NEAREST NEIGHBOUR ANALYSIS OF TWO BARLEY TRIALS

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ABSTRACT

The nearest neighbour design and analysis of Wilkinson *et al.* (1983a) is expected to give a lower residual variance than the randomised block-design. At two sites with very low coefficients of variation, little improvement in precision was achieved with the new analysis.

Additional Key Words: Recommended list trials.

INTRODUCTION

An aim of cultivar trials is to measure relative performance as efficiently as possible by reducing experimental error to a minimum. All the trials in the Recommended List series for example, are conducted using randomised complete block designs with 12 to 20 cultivars and 4 replicates of 20 m² plots. The method has been satisfactory for controlling random variation and reducing experimental error, the average coefficient of variation (C.V.) for 155 cereal trials (1980/81-1982/83) being 8.3% (Wynn-Williams, 1983).

However, other designs may be more efficient, especially when the number of entries is above 20. As the blocks increase in size, there is a greater chance of soil or other variation within blocks significantly influencing yield. Furthermore, trials are often conducted in farmers' paddocks where fertility gradients are not as well known, to the experimenters at least, as on research stations. The lay-out of blocks may prove largely ineffective; in fact blocking along a trend may even increase the error variance.

Lattice designs are used extensively for cultivar testing, especially cereals. Lattice square designs are best restricted to early generation testing because of inflexibility in entry number. The well developed cultivar testing system in the U.K. uses generalised lattice designs. Patterson and Silvey (1980) have shown an average increase in efficiency of 40% compared with randomised blocks in trials with more than 20 entries.

Neighbour adjustment has been well debated but is not commonly used. Kempton and Howes (1981) suggest that neighbour methods may be useful when variability within blocks result largely from the influence of one plot on its neighbour rather than from underlying factors. This is especially relevant in cultivar testing when a disease-susceptible cultivar subjects an otherwise resistant neighbour to high inoculumn pressure. In the Papadakis near neighbour method (Papadakis, 1937), the cultivar effect is removed and then a covariance analysis using nearest neighbours is carried out.

As an alternative, Wilkinson *et al.* (1983a,b) have proposed and tested a method that 'detrends' the data. A simple form of detrending is:

$$Y_{Ni}(b) = Y_{i-1}b(Y_{i-1} + Y_{i+1})/2$$

Where Y_{i-1}, Y_i, Y_{i+1} are yields of neighbouring plots $i-1$, i, $i+1$ and $b=1$.

It then forms unbiased estimates of the variety effects. Detrended residuals may be calculated from these. An equivalent d.f. is calculated and standard errors for treatment comparisons worked out. The details of the calculation are complex and a computer program from Dr G.N. Wilkinson was used to carry out the calculation and to generate the designs. The design can be "exactly balanced NN" in which each treatment has every other treatment as a first (1st level) or second (2nd level) neighbour on each side in 1 of 2 dimensions, partially balanced in 1 dimension (1D), or combinations in between. They have suggested that partial NN balance (2nd level) "in which the randomisation has been restricted to ensure that every treatment has all its first and second nearest neighbours with treatments different from that treatment and from each other" is reasonably satisfactory.

The objective of this paper is to report on some preliminary work using the NN design and analysis.

METHODS

Two Recommended List barley cultivar trials with 19 entries were arranged with some restriction on randomisation to give 1st level 1D partial NN balance. The balance was such that across the narrower plot dimension each cultivar had eight different immediate neighbours in the four replicates. The balance required that the number of plots be increased from 4 x 19 to 4 x 21 (or + 10.5%) to include an extra plot on each end of each replicate.

The trials were conducted on two farms in Canterbury (Table 1). Plots were 20 m² (15 x 1.35 m), sown with an Oyjord cone seeder at seeding rates adjusted for grain weight and germination of each cultivar for a target population of 300 plants/m². Plots were harvested with a Wintersteiger header and yields were adjusted to 14% moisture.

At Swannanoa, 12 plots were destroyed by a travelling irrigator and missing plot analysis was used.

