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PLOT SHAPE - NORTHERN

OPTIMUM PLOT SHAPE FOR VARIETY TRIALS

EFFECT OF COMPETITION BETWEEN VARIETIES

by

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SUMMARY

Four plot shapes were compared using four replications of 60 clones. The shapes were 4-row long (4L), 4-row short (4S), 2-row long (2L) and 1-row long (1L). The standard length of 9.2 m was used for long plots, short plots being 4.6 m. A special design was used to compare all plot shapes in sub-blocks of six clones, but it was analysed as randomised complete blocks. With guard rows and ends the trial occupied 3.7 ha. It was located on the farm of L. Johnson in the Mulgrave mill area.

Three crops, plant (P), first (1R) and second ratoon (2R) were included in the experiment. All crops were harvested green (without burning before harvest).

Lodging occurred in all crops. Harvest of the plant crop was interrupted by rain. Stalks of some clones were broken by the green-cane harvester. These factors, and the large size, were expected to make the trial variable. However, the site was excellent. Coefficients of variation (CV) for TCH of 4L plots were only 7% in the plant crop, 10% in first ratoon and 11% in second ratoon.

CV increased as plot size was reduced. It was lowest in 4L, intermediate in 4S and 2L (which are equal in size and about equal in CV), and highest in 1L. For NMG, CV of 1-row plots (23% for P, 31 for 1R and 35 for 2R) is too high to be acceptable for normal replicated yield trials.

Years and crops are completely confounded in this trial. There were large and highly significant differences between crops (years). Clones x crops interactions were fairly large and highly significant. There were six standard commercial varieties in the trial, and these multiple standards proved very effective in reducing year effects. The F value for crops fell from 347.6 for TSH to 1.3 for NMG. Q124 gave the best performance in the plant crop and was second in 1R. However, it failed badly in 2R where it fell to 34th position. Over all crops, Q113 was the top variety. It was ranked 2nd, 1st and 3rd in the 3 crops.

The 4S shape yielded significantly more than the other shapes. This was unexpected, and probably due to gains from competition with the end space of about 0.3 m used to separate plots. There was a small but significant clones x shapes interaction, for plot shapes and portions of plots equal to 1 long row. This indicates that competition caused changes in the relative performance of clones in 1L compared with larger plots.

Competition was least in the plant crop, fairly high in 1R and highest in 2R. Increased competition in ratoon crops has also been observed in earlier experiments. Normal competition analysis, [(A+D)-(B+C)] did not detect significant competition in the plant crop. It was highly significant in ratoon crops. Normal competition analysis for 3-row plots (eg A+C-2B) was simulated. It showed significantly higher error variation than the 4-row analysis. It gave some significant competition effects, but they were inconsistent. Four-row plots are clearly superior to 3-row for competition analysis. Significant competition was readily demonstrated in the plant crop by other methods, such as inflation of error variance in smaller plots, and correlations. Thus, even with a uniform trial using 4 replicates of 4-row plots, the normal competition analysis does not give a sensitive estimate of competition.

In the plant crop the ends (1 m each end, including space) of the middle rows of 4L plots were weighed separately. The plots varied in length, mainly because of incomplete germination. The weighed area sometimes had no cane on either end of the row. The inner portion of these middle rows was expected to provide an estimate of true yield free from lateral and end competition. By providing a more uniform plot length, it was also expected to provide a lower error variance. It was only partly successful. Total competition (border rows minus inner part of middle rows) was significant while lateral competition was not significant. However, removal of the ends caused a significant increase in the error variance of the inner rows. The increase was too large to be explained by the reduction in plot size. The end stool has an important effect on the stability of plot yield. The 1 m end portions showed highly significant differences between clones. However, they included different portions of the end stool, and this probably increased variability of the inner portion. It is desirable to weigh ends separately for competition studies. A 1 m measured length including space is not very successful. However, other methods may also give problems.

In carefully planted plots, there are large variations in the actual length of row occupied by cane. Potted plants of each clone, transplanted to the ends soon after germination is complete, may give a worthwhile improvement in plot technique. This would ensure that all plots had the same length of cane.

The error variance was higher in border rows than the middle rows in all crops of 4L and 4S plots. This increase in error variance was significant or highly significant in both plot shapes in both ratoon crops. Competition is expected to inflate both genetic and error variance. Inflation of genetic variance has often been demonstrated in experiments. However, this is the first experiment to demonstrate significant inflation of error variance by competition. The error variance due to lateral competition in 4L plots was about 50 per cent as large as the error variance due to other factors such as soil variation. It was about equal to the genetic variance due to competition. Thus, although error variance due to competition is difficult to detect, it is an important factor to be considered during selection. The present experiment may be the first one with sufficient precision and replication to detect it.

The model used to estimate competition effects was similar to that used in earlier experiments. However, an additional component for far lateral competition was added to it. This allows for competition which extends beyond the normal 1.5 m interspace. Thus it would affect the inner rows of 4-row plots. It would not affect the inner two rows of 6-row plots. Simultaneous equations for 4L or 4S plots gave fairly precise solutions. The genetic correlation between true yield and competition was estimated to be between 0.32 and 0.57, supporting the estimate of 0.47 obtained in an earlier experiment.

This is the first experiment in which the ratio of end to lateral competition per exposed plant could be treated as an unknown parameter in the equations. It was estimated to be 6.5 in 4L plots and 3.0 in 4S plots. The ratio of far lateral to lateral competition was estimated to be between 0.06 and 0.19.

The middle rows of 4L plots were not affected much by competition. However, competition did account for 21 % of the genetic variance in the 2R crop. For entire 4L plots, competition was not very important in plant cane. It increased in 1R, and in 2R became more important than true yield. With 4S plots, reduction in lateral competition by using four rows was mainly balanced by increased end competition due to the shorter rows. Entire 4S plots showed considerable competition in ratoon crops.

The experiment showed that replicated 4L plots give the optimum plot shape for replicated trials. There was no clear choice between weighing the whole 4L plot or only the inner rows. As expected, the CV was lower in the whole plot. The whole plot gave slightly higher estimated gains in true yield in the plant crop. However, the inner rows gave slightly higher gains in ratoon crops where there was more competition. The inner rows take less time to harvest. This is an advantage for farm trials. It is concluded that the previous recommendation should continue. Four-row long plots should be used for replicated trials, only the two middle rows being weighed.

Solution of simultaneous equations for 8 plot shapes (4L, 4S, 2L, 1L, and border or inner rows of 4L and 4S plots) gave less accurate solutions compared with equations within 4L or 4S plots. Estimates of the genetic correlation between true yield and competition tended to rise above 1.0 and had large standard errors. However, the equations gave a useful picture of competition effects over a wide range of plot shapes. By restricting the genetic correlation to a maximum of 0.6, reasonable estimates were obtained of gains from selection.

There was a marked increase in competition as number of rows per plot was reduced. Compared with 4L, competition variance approximately doubled in 4S and 2L plots, and increased several times in 1L. Competition variance was much higher in ratoon compared with plant cane. Restriction of the correlation to 0.6 instead of 1.0 did not have much effect on competition relative to true yield variance. The main effect of this restriction was to reduce covariance.

Estimated gains from selection for true yield were highest in the largest plots (4L) and lowest in the smallest plot (1L). By contrast, gains in (true yield + competition) were lowest in plots with least competition (inner rows). They were highest in the plot (1L) with most competition. Normal selection affects (true yield + competition). It is dominated by competition rather than true yield in small plots. It seriously overestimates the value of plots such as 1L.

For estimated gains in true yield, 1L plots did not perform as well as any of the larger plots. They gave lower gains than the inner rows of 4S plots, which are the same size. Border or inner rows of 4L plots, and whole 2L plots, are the same size. However, the inner rows gave the highest gains in true yield in ratoon crops. Competition reduces gains from selection for true yield. A genetic correlation of 0.6 was too low to balance the harmful effects of competition.

Realised gains from selection were similar in 4S and 2L plots. Single-row 1L plots were inferior to 4S or 2L plots, although the difference was not very big.

Efficiency of 4S, 2L and 1L plots was estimated by selection of the best 12 (or 6) clones in 4L plots. The success rate in all plot shapes was fairly high, and 1L performed about as well as 2L and 4S. For NMG, about 4 of the best 6 were selected in each shape. Only 0.6 clones are expected by chance. The success rate in this case is inflated by competition, which affects the 4L as well as the other shapes. The success rate is also expected to be lower in practice, because of genotype x environment interactions.

Selection efficiency was also estimated by using 4L plots in two replicates to evaluate selection efficiency in all plot shapes (including 4L) in the other two replicates. Efficiency was highest in 4L and lowest in 1L. The 4S and 2L plots were intermediate, and about equal. The poorest performance of all was given by 1L plots in the 2R crop where competition was most severe. For NMG, only 1 or 2 of the 6 best clones was selected by 1L plots. However, this plot gave better results with more liberal selection, 6 of the best 12 clones being selected.

