION

Low yields of grain are common when currently available local commercial wheats are spring sown in Canterbury. There is a need for a wheat cultivar which has capacity for high grain yields when spring sown. Wheat cultivars likely to be better adapted to spring sowing in Canterbury and therefore having potential for high grain yields, are those which do not need to experience a period of vernalisation, those in which grain development is normally well advanced prior to the onset of early summer drought and those which have strong resistance or high tolerance to diseases.

The Australian wheat cultivars, Gamenya and Raven, being spring wheats, earlier maturing and more resistant to powdery mildew and leaf rust, have proved to be better adapted to spring sowing and higher yielding than local wheats. Generally, the barley cultivar, Carlsberg, outyielded these wheats. However, in view of the current price differential which favours wheat, (malting barley 4.4c/kg, wheat 5.5c/kg) the malting barley crop must yield twenty-five per cent more grain than wheat before the cash return from barley expressed in terms of gross margin (Jeffery, 1963) exceeds that obtained from wheat. In the experiments described, the mean grain yield of the barley, Carlsberg, obtained from 14 common experimental sites, exceeded that of the wheat, Gamenya, by 12½%

More recently preliminary work with wheats derived from Mexican short strawed material has indicated that wheat grain yields higher than those obtained from either Gamenya or Raven are likely in the future.

It is anticipated that the availability of disease-resistant, early maturing and high yielding wheat cultivars such as Gamenya and Raven, will result in an extension of the practice of spring-sowing wheat into Canterbury districts where this practice has been technically and economically impracticable.

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