

## Paper 12 RECOMMENDED LISTS

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### INTRODUCTION

"There is scarcely a market town but has a favourite species, which having been successfully cultivated by some farmer in the neighbourhood, is by him designated with a pompous title and becomes the fashionable grain; whilst, in most instances the variation is so trifling as not to entitle it to any superior regard" (Barrister, c.1800) (from Elliott, 1962).

The number of barley cultivars in certification in New Zealand has increased dramatically in recent years. In 1973 there were five cultivars, and ten years later there are 25. The identification of superior cultivars has increased in importance, and is of great value to the nation, the growers, the merchants and the end users. It is probable that if every farmer knew and grew the best cultivars for his property barley yield would be increased by 3 or 4%. This would mean an increase of at least 10,000t, worth \$1.6 m in 1983, at no extra cost.

To determine the most suitable cultivar comparative field trials must be grown. These trials must be reliable and the information collected must be interpreted correctly.

### NEED FOR COMPARATIVE TRIALS

Many new cereals continue to become available to farmers. These result when plant breeders put together new combinations of genes. Two things are certain: firstly, no two cultivars are likely to be identical in their performance and their quality over a range of environments, and secondly, apart from the possible discovery of gross defects, the respective merits of cultivars cannot be adequately tested by individual growers.

All properties, and indeed most paddocks, are unique with respect to their combination of inherent characteristics such as soil type and climate, and induced characteristics such as fertility and management. It is for this reason that grower competitions are a very poor guide to relative cultivar performance, though the yield achieved by the

winning cultivar is well publicised. The cultivar used is only one of many variables contributing to the differences between entrants. A high yield may be achieved by good management in spite of the cultivar used.

A growers' competition where all the plots are in the same paddock is a little better for separating cultivars. However, many factors such as sowing date; plant density; fertiliser, herbicide and fungicide use; plot location; and fertility differences will normally over-ride or at least mask cultivar differences.

Growing a new cultivar in one paddock and comparing its performance with another grown in the adjacent paddock is also fraught with problems. The differences between cultivars can easily be masked by relatively larger differences attributable simply to the paddocks, and who could resist putting the new cultivar in the stronger paddock? Differences observed one year might well disappear or be reversed in another. Often a cultivar, released in an atypical and unsuitable season, will be discarded wrongly if this type of evaluation is relied upon.

This really means there are two choices: either farmers grow all the available cultivars and freely share their results, to try and decide the best from their collective experience, or researchers conduct comparative trials on properties strategically placed in the main districts. The first of these choices is unreliable, and not possible if cultivars change quickly. As long as plant breeders continue to achieve successes like those seen recently, the life span of most cultivars will be quite short.

Hence the use of properly designed and carefully managed comparative yield trials is essential. These must serve to identify and eliminate the inferior cultivars, and rank the remainder in order of merit. Cultivars with low yield or quality or with major agronomic defects are easily eliminated, often within one year, but to pick the good from the average is never so easy. To achieve this aim there are two basic requirements: the trials must produce reliable results, and the results must be correctly interpreted.

## RELIABILITY OF TRIALS

### Replication

Not all cultivars produce the same yield in any one place, nor does any specific cultivar do equally well in a number of places. This performance variability occurs within a paddock, within a region, between regions and between years. To achieve a reliable indication of the merits of a cultivar, and to measure just how reliable the conclusions are, we have to use replication. This means several plots of each cultivar in each trial, and trials in several places.

Within a trial site each cultivar is sown in a number of small plots. This minimises any chance effects, or the possibility of a cultivar being favoured or disadvantaged by its location on the ground. Normally one plot of each cultivar goes into each of a number of blocks of land called replicates. No significance is attached to the yield of individual plots but the mean yields are used. Statistically the effectiveness of reducing unexplainable variation by replicating cultivars can be measured. The variation in yield within a trial can be partitioned into that due to the cultivars, that due to the replications, and a remainder, the amount of variation left over. This can be expressed as the coefficient of variation (CV). For cereal trials a CV for yield of 5-10% is to be expected. If it is above 15% the results would likely be treated with caution and an explanation for the high variability would be sought. The average CV for 155 cereal trials in the national series (1980/81 - 1982/83) was 8.3%.