Multiple regression analysis showed that 4S and 2L plots were about equally efficient for predicting the yield of inner rows of 4L plots. The 2L plots are less expensive to plant and harvest mechanically, so 2L plots are preferable to 4S plots. The 1L plots were slightly less efficient than the inner rows or border rows of 4S plots. On an equal area basis, these results indicate that selection for true yield would be more efficient in short 2-row plots than 1L plots.

Border rows of 4L plots were predicted more efficiently than inner rows. Competition inflated the genetic variance and this gave better prediction. Plots exposed to competition also became more efficient for prediction of border rows. Border rows of 4S plots became more efficient than inner rows. Single-row plots became more efficient than the inner rows of 4S plots. Because of competition, small plots always appear better than their true value for selection.

There were highly significant correlations between competition and weight of 4-row plots. For 4L plots the phenotypic correlations were 0.35 for the P crop, 0.58 for 1R and 0.64 for 2R. The correlation increases as competition increases.

There were highly significant genetic and phenotypic correlations between competition in 4L vs competition in 4S plots. These correlations have theoretical value because they show that competitive ability is a real genetic character of a variety. It is expressed in plots of different sizes and is maintained to a significant degree over different crops and years. They confirm a basic assumption made in earlier competition studies. It is safe to conclude that competitive ability is a normal genetic character with some stability despite genotype x environmental interactions.

CCS, fibre and appearance grade are not correlated with competition. However, TCH, TSH and NMG show highly significant correlations with it. Weight of cane is the character directly affected by competition.

In all crops, phenotypic correlations with 4L for NMG were appreciably lower in 1L compared with 2L and 4S plots. The differences are highly significant, and show that 1L plots are less efficient than 2L and 4S plots for selection. In all crops, the lower correlations for NMG were due to significantly lower correlations with 1L plots for all characters - appearance grade, CCS, TCH and TSH.

The experiment confirms the value of weighed 20-sett (1L) plots for stage 2 of selection. The 1985 experiment at Meringa showed that this plot is much better than the visually selected 30-sett plot which it replaced. In the present experiment, the 1L plot performed well, especially for selection of superior clones. It was not quite as effective as the middle two rows of a 4S plot, which has the same area. However, the 1L plot is less expensive for mechanical planting and harvesting. At stage 2, where many clones are screened, the lower cost more than balances the slightly lower efficiency of the 1-row plot. With the same resources, more clones can be processed in 1L than short 2-row plots. Gains from selection would be higher in 1L, despite slightly lower efficiency.

This trade-off of selection efficiency against cost per plot becomes much less efficient at later stages of selection. The use of replicated 1L or 2L plots involves the risk of a loss of genetic variance. Clones high in true yield but low in competitive ability, could be discarded. Selection in these plots would be based mainly on competitive ability rather than true yield. True yield is a very important character. It is theoretically unsound to base its selection mainly on a correlated character such as competitive ability. The correlation between true yield and competition is too low for this purpose.

Two row plots (2L) performed well. Considering cost of planting and harvest, they are superior to 4S plots. They would be useful if many clones were screened at an earlier stage in replicated trials.

Efficiency of plot shapes depends more on plot size than on competition. Narrow 1L and 2L plots were fairly efficient, despite severe competition. This indicates that the effect of competition on selection efficiency has been over-estimated in the past. However, the experiment also refuted the idea that competition might improve selection efficiency in small plots. Comparisons giving that indication were found to be biased by competition. When such bias was avoided, 1L and 2L plots were inferior to guarded plots of the same size. Although the experiment supplied new information, it supports earlier conclusions about optimum plot shapes for selection.

Four-row plots are appropriate for normal replicated trials. The previous recommendation of 4-row plots, with the middle two rows harvested, should be continued.

1. INTRODUCTION

Skinner (1961) used a mathematical model to partition genotypic variance into portions due to true yield and competition. He found that competition was more important than true yield in small single-row plots. It was important in 3-row plots, especially in ratoon cane. The genotypic correlation between true yield and competition was estimated to be about 0.39. This correlation was estimated to be 0.47 by Skinner and Hogarth (1978) and 0.46 by Wu (1984) using plant volume instead of yield.

Skinner (1961) concluded that, for replicated trials, it was better to 'live with' competition than avoid it. Plots three or four rows wide were adopted as standard practice for replicated trials, making it possible to include many more varieties. This change gave a real increase in production of commercial varieties. The model used by Skinner showed that competition would also inflate the error variance. This effect was not detected in the experiments, and Wu (1984) found it to be very small.

Skinner and Hogarth (1978) conducted competition analyses on 34 variety trials in different parts of the state. They found that it was inefficient to weigh only the middle row of 3-row plots. They concluded that a four-row plot, with only the middle two rows weighed, was the most efficient plot shape for normal weighed trials.

A similar conclusion was reached in an experiment comparing plot shapes harvested at Meringa as plant cane in 1985. Competition was higher than usual (research report, JCS to KCL 10th April, 1986). There was competition with weeds, as well as competition with other varieties. The experiment showed that weighed 20-sett plots, which replaced 30-sett plots at Meringa in 1985, were superior to visually selected 30-sett plots. However, they showed a large amount of competition, making them unsuitable for measurement of yield at later stages of selection. The results also indicated that competition made them less efficient than the weighed middle row of a 30-sett plot. The latter plot had a large error variance. This left doubts about the 20-sett plot, so more research was necessary. The young ratoon crop of the trial was damaged by competition from weeds, and later suffered cyclone damage. No more results were obtained, but information from it was used to design a second trial. This trial was too large for the land available on the Experiment Station. It was planted on the farm of L. Johnson, Highleigh, in the Mulgrave area.

2. MATERIAL AND METHODS

2.1 Trial design

The trial consisted of 60 clones (Table 1) planted in four randomised blocks (Table 2). Four plot shapes were used for each clone. The 60 clones included six standard varieties (Q113, Q114, Q117, Q120, Q122 and Q124). The other 54 clones were typical selections for the YOT stage, except that only clones producing enough planting material for the four plot shapes could be included. This meant that clones were obtained from two series of YOT trials.

The four plot shapes are named 4L, 2L, 1L and 4S. The number (1 - 4) refers to the number of rows per plot. L is the normal plot length of 9.2 m, and S refers to short rows half the normal length. These row lengths included a space of about 0.3 m to separate plots.

A special design was used to increase the accuracy of comparisons between plot shapes. Each replicate was divided into 10 sub-blocks. Within a particular sub-block, six clones occur in all four plot shapes. No clone in any plot competes with itself on the plot boundaries. On the interface between replicates, the same condition was imposed. The design is balanced in the sense that in each of the four replicates, a given clone occurs with a different sub-set of five clones. Except these restrictions, complete randomisation was used when allotting clones to key numbers, sub-blocks within blocks, and blocks to the field. This arrangement avoids location effects which are expected if plots of the same shape are kept together in part of each block. It also gives a more accurate comparison between shapes, compared with a factorial arrangement in which each clone x shape combination is allotted at random to the block.

The trial was harvested green, no crop being burnt before harvest.

The design was analysed as randomised complete blocks, the restriction imposed by the sub-blocks being ignored. It is not considered that this restriction would cause any important bias in the analysis of variance. The more accurate comparison of shapes should be shown by normal analysis of variance. It may be possible to improve accuracy further by special analysis, but this was not attempted.

In the plant crop, cane in the end portions of the middle rows of 4L plots was weighed separately. This cane was thrown back into the row and included in the weights used for analysis. The portion at each end of a row was a measured 1.0 m. It included about 0.15 m of end space, about 0.3 m being left between plot ends to separate varieties. The middle rows, with end weights subtracted, were expected to provide a direct estimate of true yield free from competition. This was intended for all crops, but could not be done in ratoon crops, due to lack of resources to process the lodged crops.

2.2 Estimation of competition

The experiment was designed to estimate the efficiency of different plot shapes, considering effects on error variance and competition. Effects on error variance (σ_E^2) were compared using the coefficient of variation (CV):

$CV = 100\ \sigma_E/GM$ where GM = General Mean

Total genetic variance (σ_G^2) was computed from analysis of variance:

$$\sigma_G^2 = (\sigma_T^2 - \sigma_E^2)/R$$

where R = number of replicates,

σ_E^2 = Error variance,

σ_T^2 = Treatments (varieties) variance, with expectation $\sigma_E^2 + R\sigma_G^2$

Following the method developed by Skinner (1961), the total genetic variance was subdivided into portions due to true yielding ability (σ_g^2), competitive ability (σ_c^2) and covariance between true yield and competition. These estimates were used to compute gains from selection.

The model (Table 3) is similar to that used by Skinner (1961) except that an additional component (f = far lateral competition) was introduced. This component represents lateral competition extending beyond the 1.5 m interspace. That is, this competition is assumed to affect the inner rows of 4-row plots. It would not be expected to affect the two inner rows of a 6-row plot. This component was added to the model after it was found that the genetic variance was higher in 2L than in the border rows of the 4L shape. If a and b are constants, the general form of the model is:

$$G = ag + bc \qquad \text{(i)}$$

where G, g and c are the genetic components corresponding to the variances σ_G^2 (total), σ_g^2 (true yield) and σ_c^2 (competition).