TABLE 1: Trial site information

		Site	
		Mitcham	Swannanoa
Sowing date		12 September	31 October
Soil type		Hatfield silt loam	Wakanui s.l.
Cultivation		Conventional	Minimum
Previous crop	1982	Wheat	Wheat
	1981	Clover	Peas
	1980	Pasture	Barley
Fertilizer	1983	125 DAP	125 DAP
(kg/ha)	1982	250 S. ammonia	125 DAP
	1981	375 30% K Super	250 Legume Mix
	1980	175 30% K Super	170 16:10:10

RESULTS

The two barley trials were similar to each other in many respects, with high mean yields, low C.V.'s and a large range of cultivar mean yield, above and below the standards (Tables 2 and 3).

Cultivar names have not been used as rankings in individual trials can be very misleading (Wynn-Williams. 1983).

TABLE 2: Relative yields of 19 cultivars following analysis by randomised block (RB) and nearest neighbour (NN) designs: Mitcham.

Entry No.	Relative Yield* R.B.	Relative Yield* N.N.	Ranking Change
1	116.4	115.6	—
2	112.4	114.0	—
3	111.4	111.7	—
4	108.0	108.5	—
5	107.5	106.2	−4
6	106.3	108.0	+1
7	106.2	107.0	+1
8	105.8	106.8	+1
9	105.6	106.6	+1
10	101.1	102.3	—
11	101.0	99.2	−3
12	100.4	100.6	−1
13	100.0	100.7	+1
14	99.3	100.8	+3
15	96.1	96.3	—
16	93.0	92.0	−2
17	92.1	93.2	+1
18	91.2	92.1	+1
19	90.0	90.1	—
C.V. (%)	5.7	5.4	
Mean Yield of Standards (t/ha)	7.02	7.21	

*Relative to the mean yield of standards (5, 12 and 17) equalling 100.

TABLE 3: Relative yields of 19 cultivars following analysis as randomised block (RB) and nearest neighbour (NN) designs: Swannanoa.

Entry No.	Relative Yield* R.B.	Relative Yield* N.N.	Ranking Change
4	118.8	118.3	−3
1	118.5	123.8	+1
10	117.6	120.2	+1
7	113.8	119.4	+1
5	111.1	112.5	−2
14	110.7	111.3	−2
2	110.7	116.9	+2
11	110.0	114.2	+2
19	106.8	104.6	−1
13	105.6	107.6	+1
18	103.1	104.1	—
9	101.7	102.0	—
3	99.7	100.6	−2
6	99.4	101.8	—
15	99.4	102.0	+2
16	98.2	97.5	—
17	96.9	95.2	—
12	92.0	92.3	—
8	91.4	89.2	—
C.V. (%)	5.0	5.5	
Mean Yield of Standards (t/ha)	5.98	5.89	

*Relative to the mean yield of standards (5, 12 and 17) equalling 100.

NN adjustment changed relative yield by less than 2% in trial 1 and had no significant effect on ranking. In trial 2, relative yields were altered by up to 6% although the effect on ranking was still small. The adjustment reduced the C.V. slightly in trial 1, but the loss of 12 plots in trial 2 caused a considerable loss of efficiency of the method and the C.V. increased following NN adjustment.

CONCLUSIONS

Wilkinson *et al.* (1983b) showed that NN analysis reduced residual variance and as a consequence reduced the probability of one or more cultivars being favoured (or prejudiced) by location within replicates. This did not occur in these trials, probably because the sites were very uniform although previous barley trials on the Mitcham farm had C.V.'s of 9.7 and 7.5.

Patterson and Silvey (1980) showed for a series of barley trials "that the differences between trial means of newly recommended cultivars may be 27% too large ... there is therefore a tendency, if the bias in the new varieties is ignored, to change lists of recommended varieties too often." Wilkinson *et al.* (1983b) showed a reduced relative yield gain. This effect was absent in trial 1 and there was an apparent increase in trial 2.

However, although the analysis of these trials showed no benefit from the method, it should be tested further, especially in trials with a larger number of entries.

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