Trials are further replicated by sowing at a number of sites within a region. The location of these sites within regions is more important for the narrowly adapted cultivars than the widely adapted ones. A cultivar which has a good average performance in all regions is widely adapted and less likely to perform differently on different properties than one which is exceptionally high yielding only in one region.

### Standardisation

In order to compare the performance of cultivars as precisely as possible, at each site and over a number of sites, many of the conditions are standardised.

Because cereal seed lines differ in seed weight and germination percentage, sowing rates are standardised so that each cultivar is sown at the same density of viable seeds, to give a target population of 300 plants/m<sup>2</sup> (400/m<sup>2</sup> in South Otago and Southland).

Although over the past three seasons, because of variable and sometimes low establishment, these targets were not reached on average (Table 1), yield differences were not related to plant number in South Otago and Southland, and plant number explained only 3% of the yield variation in the remaining trials. Sowing rates were calculated assuming that 85% of viable seeds produced plants. This was an overestimate, and under the conditions of these particular trials the figures should have been 64% and 79% in South Otago-Southland and the remaining trials respectively.

TABLE 1: Plant population and yields in comparative cultivar trials.

	Southern N.I.	
	Canterbury	South Otago
	North Otago	Southland
Target population — plants/m <sup>2</sup>	300	400
Mean population — plants/m <sup>2</sup>	279	302
(range)	(180-365)	(151-471)
Yield — t/ha	5.5	5.9
(range)	(2.2-10.3)	(4.1-7.5)
Correlation coefficient —	0.18**	-0.30 N.S.
yield vs. plant number	375 d.f.	40 d.f.
Number of observations	377 <sup>1</sup>	42 <sup>2</sup>

<sup>1</sup> 26 trials (1980/81 - 1982/83)

<sup>2</sup> 3 trials (1981/82 - 1982/83)

All seed sown is treated with the same fungicide (currently Vitaflo) at the recommended rate.

All trials are sown as randomised complete block designs, although another design, described by Wilkinson *et al.* (1983), is being investigated.

### Trial location and number

The majority of trials in the series are grown under commercial conditions of soil fertility and disease load in farmers' paddocks (Table 2). Some believe this adds to the credibility of the results obtained, because these trials receive less care and attention than those on research stations.

TABLE 2: Number and location of the 23 Recommended List and Preliminary barley trials in 1983/84.

Region	Research Stations	Farms	Trials/10,000 ha <sup>1</sup>
Southern North Island	1	3	3.1
Marlborough	0	1	6.4
Canterbury	3	9	3.0
North Otago	0	1	4.5
South Otago	0	2	6.6
Southland	1	2	7.4
New Zealand	5	18	3.6

<sup>1</sup> No. of trials per 10,000 ha barley harvested in 1980 (Agricultural Statistics 1979-80).

The trials are of two types: Preliminary trials which test potential new cultivars against two standards, and Recommended List trials which include the important commercial cultivars (all those occupying at least 5% of the certified seed area) and the best cultivars from the Preliminary trials. Of those sown in 1983/84 10 were Preliminary trials (with 15 entries) and 13 Recommended List trials (with 18 entries).

Recommended List trial numbers are high enough to obtain a quick overall estimate of performance and regional performance over a number of years (Douglas *et al.*, 1977). There are relatively many more of these trials in New Zealand (Table 2) than in England and Wales, where the ratio is 0.16/10000 ha of crop (Anon., 1979; Mann, 1980) or Denmark where the ratio is 1.0/10000 ha (Coles, 1980). However, the range of growing conditions in New Zealand is greater, and the intensity of cropping relatively low

Douglas *et al.* (1977) suggest that the theoretical number of trials required to establish significant differences should be increased by 20% to cover trials written off. Over the seasons 1980/81 — 1982/83 seed was distributed for a total of 175 cereal trials and only 19 (11%) were not included in the final analysis.