Expected variances are obtained by squaring the terms, that is:

$$\sigma_G^2 = a^2\sigma_g^2 + b^2\sigma_c^2 + 2ab\, r\sigma_g\sigma_c \qquad \text{(ii)}$$

where r is the genotypic correlation between true yielding ability and competitive ability.

Expected variances were used to compare eight different plot shapes. The shapes included 4L, 4S, 2L, and 1L plots. The other four shapes were border rows of 4L, inner rows of 4L, border rows of 4S, and inner rows of 4S. For 4-row plots, expected variances were also used to compare the whole plot, border rows, inner rows, and competition estimated as border rows - inner rows. In all cases the character measured was weight in kg.

For plot totals, all 8 shapes were adjusted so they had the same general mean as (GM of 4L)/4. The genetic and error variance for each shape was adjusted by multiplying it by $[(\text{GM of 4L})/4/(\text{GM of shape})]^2$. For example, variances of 4L were divided by 16. This adjustment had an effect similar to conversion of plot totals to a value such as tonnes per hectare. In addition, it removed differences between general means for plot shapes. The model (Table 3) on a 'per plant for each plot' basis is used for this comparison. In equation (i), a = 1, b = x + nw + mz, and:

$$\sigma_G^2 = \sigma_g^2 + b^2\sigma_c^2 + 2b\, r\sigma_g\sigma_c \qquad \text{(iii)}$$

where x, w, and z are variables showing the amounts of lateral (c), far lateral (f) and end (c') competition expected for each plot shape, and n and m are parameters which express far lateral and end competition as a decimal of lateral competition.

In previous studies, the equations were solved manually. It was necessary to assume a value for m (eg c' = 2c) to solve them. In the present experiment, computer software made it possible to solve the equations with m (as well as n and r) as unknown parameters. For each crop, the 8 plot shapes gave a group of 8 equations which were solved using nonlinear regression. An iterative process (Marquardt-Levenberg algorithm) available in SigmaPlot software was used.

For 4-row plots, totals (kg, not adjusted) were used. The model (Table 3) on a 'per plant for each row' basis is used, with equation (ii). For each plot shape (4L, 4S) in each crop, there were 4 simultaneous equations. They were solved using the methods described above for 8 plot shapes. Other equations involved 1 m end portions of inner rows, weighed separately in the plant crop. They were solved using equation (ii) with the model on a plot total basis.

2.3 Statistical analysis

Most statistical analysis was carried out using GENSTAT software. Many programs were written in Turbo Basic, and a few in Fortran. These programs performed analyses not available in commercial software. SigmaPlot software was used for figures, and to solve competition equations.

Standard analysis of variance was conducted. This included RCB analysis, and factorial analyses with clones and plot shapes as factors. Methods and models followed those described by Steel & Torrie (1980). Normal harvest characters (Appearance grade, TCH, TSH, NMG) were analysed. AOV was also conducted on weight (kg) of separate rows and various combinations of rows in different plot shapes. It was also conducted on lateral competition for weight (kg) in 4L and 4S plots. If the four successive rows of a plot are designated a b c d, competition estimates analysed were (a+d)-(b+c), a+d-2b, and a+d-2c. The last two estimates are similar to those obtained from competition analysis of a 3-row plot. They were performed to test the hypothesis that the error variance for this estimate may be inflated, because the weight of the middle row is doubled.

Combined analyses over P, 1R and 2R crops were conducted. Split-plot and split-block designs were used for the analyses, results being presented for fixed and random models. The mathematical models and expected values for the mean squares are shown in Table 4 for the split-plot design and in Table 5 for the split-block.

Correlation matrices were computed for all characters. Genotypic, phenotypic and environmental correlations were computed for the most important characters.

Multiple regression analysis was used to estimate the efficiency of plot shapes of the same size (4S, 2L or 1L, bc4S, ad4S). Efficiency was estimated by prediction of yield (kg) of the middle (Y = bc4L) or outer (Y = ad4L) rows of 4L plots. Prediction of the middle rows is more important because they are less affected by competition. A comparison of prediction of the border with the inner rows indicates the effect of competition on prediction. A similar analysis was conducted for harvest characters, using Y= 4L. T values (t = estimated regression coefficient / standard error of this estimate) were presented instead of regression coefficients. They provide a standard estimate which can be used to compare different plot shapes.

Efficiency of a multiple regression equation was expressed by the *percentage variance accounted for*, provided by GENSTAT regression analyses. This is the difference between residual and total mean squares in the regression AOV, expressed as a percentage of the total mean square. It is not quite the same as R^2, the squared coefficient of multiple correlation, which gives a similar ratio for sums of squares.

Realised gains from selection in 4S, 2L and 1L plots were evaluated by performance in 4L plots. Evaluation included TCH, TSH, NMG, and weight (kg) in the middle rows of the 4L plots.

Efficiency of 4S, 2L and 1L plots was estimated by success in selecting the best 12 (or 6) clones in 4L plots. The number of clones which must be selected in the smaller plots, to select all clones in the best group in 4L, was also computed.

The above estimates used all 4 replicates, with 4L plots for evaluation. This gave the most accurate available comparison. In practice, selection is often based on only two replications. Use of 4L plots for evaluation also prevented comparison of 4L with the smaller plots. Because of this, efficiency of selection in 2 replications of all 4 plot shapes was also tested. Efficiency was evaluated using 4L plots in the two replicates which were not selected.

3. RESULTS AND DISCUSSION

3.1 AOV of harvest data

The trial was lodged in all three crops. This added to the time required to harvest the large complicated trial. The harvest of the plant crop was interrupted by rain. The green cane harvester broke the stalks of some clones which were open, but not lodged. About half of each broken stalk was gathered into the next row, and thus weighed in the wrong row. This transfer of cane could be detected by examining the harvest data in the field. Although these factors were expected to result in excessive environmental variation, this did not occur. Analysis of variance (Table 6) shows that the trial is less variable than usual. CV for TCH of 4L plots was 7% in the P crop, 10% in 1R and 11% in 2R. Because of this, no attempt was made to adjust plot weights for broken stalks. This adjustment would have been difficult. Broken stalks were counted. However, rows which received broken cane from adjoining rows, were not recorded completely.

The CV increases as the plot size is reduced. The 4S and 2L plots are fairly similar, and more variable than the 4L plots. The 1L plots are very variable, CV for TCH being 15, 24 and 28% in the P, 1R and 2R crops. For CCS, CV also increases as the plot size is reduced. It is low (4%) in 4L, intermediate (5-8%) in 4S and 2L, and highest (6-9%) in 1L. Appearance grades are fairly variable, probably due to the lodged crops. This makes CV much higher for NMG than for TCH, and increasing as plot size is reduced. For NMG, the CV for 1-row plots (23% for P, 31 for 1R and 35 for 2R) is too high to be acceptable for a normal replicated yield trial.

It was necessary to reject clones which did not provide enough planting material for the four replicates of four plot shapes. This may reduce genetic variation in the trial to some extent. However, there was a large amount of genetic variation in the clones included in the trial. In 4L plots, F values for TCH are about 13.5 (Table 6). They range from 7.8 to 10.9 for NMG. F values for all characters in all plot shapes were highly significant. However, in small plots the F value does not give a reliable estimate of genetic variation for true yield, because it is inflated by competition.

Four replications were used in the trial, to provide accurate results for competition analysis. However, two replicates are often used in variety trials, so some analyses were repeated using two replications. The AOV (Table 7) shows a reduction in F values, but they are still fairly high and highly significant for all important characters.

A combined analysis over crops (Table 8) shows large and highly significant differences between crops (years). Years and crops are completely confounded in this trial. Clones x crops interactions are fairly large and highly significant, for the main harvest characters. There were six standard varieties in the trial, and these multiple standards proved very effective in reducing year effects. For the fixed model, the F value for crops (Year, 4L) fell from 347.6 for TSH to 1.3 for NMG.

A factorial analysis of plot shapes (Table 9) shows unexpected significant differences between shapes. The 4S shape yielded more than the other shapes. This difference cannot be explained by normal competition between clones, because each shape contained the same clones. It is probably due to competition with the end space (0.3 m) which separated the ends of plots. On average, the end stool is heavier than other stools in a plot. The 4S shape has a higher ratio of end / other stools compared with the other plot shapes. For competition equations, variances for the group of 8 plot shapes were adjusted on the basis of equal mean values.

There was no significant clones x shapes interaction for the 4 shapes ≡ 2 long rows (Table 9a). However, there was a highly significant interaction for 1-row plot shapes in both ratoon crops. The F value for the interaction is small compared with that for clones. However, results discussed below show that competition was higher in the ratoon crops. The results indicate that competition resulted in changes in the relative performance of clones, probably in 1L plots compared with larger plots.

3.1.1 Competition AOV

For the normal competition analysis (AD-BC, Table 10) of 4L plots, competition is not significant in the plant crop. It is highly significant in the ratoon crops. The second ratoon crop has the highest F value. In 4S plots, competition is not significant in the P crop. It is significant in the ratoon crops, with 1R and 2R variance ratios about equal. Results for the larger 4L plots are more reliable. It is concluded that competition was higher in the 2R than the 1R crop. The results confirm previous observations that competition tends to be higher in ratoon than in plant crops.

Competition estimated by simulated 3-row plots (AD-2B, AD-2C) gave more variable results. However, it was significant in several cases. In 4L plots AD-2B showed just significant competition in the P crop, non-significant in 1R and highly significant in 2R. AD-2C showed no competition in the P crop, but highly significant competition in both ratoon crops. In 4S plots, AD-2B showed significant competition in the P crop, but no significant competition in 1R or 2R. AD-2C showed no competition in plant cane, but highly significant in both ratoon crops. There is a serious lack of consistency in these significant differences. Competition becomes significant or not significant when a change is made from for row B to row C for the middle row. This shows that 3-row plots are inferior to 4-row plots for competition studies.

The estimates of lateral competition based on 3 rows all have higher error variances than the corresponding estimates based on 4 rows. The difference is highly significant in 6 of the 12 comparisons, and significant in two others (Table 10). The results clearly confirm the superiority of 4-row plots for competition analysis.

The normal competition analysis (AD-BC, 4L) shows no significant competition in the plant crop. However, F values for separate rows show that competition occurred in the plant crop as well as the ratoon crops. In all crops, the F values are higher for the border rows (A, D, AD) than for the middle rows (B, C, BC).

3.1.1.1 Effect of competition on error variance

Skinner (1961) pointed out that competition would inflate error variance as well as genetic variance. Inflation of genetic variance was easily demonstrated in experiments. However, the present experiment is the first to show significant inflation of error variances due to competition. In both ratoon crops the CVs are higher in the border rows (A,D, AD) than in the middle rows (B, C, BC, Table 10). This effect is examined in more detail in Table 11, using error variances.

The error variance is higher in the border rows (AD) than the middle rows (BC) in all crops in 4L and 4S plots. The effect is significant or highly significant in both ratoon crops. For 4S plots, the error variance was significantly higher in row A than row B in the plant crop. No lateral competition was detected in the plant crop by normal competition analysis (AD-BC, Table 10). However, competition estimated by AD-2B was significant.

The present experiment may be the first one conducted with sufficient precision to detect inflation of error variance due to lateral competition. The increased precision occurs because of the use of 4-row plots, four replicates, and choice of a uniform site. Error variance due to competition is more difficult to detect than genetic variance due to competition. By definition, error variance due to competition cannot increase with increased replication. Treatments variance increases as the genetic variance is multiplied by the number of replicates. Error variance due to competition occurs because the clones surrounding a particular clone are different in different replicates. Thus the competition effect on the clone will differ in different replicates. It is an error effect, but it is produced by genetic differences in competitive ability. This effect is expected to show a large sampling error in different replicates. Each increase in replication reduces the mean sampling error, and thus improves the estimate of error variance due to competition. Detection of error variance due to competition was probably due to the increased precision of the present experiment. It is also possible that the effect was present in earlier experiments but not detected. For this purpose, the earlier experiments were not designed as well as the present one. In recent years we have realised that the normal competition analysis (eg AD-BC) is not very sensitive, and often fails to detect competition. Inflation of genetic variances in border rows often provides a more sensitive estimate of competition. Because of this, the standard competition analysis was altered for recent projects. It now includes separate analysis of each row, and each combination of border and inner rows.

Although Wu (1984) found the effect of competition on error variance to be very small, the effect is large in the present experiment. It is likely that Wu's conclusion, like that from earlier experiments by BSES, was drawn because of insufficient precision in the experiments. In ratoon crops the error variance due to lateral competition (AD-BC, Table 11) is about 50% as large as the error variance due to other factors such as soil variation. The error variance of BC provides an estimate of the error variance due to soil variation and other factors. It will be a slight over-estimate because of some inflation due to end competition. The error variance due to lateral competition is about equal to the genetic variance due to competition (Table 11). Error variance due to competition is an important factor to be considered during selection.

3.1.1.2 Competition with space at ends of plots

Weight of the inner rows of 4L plots with end portions removed, was expected to provide a reliable estimate of true yield free from competition. This could only be done in the plant crop. It was not fully successful (Table 10, LongE). The error variance was increased significantly in each separate row. The increase is not significant for both rows combined, or for competition (footnote, Table 10). However, the method did have some success. Despite the 20% increase in error variance, competition was significant in the plant crop when end portions were removed from the inner rows. It was not significant when entire inner rows were used in the estimate. It was unfortunate that resources were not sufficient to weigh the ends separately in the ratoon crops. With much larger amounts of competition in ratoons, middle rows with ends removed would have provided valuable estimates of true yield. The estimate is inflated by far lateral competition, but such inflation would be small.

In some cases, the measured 1.0 m did not contain any cane, and gave a zero weight at both ends of a row. This was mainly due to incomplete germination, although in some cases it may have been due to variations in the length of row planted. Removal of the ends reduced the plot length from 9.2 to 7.2 m. However, it also gave a more uniform length of cane weighed in the row. This was expected to give a lower error variance, despite the reduced row length.

In fact, removal of the ends caused a significant increase in the error variance. The increase is not solely due to the reduction in plot length to 7.2 m. The CV is about the same as that for corresponding 4.6 m rows of 4S plots. The results show that end effects are important. The end stools play an important part in stabilising yield of the plot.

A 1 m length of row, not a 1 m length of cane, was removed from each end. With uneven plot lengths, this meant that different portions of the end stool were weighed in each end. If all of the end stool was removed, there would be a fairly severe reduction in weight of the inner portion. Sometimes, with a short plot, none of the end stool was removed. This probably resulted in serious inflation of the inner row weight, when the weight was readjusted to a length of 9.2 m. In other plots removal of varying portions of the end stool would increase variation of the inner row weight.

The end stool usually increases in size to utilise all light, nutrients and moisture available in the end space. This 'competition with the end space' extends over much longer distances than the 0.3 m space left at the end to separate varieties. It is known to extend further than the 1.5 m space left between rows. Before tractors were used, cane planted 'on the square' with plants about 1.5 m apart in the row, gave excellent crops. In the present experiment, the general mean for the ends of the two middle rows, adjusted to 9.2 m, is 291.6 kg. This is very similar to the mean for the two rows including ends (291.8). The mean for the two rows omitting ends but adjusted to 9.2 m was also 291.8 kg. Thus the ends had the same average yield as the rest of the row, even though they included space. The ends showed a highly significant difference between clones ($F = 1.8^{**}$), despite large variations in the ratio of cane to space in the end portion.

In competition experiments, it is desirable to weigh end portions separately. This allows direct estimates of true yield in the inner portion of the plot. The method used in the present experiment did not give very good results. It may be better to measure inward from the start of the end stool, and weigh a measured length of cane. For example 1 m on each end, including all of the end stool, could be weighed. With this method, it would be necessary to measure the length of cane left after removing the ends, and the length of space outside the ends. However, this method may also give unexpected problems in practice.

The results show that the end stool is important. They also show that, in carefully planted plots, there are large variations in the actual length of row occupied by cane. The use of potted plants of each clone, transplanted to the ends soon after germination is complete, may give a worthwhile improvement in plot technique. These plants could ensure that all plots had the same length of cane.

3.1.2 Genotypic and error variances

The increase in error variance with reduced plot size is discussed above. More details are given in Table 12 for harvest characters, and in Table 13 for weight (kg) of different plot shapes. The effect of competition on error variance can also be detected in these tables. For TCH the ratio of the error variances for 1L compared with 4L plots was 4.1 in the plant crop. It was higher in ratoon crops (5.9 in 1R and 6.3 in 2R) where competition was more severe. For CCS, error variance was lowest in 4L, highest in 1L plots and lower in 2L than 4S plots.

The genotypic variances were inflated by competition in smaller plots. The ratio of the GCVs for TCH of 1L / 4L plots (Table 12) was 1.3 in the P crop. It was 1.7 in 1R and 2R crops. The data in Table 13 were used in competition equations.

3.2 Estimation of variance components

3.2.1 4-row plots

The four simultaneous equations used for each 4-row shape gave fairly precise solutions for 4L (Table 14) and 4S plots (Table 16). This indicates that exact solutions could have been obtained manually, given sufficient skill. The standard deviations for the estimates are extremely small. The estimates of the genotypic correlation between true yield and competition (r) range from 0.32 to 0.75. However, the highest correlations in both 4L and 4S plots are in plant cane, which showed the least competition. The estimates for ratoon cane are expected to be more reliable. These estimates range from 0.32 to 0.57. They support the average estimate of 0.47 obtained by Skinner and Hogarth (1978).