## INTERPRETATION OF RESULTS

### Aggregation of trial data

Just as the results of one set of plots in a trial are not considered on their own, so the results of one trial in one year must be considered as only one of a number of possible results. Some cultivars respond particularly well to some types of season, but at the time of sowing, the nature of the coming season is unknown, so results from a number of seasons must be considered. The greater the number of sites and number of years, the more reliable the estimate of relative performance will be. Douglas *et al.* (1977) suggest that the traditional three year minimum is soundly based unless a cultivar is outstandingly good or bad.

Grain yield is the main character of economic significance to be recorded. It is a summation of the effect of all the events which have beset the crop. In the absence of fungicides yield is reduced by the effect of any fungus diseases to which a cultivar is susceptible.

In summarising yield data the cultivar yields are not expressed in tonnes per hectare, but as percentages of the overall trial mean or of the mean yield of control cultivars. The mean of a set of control cultivars should be reasonably stable from year to year, and it is preferable that these cultivars be widely adapted, and known and grown by farmers.

The yield data from trials conducted from 1975/76 to 1982/83 on which the 1983 Recommended Lists (see Appendix) are based are presented in Table 3. The control cultivars are Hassan and Mata. In a small number of trials one or other of these cultivars was not included and a different control was used. Results have been adjusted to compensate for this.

The greater the number of trials which contribute to the cultivar mean yield the more reliable the figure. What do these results mean for two cultivars which have been in the same number of trials in the same years, for example Claret and Koru in Canterbury-North Otago? These results don't show that in all years and locations in this region Koru will outyield Claret by 6%. They indicate that providing the testing sites were and remain representative of the region, on average over a number of seasons and on a range of farms, Koru should yield 6% better than Claret.

**TABLE 3: Base yield data for 1983 Recommended Lists in Southern North Island; Canterbury-North Otago; South Otago-Southland**

Cultivar	No. years in trials	Relative Yield <sup>1</sup> (No. trials)		
		S.N.I.	C.N.O.	S.O.S.
Ark Royal	4	92.6 (14)	107.3 (29)	105.6 (10)
Claret	4	102.1 (14)	100.4 (32)	101.3 (9)
Georgie	4	100.6 (23)	103.6 (40)	107.8 (12)
Goldmarker	4	101.1 (16)	107.2 (25)	104.3 (8)
Goldspear	5 <sup>2</sup>	101.6 (14)	102.6 (34)	106.2 (10)
Gwylan	3	95.5 (10)	107.1 (20)	96.3 (5)
Hassan	8	100.6 (39)	99.9 (65)	101.2 (24)
Kaniere	6	101.0 (20)	101.6 (27)	105.4 (15)
Koru	4	103.3 (14)	106.4 (32)	101.3 (10)
Kym	4	106.1 (14)	104.1 (32)	99.6 (8)
Liberty	3	110.1 (9)	99.7 (25)	106.3 (7)
Magnum	4	99.3 (18)	107.4 (29)	100.7 (10)
Makareta	4	104.6 (16)	100.6 (25)	101.7 (7)
Mata	8	99.3 (35)	100.3 (77)	98.9 (21)
Opiki	4	103.6 (14)	100.5 (30)	100.8 (8)
Triumph	3	98.0 (13)	101.0 (36)	100.0 (9)
Zephyr	6	96.3 (27)	98.0 (43)	99.0 (16)
297-72B	4 <sup>3</sup>	87.8 (11)	97.1 (27)	109.5 (7)

<sup>1</sup> Relative to mean yield of Mata and Hassan = 100

<sup>2</sup> 4 years S.N.I.

<sup>3</sup> 3 years S.O.S.

Significant differences from mean of standards in bold type (P = 0.05)

### Quality

Scores for 1000 grain weight and absence of screenings are presented in the 1983 Lists. Cultivars which are currently accepted for commercial scale malting by various maltsters in New Zealand are indicated.