The ratio of end to lateral competition per exposed plant (m) was treated as an unknown parameter in the equations. It is estimated to be higher (about 6.5) in 4L than in 4S plots (about 3.0). The ratio for 4L is a little higher than expected. However, all estimates are reasonable, considering results from earlier experiments.

Far lateral competition is expected to be much smaller than lateral competition. The ratio (n) was restricted to a maximum of 0.2 when solving the equations. The restriction did not operate for 4L plots. The estimated ratio for 4L plots ranges from 0.06 to 0.19, and these estimates are reasonable. The restriction prevented the estimate rising above 0.2 in 4S plots. Little notice can be taken of the estimates for these plots. The higher values probably indicate errors in the estimates of genetic variances in 4S plots.

Estimates of genetic variance for 4L (Table 15) and 4S plots (Table 17) show higher competition in border rows of a plot, and in ratoon cane. These estimates are affected by plot size. The estimates expressed as per cent of the total genetic variance (Table 18) make it easier to compare plots differing in size.

The two middle rows are not affected much by competition which usually contributes less than 10 % of the total genetic variance. However, they are affected to some extent.

Competition accounts for 21 % of the genetic variance in the inner rows of 4L plots in the 2R crop. Competition is not very important in 4-row plots in plant cane. It increases in 1R, and in 2R becomes more important than true yield in 4L plots.

Overall, the results in Table 18 favour weighing the middle rows of 4L plots for yield trials. True yield variance then provides a higher proportion of the total genetic variance. Error variance seems too high in these plots but this is an illusion. It occurs because it is expressed as per cent of the total genetic variance. The per cent error variance is high because the total genetic variance is lowest (least inflated by competition and covariance) in these plots. Rows bc and ad are the same size and can be compared directly in Table 15. This shows that the error variance is higher in the border rows, being inflated by competition.

Estimates of true yield (g) and competition (c) components are lower in 4S than 4L plots. This occurs because components on a plant per row basis are used independently for the two plot shapes. Both shapes have the same multiple for g (eg 4g for abcd). Thus the genetic variance (Y) is much higher in 4L because of the larger plots. The equations are designed to study competition within 4L or 4S plots, not to make comparisons between them. Some comparison can be made between them in Table 18. However, the main comparison is based on equations involving eight plot shapes.

In the plant crop, an estimate of true yield was obtained by the weight of the inner rows with end portions removed. This estimate was less useful than expected for competition equations because the method increased the error variance. The genetic variance was higher for true yield of the inner rows than for the whole rows (1316.2 trueBCLP vs 1192.9 bc4LP, Table 13a). This shows an error in the estimates. No reasonable solution could be expected from equations which included both types of inner rows. The estimate of genetic variance for true yield is probably poor, because of the higher error variance. Equations were solved for this estimate of true yield, the border rows, the estimate of competition using true yield, and weight of end portions of the middle rows (Table 19). An exact fit was obtained. However, the estimate of the genetic correlation between true yield and competition (0.17) is probably low. This gives a reduced estimate of covariance in the border rows and an inflated estimate of genetic variance.

3.2.2 Competition variance in eight plot shapes

Equations for eight plot shapes (Table 20) give less accurate solutions, compared with equations within 4L or 4S plots (Tables 14 and 16). The estimates of genetic correlations between true yield and competition are close to 1.0 but are not reliable, the standard deviation being larger than each coefficient. The estimates of genetic correlations are not expected to be reliable, because they are partly based on the same clones in different plots. Environmental differences in fertility may inflate the errors.

The false high estimates of the genetic correlation would create large amounts of covariance, giving a false impression of the value of plots exposed to much competition. Because of this, the equations were also solved by restricting the correlation to 0.6 (Table

20). This is higher than the accurate estimates obtained by solutions within 4-row plots. However, it is low enough to give reasonable estimates of the effect of competition on different plot shapes. The fit is not made much worse by this restriction.

Estimates of the ratio of far lateral competition are also unreliable. The estimates of the ratio of end to lateral competition range from 2.6 for 1R to 5.8 for 2R, but only the latter estimate is reliable. Estimates of the true yield component (g) are reasonable, and fairly reliable. Competition estimates are reasonable, but only that for the 2R crop is reliable. These comments may give the impression that little notice can be taken of the estimates, because of lack of precision. However, the general picture they present is much more valuable than the impression given by detailed comments. The equations within 4-row plots were designed to give precise estimates. The equations involving 8 plot shapes were designed to give a wider comparison of true yield and competition. For this purpose, they provide the best estimates obtained from any competition experiments.

The equations are on a plant per whole plot basis. However, the variances for all shapes were adjusted on the basis that all shapes had the same mean. This mean is the average value of one row of a 4L plot. They are thus on a 'plant per long row' basis as well as a plant per whole plot basis. Direct comparisons can be made between different shapes, and they can be compared with the 4L plots in Table 14. The estimates of g and c show reasonable agreement, despite the large standard deviations for c in P and 1R crops in Table 20.

Genetic variances estimated for 8 plot shapes, with the correlation restricted to 1.0 (Table 21) or 0.6 (Table 22), show a marked increase in competition in smaller plots. Competition variance is about twice as high in 4S or 2L plots compared with 4L. It is about 7 times as high in 1L compared with 4L. Competition variance is slightly higher in 2L than 4S plots but the difference is not very marked. Competition is not avoided by using short 4-row plots. The reduction in lateral competition as number of rows increases, is accompanied by an increase in end competition. With increased cost for mechanical planting and harvesting, 4S plots are not an attractive practical proposition.

There is a marked increase in competition variance in ratoon crops. Normal competition analysis did not detect significant lateral competition in plant cane. However, the results for different plot shapes give a clear demonstration of competition in plant cane, 1L plots showing most competition, and 4L least.

Although all plot shapes were adjusted to have the same mean value within each crop, no adjustment was made for differences between mean values in different crops. For TCH, the general means were 106.3 for the plant crop, 109.8 for 1R and 85.0 for 2R (Table 6). Thus the lower estimate of true yield variance for 2R (Table 21) is probably due to the lower yield of the crop. It does not indicate any real reduction in true yield variance in the 2R crop. The table provides valid comparisons within crops, and valid comparisons of relative amounts of competition to other variance between crops. However, the actual variance estimates between crops are not comparable. Some allowance can be made for the effect of different means for crops. The results then show that competition was lowest in the plant crop, intermediate in 1R and highest in 2R. This is shown by competition variance expressed as per cent of true yield variance (Table 23).

Restriction of the correlation to 0.6 instead of 1.0 does not have much effect on the ratio of competition to true yield variance. The main effect of this restriction is to reduce covariance.

3.2.2.1 Regression of genetic variance on competition components

The regression of the genetic variances of the 8 plot shapes on their competition components is shown in Figures 1, 2 and 3 for the P, 1R and 2R crops. In each figure the X axis shows the total competition component for each plot shape (Table 20), with genetic variance on the Y axis. The symbols show the actual genotypic variances listed in the Table 20. The plotted line is a second order polynomial curve. However, it is fitted, not to the actual genetic variance, but to the values estimated by solving the simultaneous equations in Table 20. Thus the figures show not only the regression of actual genetic variances on competition components, but the extent to which the competition model explained the genetic variation.

The actual genetic variances are very close to the values predicted from the competition model. The largest error occurs for 2L in the plant crop, with actual genetic variance about 13% higher than predicted. The accuracy of prediction increases as competition increases. It is lowest in the plant crop and highest in the 2R crop (Figure 3). The predicted values which provided the regression line, involve computation of variances and covariances. However, the figures also show a close curved regression of genetic variance on the components.

A second degree polynomial, $Y = a + bX + cX^2$, would give a good fit to the actual values, as it did to the fitted values. The equations for the 8 plot shapes are on a plant per plot basis. Thus the multiple for true yield (g) is 1.0 for all plot shapes. True yield variance is the same for all plot shapes, and corresponds to the intercept (a) in the second degree polynomial. X corresponds to covariance generated by the competition component, and X^2 corresponds to competition variance. Thus the second degree polynomial does not differ much from the general competition equation (iii). The second degree polynomial is often used for curvilinear regression when the theoretical equation is not known, because it is often found to fit the data. However, the close fit in the present experiment is probably promoted by correspondence between the theoretical competition equation and the polynomial.

The figures show the marked effect of competition on genetic variance. True yield variance is measured by the point at which the regression line crosses the Y axis, slightly less than 300 in the plant and 2R crops. In the plant crop, normal competition analysis did not detect significant lateral competition. However, competition accounts for about two-thirds of the genetic variance shown in Figure 1. In the second ratoon crop, true yield variance is less than 20% of the genetic variance shown by 1-row plots. The regression is partly due to covariance. However, the figures give a clear picture of the major effect of competition in small plots, especially in ratoon crops.