### Yield-quality trade-off

In a breeding programme progress towards a high yielding or high quality cultivar is faster than if intensive screening is carried out for both characters concurrently. Although high yield and high quality are by no means mutually exclusive a negative relationship exists which should be taken into account in the interpretation of results. For the farmer the yield-quality trade-off is often only crudely catered for by premiums and discounts.

Wheat and barley Recommended Lists will take this yield-quality conflict into account by, for example, recommending feed barleys with outstanding yield, and malting quality barleys with only moderate yielding ability.

### Agronomic traits

It is expected that cultivars with major defects will be eliminated early in the trial process. They may be withdrawn by the breeder or the breeder's agent, or rejected by the trialling committee.

The remaining cultivars are scored for disease resistance and agronomic traits. If a cultivar on the Recommended List has a low score for a particular character this does not mean it is a major defect, as it must have achieved a satisfactory yield despite the defect. It does mean that this character deficiency should be considered together with attributes when selecting a cultivar.

## RECOMMENDED LISTS IN NEW ZEALAND

Experience overseas suggests that to be successful and useful to all parties, including farmers, seed merchants and end users, recommended lists must be objective, restrictive and quantitative. To meet these requirements the system used by the National Institute of Agricultural Botany (N.I.A.B.) has been used as a model in New Zealand. The N.I.A.B. lists apply to the whole of the United Kingdom except Western Scotland, but in New Zealand a further refinement of regional recommendations has been routinely included.

### Objectivity

Objectivity is achieved by using comparative trials, as previously described, and by having the lists produced by a balanced committee of breeders, farmers and MAF representatives.

### Restrictiveness

Many overseas organisations publish descriptive lists of the cultivars which are available, and while being accurate and unbiased they make no attempt at recommending some cultivars ahead of others.

The number of barley cultivars in certification in 1981/82 was 25; of these 2 (Illia and Priver) are sold for winter sowing, and 5 (Julia, Kakapo, Manapou, Pirouette and Universe) had each decreased to less than 5% of the certification area. The remaining 18 were included in trials together in 1982/83. Based on performance in 1982/83 and in trials back to 1975/76 the restricted lists were drawn up.

The categories for listing are Full, Special, Provisional and Becoming Outclassed. The guidelines used by the Recommended List Committee to produce the 1983 Barley lists included:

- 4 or more years in trial for Full recommendation (3 or more for Provisional). In addition cultivars had to have been in trials in N.Z. for two years at more than one site before being considered for entry to the Preliminary trials series.
- 10 or more trials in a region for Full recommendation.
- Yielding ability relative to the standard cultivars.
- A proven special commercial end use for special listing.
- Freedom from any known major defects.
- Seed of at least breeders grade being sown in the season under consideration.

### Quantification

Cultivars are described in quantitative terms for all characteristics including yield, agronomic traits and disease resistance. Only malting quality is currently not expressed numerically although a means of doing this is being investigated by the committee.

### Regional lists

Separate recommendations are made for three major cropping regions: Southern North Island, Canterbury-North Otago, and South Otago-Southland.

The need for at least three regions is exemplified by Makareta, Gwylan, and 297-72B, each of which has

performed very well in only one region. Furthermore only one cultivar, Goldspear, has a full recommendation for all regions.

### Future

In future when sufficient data have been collected a separate recommendation for Marlborough may be made. Similarly, in time it may be possible and desirable to make sub-regional recommendations. For example the Canterbury-North Otago region could have separate recommendations for areas of high and low yield potential if cultivar performance indicates this need.

More disease and agronomic data will be published in future as the information becomes more accurate and discriminating. Special fungicide x cultivar interaction trials would be desirable and should be conducted as resources allow.

### Caution

It must be realised that recommended lists are only a guide to regional performance as they deal in averages. They do not relate to a particular farm with its individual conditions including soils, fertility, irrigation, windiness and management.