3.3 Gain from selection

3.3.1 Gains estimated from variances

Estimates of genetic variance (Tables 21, 22) were used to estimate gains from selection in the 8 plot shapes. Gains were estimated for true yield and true yield + competition (Tables 24, 25). Gains using correlations restricted to 1.0 (Table 24) seriously overestimate the value of small plots, because of the high covariance. Gains using correlations restricted to 0.6 also overestimate the value of small plots. However, they are much closer to the real situation.

As expected, gains for true yield are highest in the largest plots (4L) and lowest in the smallest plot (1L). By contrast, gains in (true yield + competition) are lowest in the plots with least competition (bc4L). They are highest in the plot showing most competition (1L). Gains in true yield + competition, which result from normal selection, are dominated by competition rather than true yield. The phenotypic values seriously overestimate the value of plots such as 2L and 1L which are subject to most competition.

Skinner (1983) drew attention to selection bias which causes trials to over-estimate the true commercial value of varieties. In addition to the factors he discussed, competition would cause selection bias. Plots with 3 or 4 rows, normally used for variety trials, are subject to competition. Varieties selected from these trials will owe their superior performance partly to gains from competitive ability. These gains are lost when the selected varieties become commercial and are planted in pure stands.

For gains in true yield, 1L plots do not perform as well as any of the larger plots (Table 25). 1L plots are the same size as the inner rows of 4S plots (bc4S), but they give lower gains in true yield. Border or inner rows of 4L plots, and whole 2L plots, are all the same size. However, the inner rows of 4L plots give the highest gains in true yield in ratoon crops. Border and inner rows of 4S plots are the same size. The inner rows, which show much less competition, give the higher gains in true yield, in ratoon crops. These results show that competition reduces gains from selection for true yield. A genetic correlation of 0.6 between true yield and competition is not high enough to balance the harmful effects of competition.
Half of the covariance between true yield and competition was included when computing the expected gains from selection for true yield. Thus any benefit from the genetic correlation between true yield and competition has already been included in the estimated gains. There is no basis for expecting any additional gain in true yield because of this correlation.

With a genetic correlation of 0.6, estimated gains from selection for true yield are slightly higher for 4L than for inner rows of these plots (bc4L, Table 25). However, a much more reliable comparison is given by estimated gains for portions of 4L plots (Table 26). These equations gave accurate estimates of the genetic correlation between true yield and competition (Table 14). Solutions were obtained without any artificial restraints. Actual estimates, instead of assumed values for the genetic correlation, were used.

The results (Table 26) show that replicated 4L plots give slightly higher gains in true yield in the plant crop, where there is not much competition. However, the inner rows of the 4L plots give slightly higher gains than the whole 4L plots in ratoon crops. The inner rows tend to be superior when there is much competition. They are cheaper to harvest. The experiment thus supports the conclusion by Skinner and Hogarth (1978) who recommended 4-row plots, with only the two inner rows weighed. A similar conclusion was reached in the experiment harvested as plant cane at Meringa in 1985.

Removal of the end portions gives slightly higher gains in true yield (Table 26a and 26c). This occurs despite an increase in error variance. However, the estimates with ends removed are not considered very reliable. The estimated gains would not justify the large amount of work involved in removal of end portions in practical trials.

3.3.2 Realised gain from selection

Realised gains from selection are similar in 4S and 2L plots (Tables 27, 28). Single-row (1L) plots are inferior to 4S or 2L plots, although the difference is small. Gains in these plots were assessed by performance in 4L plots. All 4 replicates were used for selection and evaluation. The 4L plots were exposed to competition. This is expected to give a bias in favour of 1L plots which show most competition. However, 1L plots performed about equally well when gains for TCH were evaluated using middle rows (bc4L) instead of the whole 4-row plot. The middle rows were much less subject to competition, so the results indicate that competition did not bias the results in favour of the 1L plots.

Competition did affect the estimated gains. For selection in each plot shape for TCH, gains estimated by TCH (4-row 4L plot) were higher than in bc4L. This would be partly due to the larger plot size for TCH. However, the superiority of TCH over bc4L estimates was highest in the 2R crop which had the most competition. The higher estimated gains for 4L compared with bc4L were partly due to inflation of this estimate by competition.

Realised gains from selection were estimated under very favourable conditions in this experiment. They were estimated within the one experiment, so there were no genotype x environment interactions. The results summarised in Table 28 involve comparisons within each crop. There were no genotype x year or genotype x crop interactions. Under these circumstances, the lack of marked differences between plot shapes probably means that the real differences between shapes were fairly small.

3.3.3 Clones selected

Examination of sorted means (Table 29) shows reasonable agreement between performance of the best varieties in 4L, 4S, 2L and 1L plots. For example, Q124 (key number 16) was outstanding in the plant crop, with top rank for NMG in all four plot shapes. Q113 (number 39) was in the top 6 in all four plot shapes, in all 3 crops. Despite large competition effects, 1L and 2L plots were of some value for selecting the best clones.

There was very little difference in efficiency of selection of the best clones in 4S, 2L, and 1L plots (Table 30). The success rate in all plot shapes was fairly high. For NMG, about 4 of the best 6 were selected in each shape. Only 0.6 clones (10% of 6) are expected by chance. About 9 of the best 12 were selected. Only 2.4 (20% of 12) are expected by chance. However, the success rate would be much lower in practice where genotype x location and genotype x year interactions occur.

3.3.3.1 Selection based on two replications

With selection based on two replications, selection efficiency was highest in 4L and lowest in 1L (Table 31). The 4S and 2L plots were intermediate, and about equal. The poorest performance of all was given by single-row plots in the 2R crop where competition was most severe. For NMG, only 1 of the 6 best clones was selected in 1L plots when replicates 1+2 were selected. Only 2 of the best 6 were selected when replicates 3+4 were selected. However, better results were given with more liberal selection, 6 of the best 12 clones being selected.

The effect of competition on selection efficiency was also studied by using the middle (bc4L) or border rows of 4L plots for evaluation. Selection was made in 12 plot shapes in the other two replicates. These shapes were equal to one or two long rows in area. With evaluation using middle rows (bc4L, Table 32), ad4L and bc4L plots gave the best selection and 1L was worst. When the border rows were used (ad4L, Table 33), best results were given by 2L followed by bc4L. There was little or no difference between the several plots equal in size to 1 long row. There was no clear association between selection efficiency in border and inner rows of 4L and 4S plots, and evaluation using border or inner rows of 4L plots. Plot size seems to have more influence than competition on efficiency of selection. However, differences between plots are not very big and there is a lot of variation in the estimates. The two-row plots (border or inner of 4L) in two replicates are probably not accurate enough to give reliable discrimination for selection efficiency in different plot shapes.

3.4 Multiple regression analysis

3.4.1 Prediction of yield of inner rows

Overall, 4S and 2L plots were about equally efficient for predicting the yield of inner rows of 4L plots (Table 34). T values for the partial coefficients show 4S less efficient in the plant crop (1.8 vs 3.8**), about equal in 1R (2.8** vs 3.3**) and more efficient in 2R (3.5** vs 1.4). The 2L plots are less expensive to plant and harvest mechanically, so these results support the use of 2L plots in preference to 4S plots.

1L plots were slightly less efficient than bc4S plots in all crops. 1L plots were equal to the border rows of 4S plots (ad4S) in the plant crop (3.5**, 3.5**). However, they were inferior in 1R (2.5*, 4.4**) and 2R (1.6, 4.6**). The border and inner rows of 4S plots were about equally efficient. On an equal area basis, these results indicate that selection for true yield would be more efficient in short 2-row plots than 1L plots. However, the improvement in selection efficiency may not justify the extra cost of planting and harvesting the short 2-row plots.

3.4.2 Prediction of yield of border rows

Border rows of 4L plots were predicted more efficiently than inner rows (Y = ad4L compared with Y = bc4L, Table 34). There was an increase of about 10% in 'percent variance accounted for'. The increase was highest in the crop (2R) with most competition, and highest in plots most exposed to competition. For example, in the 2R crop this increase was 13% (from 73 to 86) for the border rows of 4S plots. It was only 5% (from 68 to 73) for the inner rows of these plots. This shows that competition had a major influence on estimated selection efficiency. Competition inflated the genetic variance and this gave better prediction in plots exposed to competition.

Competition also changed the estimated value of different plot shapes for selection. For example, border and inner rows were about equal for prediction of inner rows in all crops. For prediction of border rows, they remained about equally efficient in the plant crop which did not show much competition (4.3**, 3.8**). However, in the ratoon crops the border rows were much more efficient than the inner rows for predicting yield of border rows. The t values were 2.9**, 7.3** in the 1R crop and 2.2*, 7.7** in the 2R crop. 1L plots also became superior to inner short rows in the ratoon crops. However, they remained inferior to outer short rows, although the latter had less advantage from competition.

Estimates of the efficiency of small plots are seriously biased by competition. One-row plots are much less efficient for selection than they seem to be. The results for prediction of inner rows indicate that they are less effective than short two-row plots of the same area.

3.4.3 Prediction of harvest characters

Multiple regression analysis was used to estimate the efficiency of 4S, 2L and 1L plots for predicting harvest characters of 4L plots. The 4S and 2L plots were equally efficient in ratoon crops (Table 35). In the plant crop, which was least variable and had least competition, 2L plots were superior to 4S. This superiority applied to all characters, including CCS. The superiority for CCS was unexpected because the samples were similar in size. Considering all crops, the results favour the use of 2L rather than 4S plots.

The smaller 1L plots were clearly inferior to 4S and 2L plots, for all characters in all crops. The 4L plots were exposed to competition, and this would have favoured the 1L plots which were exposed to most competition. However, this did not balance the reduction in efficiency caused by the small plot size.

3.5 Correlations

As expected, there are highly significant correlations between competition (ad_bc) and weight of 4-row plots (Table 36). For 4L plots this correlation is 0.35** for the P crop, 0.58** for 1R and 0.64** for 2R. The correlation increases as competition increases in successive crops. AOV did not detect significant competition in the P crop. However, the highly significant correlation of 0.35** is sufficient to show there was highly significant competition in 4L plots in the P crop. There is ample other evidence, including estimates from competition equations, to show that competition did occur in the plant crop. Even with a precise trial with adequate replication and 4-row plots, the normal method (ad_bc) is not very effective for detecting competition.

In ratoon crops there are highly significant correlations between competition in 4L plots vs competition in 4S. This occurs, even when different crops are involved (Table 36, near the end of Table 37a). The phenotypic correlations between variety means range from 0.36** to 0.43**. The genetic correlations (Table 37a) range from 0.79** to 0.92**. They are highly significant despite fairly high standard errors which range from 0.25 to 0.33. These correlations have theoretical value because they show that competitive ability is a real genetic character of a variety. It is expressed in plots of different sizes, and is maintained to a significant degree over different crops and years.

This may seem obvious, considering that large significant increases in genetic variance due to competition have been demonstrated in several experiments. However, these experiments have left open the possibility that the increases in genetic variance may have been due to genotype x environment interactions. It was assumed that a clone strong or weak in competitive ability would retain this characteristic under different environmental conditions. However, the experiments did not provide critical evidence. The above correlations provide this evidence. They confirm a basic assumption made in earlier competition studies. It is safe to conclude that competitive ability is a normal genetic character with some stability despite genotype x environment interactions.

The importance of genotype x environmental interactions for competitive ability compared with true yield is not known. An indication might be obtained by comparing the above correlations for competition with those for the inner rows of the plots (bc4L, bc4S, Table 38b, 38c). Although these rows are exposed to some competition, their performance is controlled mainly by true yield. The genetic correlations for the inner rows range from 0.73** to 0.98**, not very different from those for competition. However, these correlations for the inner rows are much more accurate, the standard errors ranging from 0.035 to 0.078. The phenotypic correlations for variety means are much lower for competition than the inner rows, the differences being highly significant. For the inner rows these correlations range from 0.66** to 0.85**. These correlations for competition and the inner rows were all estimated accurately, the maximum standard error being 0.028. The environmental correlations are slightly higher for the inner rows than for competition. They are still too low to explain the much higher phenotypic correlations for inner rows. For example, the environmental correlations in the 1R crop were very similar for competition (0.06) and inner rows (0.10), neither being significant. However, this correlation showed the largest difference for the phenotypic correlation (0.85** for inner rows vs 0.40** for competition).

The much higher phenotypic correlations for inner rows than for competition may occur because competition is measured by a difference. It thus has about twice the error variance of the inner rows (Table 13b, 13c). Because of this possibility, the comparison does not provide critical evidence about the size of interactions for competitive ability. Since the genetic correlations are fairly similar, genotype x environment interactions may not be very different for competition and true yield.

CCS, fibre, and appearance grade are not correlated with competition (Table 39). However, TCH, TSH and NMG show highly significant correlations with competition, as expected from the correlations discussed above for weight. TCH is the character directly affected by competition.

Competition shows moderately high phenotypic correlations with plots exposed to a lot of competition. For example, 2L plots in the 1R crop show highly significant correlations with competition (ad_bc) in 4L plots. These correlations were 0.40** in the plant crop, 0.58** in 1R and 0.62** in 2R (Table 36). The corresponding correlations for 2L plots in the 2R crops are 0.46**, 0.65** and 0.68** (Table 36).

Competition in 4-row plots (ad_bc) shows highly significant genetic correlations with smaller plots exposed to competition (Table 37). For example, competition in 4L plots in the 1R crop has a correlation of about 0.6** with plant crops of 2L and 1L plots. This correlation is about 0.9** with their 1R and 2R crops.

For harvest characters, genotypic correlations between 4L and all smaller plots are high, with low standard errors (Table 40). These genetic correlations are inflated by competition and increase in the ratoon crops. The genetic correlations with 4S and 2L plots in the ratoon crops are close to 1.0. They are highly significant, with very low standard errors. The genetic performance of the clones, for (true yield + competition) is very similar in 4L, 2L and 4S plots. The genetic correlation between 4L and 1L plots is lower, although still high and highly significant. For NMG, this correlation is 0.81** in the plant crop, 0.96** in 1R and 0.92** in 2R.

The genetic correlations are based on components which cannot be detected in individual clones. The phenotypic correlations give a better indication of efficiency of mass selection. They are lower than the genetic correlations. However, they are still fairly high, with very low standard errors.

In all crops, the correlations with 4L for NMG are appreciably lower in 1L compared with 2L and 4S plots. The differences are highly significant, and show that 1L plots are less efficient than 2L and 4S plots for selection. In all crops, the lower correlations for NMG are due to significantly lower correlations with 1L plots for all characters. The lower correlations for CCS are not surprising because the standard 2-stalk CCS sample was used for 1L plots. Previous research has shown that this sample gives poorer estimates compared with the larger samples used in the larger plots. However, previous research has also shown that the 2-stalk CCS sample is much superior to hand refractometer brix which it replaced at that stage of selection. The results show that it is more difficult to allot reliable appearance grades in 1L than in larger plots.

Phenotypic correlations with 4L are fairly similar for 4S and 2L plots for NMG. The only significant difference occurs in the plant crop, with 2L superior, but the difference is small.

The above correlations depend on (true yield + competition), so they provide no direct evidence about efficiency of selection for true yielding ability. Some evidence is provided by correlations with the middle rows of 4L plots (Table 38a). These rows showed very little competition in the P and 1R crops, although they showed a moderate amount in 2R. In all crops the 4S, 2L and 1L plots show lower correlations with the middle rows than with whole 4L plots. The correlations are significantly lower for the 1L than the 4S or 2L plots. However, compared with 4S and 2L plots, 1L plots keep about the same relative (lower) values when correlated with 4L or its middle rows. That is, poorer performance of the 1L plot is mainly due to its smaller size, rather than the large amount of competition it shows.

3.6 Optimum plot shapes for variety selection

The experiment confirms the value of weighed 20-sett (1L) plots for stage 2 of selection. The 1985 experiment at Meringa showed this plot clearly superior to the visually selected 30-sett plot it replaced. However, it also indicated that the 1L plot might be inferior to the weighed middle row of a 30-sett plot. In the present experiment, multiple regression analysis showed two rows of a 4S plot superior to a 1L plot. Other measures of efficiency did not contradict this conclusion. However, they indicated that the difference between the two shapes (two short rows or one long row) is small. The 1L plots are much more economical than short 2-row plots, because of mechanical planting and harvesting. Large populations are screened at stage 2, so it is efficient to accept a small reduction in selection efficiency to reduce costs. With the same allocation of resources, more clones could be weighed in 1L than short 2-row plots. The increased selection differential would more than balance the slight loss in efficiency for each clone in a 1L plot.

However, this trade-off of selection efficiency against cost per plot becomes much less efficient at later stages of selection. At later stages, each clone represents a large investment of resources. There is a serious loss if a superior clone is accidentally discarded. Such losses are likely to be higher than savings achieved by use of smaller plots. Furthermore, there is no reservoir of additional clones for testing in later stages. The breeder no longer has the option of testing 100 clones in 4-row plots or 200 clones in 2-row plots. The second 100 clones would be very inferior in average performance.

When considering effects of competition on selection, the genetic correlation between true yield and competition is critical, and it is very difficult to measure accurately. In the present project, reliable estimates were only provided by competition analysis within 4-

row plots (Tables 14 and 16). For ratoon crops where there was most competition, the estimates range from 0.32 to 0.57. They support the earlier estimate of 0.47 obtained by Skinner and Hogarth (1978). This correlation means that more than 50 % of the clones above average in true yield are also above average for competitive ability. However, it is low enough to mean that a reasonable proportion (eg one third) of the clones above average in true yield are below average in competitive ability.