Reports of cultivar performance overseas must be interpreted with caution. Cultivars recommended elsewhere may be entirely unsatisfactory in New Zealand. This is especially true of some barley cultivars from Europe which may suffer severely from neck break under our windy conditions.

## ACKNOWLEDGEMENTS

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## APPENDIX

### Recommended Lists (1983) for Spring Sown Barley

#### Southern North Island

	Full				Provisional Special			Becoming Outclassed					
	Kym	Makareta	Koru	Claret	Goldspear	Liberty	Goldmarker	Triumph	Kaniere	Hassan	Georgie	Mata	Magnum
Yield as percentage of control	106	105	103	102	102	110	101	98	101	101	101	99	99
Shortness of straw	6	5	4	7	6	5	6	5	6	7	7	4	5
Earliness of heading	7	6	7	6	5	5	4	5	6	8	7	6	4
Resistance to <i>Rhynchosporium</i>	(3)	(5)	(8)	(5)	(5)	(5)	(6)	(6)	(6)	(4)	(3)	(7)	(7)
1 000 grain weight	6	6	7	5	5	5	5	6	6	6	6	5	5
Absence of screenings	8	8	7	7	6	6	5	7	8	8	7	7	7

#### Canterbury-North Otago

	Full								Provisional Special	Becoming Outclassed		
	Magnum	Ark Royal	Goldmarker	Gwylan	Koru	Kym	Georgie	Goldspear	Kaniere	Triumph	Mata	Hassan
Yield as percentage of control	107	107	107	107	106	104	104	103	102	101	100	100
Shortness of straw	5	3	6	8	4	6	7	6	6	5	4	7
Earliness of heading	4	4	4	4	7	7	7	5	6	5	6	8
Resistance to <i>Rhynchosporium</i>	(7)	(7)	(6)	(7)	(8)	(3)	(3)	(5)	(6)	(6)	(7)	(4)
1 000 grain weight	5	5	5	6	7	6	6	5	6	6	5	6
Absence of screenings	7	5	5	5	7	8	7	6	8	7	7	8

South Otago-Southland

	Full					Provisional Special			Becoming Outclassed			
	Georgie	Goldspear	Ark Royal	Kaniere	Goldmarker	Makareta	297-72B	Liberty	Triumph	Hassan	Magnum	Mata
Yield as percentage of control	108	106	106	105	104	102	109	106	100	101	101	99
Shortness of straw	7	6	3	6	6	5	6	5	5	7	5	4
Earliness of heading	7	5	4	6	4	6	4	5	5	8	4	6
Resistance to <i>Rhynchosporium</i>	(3)	(5)	(7)	(6)	(6)	(5)	(4)	(5)	(6)	(4)	(7)	(7)
1 000 grain weight	6	5	5	6	5	6	6	5	6	6	5	5
Absence of screenings	7	6	5	8	5	8	7	6	7	8	7	7

Notes to the tables

Full-Recommended for growing in the whole of the region. Cultivars have been in comparative trials for at least four seasons.

Special-Recommended for growing in the whole of the region as the grain has a special use.

Provisional-Cultivars with Provisional recommendation have shown agronomic merit in comparative trials over at least 3 years, but further trials will be necessary before they received Full, or Special recommendations. As an indication of availability, provisionally listed cultivars must have breeders grade seed being sown in the season under consideration.

Becoming outclassed-Cultivars previously with Full, Special or Provisional recommendations which are

becoming outclassed.

Minor cultivars-Older cultivars which have less than a 5% share of the certification area are dropped from trials and are not considered for recommendation.

Malting cultivars: Ark Royal, Mata and Triumph are accepted for malting in New Zealand.

Grain yield at 14.5% moisture is expressed as a percentage of the mean of the control cultivars (Mata and Hassan).

Agronomic traits are scored on a 1 to 9 scale. A high figure indicates that the cultivar shows the desirable character to a high degree.

Parentheses: Numbers in brackets indicate that the score is based on limited observations.