The yield of small plots is determined mainly by competitive ability rather than true yield (Figures 1, 2 and 3). Without replication, at early stages of selection, error variance is high and selection is not very effective. With liberal selection, a reasonable number of clones with high true yield and low competitive ability may be selected. If the middle two rows of 4-row plots are used in replicated trials, such clones have a reasonable chance of becoming commercial varieties. If small plots are used for replicated trials, such clones are certain to be discarded. The combination of replication with small plots makes selection against weak competitive ability too effective. Such a selection system is expected to be inefficient because of the loss of genetic variance. A large amount of genetic variance is lost because clones high in true yielding ability but low in competitive ability are discarded.

The change from 30-sett to 20-sett plots at Meringa increased selection pressure against clones weak in competitive ability. However, this is partly balanced by the larger numbers which are tested. A move to small replicated plots at later stages would eliminate clones weak in competitive ability. This might be acceptable if seedling populations contained a surplus of strong competitors good enough to become commercial. In this case, savings achieved by reducing plot size in replicated trials might be sufficient to pay for the loss (about one-third ?) of the seedling area occupied by weak competitors. However, the available evidence is that genetic variance is a limiting factor, and seedling populations do not contain a large surplus of commercial varieties.

Unreplicated 1L plots are suitable for screening many clones at stage 2. However, they are not suitable for replicated trials. Aside from severe competition, they are too variable. For NMG, CV was 31% in 1R and 35% in 2R (Table 6). This is partly due to the use of 2-stalk CCS samples. However, CV for TCH was also high (24% in 1R and 28% in 2R). They will always seem better than they are, because genetic variances and F values are badly inflated by competition.

Two-row plots (2L) performed well in this experiment. Considering cost of planting and harvest, they would be more efficient than 4S. They could be useful if replication were introduced at an earlier selection stage. They are not efficient for normal replicated trials because they show large competition effects, and CVs are rather high.

Replicated 1L or 2L plots would base selection mainly on competitive ability rather than true yield. True yield is a very important character because it dominates TSH and NMG. It is theoretically unsound to base selection for such an important character mainly on a correlated character, especially when the correlation is known to be fairly low. The object should be to select directly for true yield. However, some competition must be accepted.

Reduction in competition involves an increase in plot size. If plots are made too large, gains from selection will decline despite reduced competition. The number of varieties in replicated trials would become too small, reducing the selection differential. In the present experiment, the optimum plot shape for replicated trials is the 4-row long plot. The results leave a choice between weighing whole 4L plots, or only the two inner rows of these plots.

As expected, 4L plots had the lowest CV. The middle rows of 4L plots are satisfactory for CV. They are lower than other plots of the same size, such as 4S (Table 10) or 2L (Table 41), in ratoon crops. In ratoon crops, the middle rows of 4-row plots gave slightly higher gains in true yield, compared with weighing whole 4-row plots. The middle rows take less time to weigh. This is an advantage, especially in farm trials. It is concluded that the previous recommendation should continue. Four-row long plots should be used for replicated trials, only the two middle rows being weighed.

4. ACKNOWLEDGEMENTS

This experiment fully extended the resources of the Plant Breeding staff at Meringa. The full participation of all technical staff is gratefully acknowledged. We are grateful to Mr. Les Johnson who allowed us to use his farm. His management of the large experiment was so good that it could easily be overlooked, because there were no problems. The site was ideal, with low variability. Credit for selection of the site belongs to Mr. Johnson who also chose the standard varieties used in it.

5. REFERENCES

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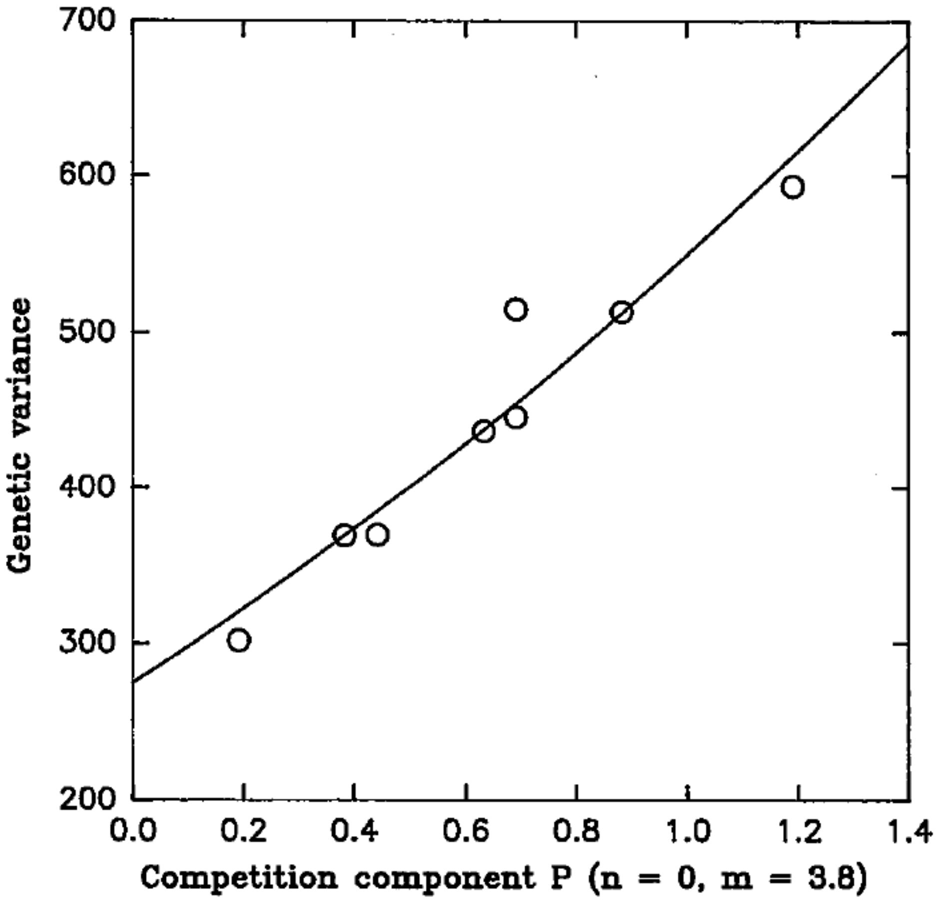


Fig. 1. Plant crop, symbol = actual, line = fitted

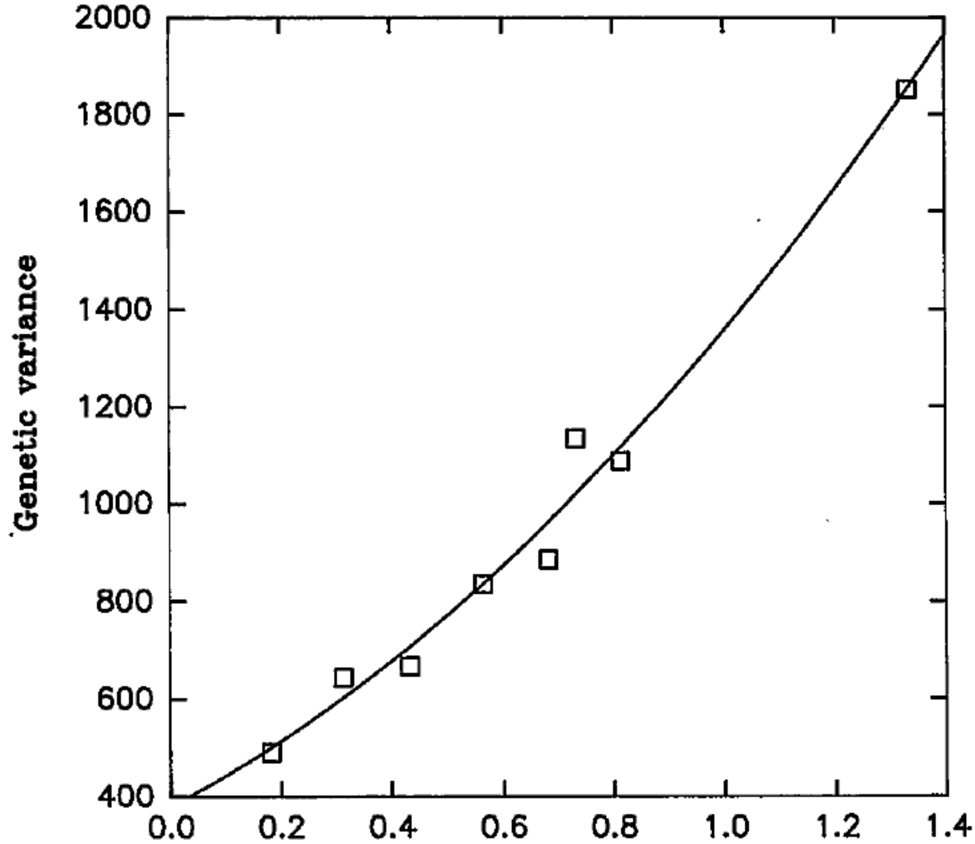


Fig. 2. 1R crop, symbol = actual, line = fitted

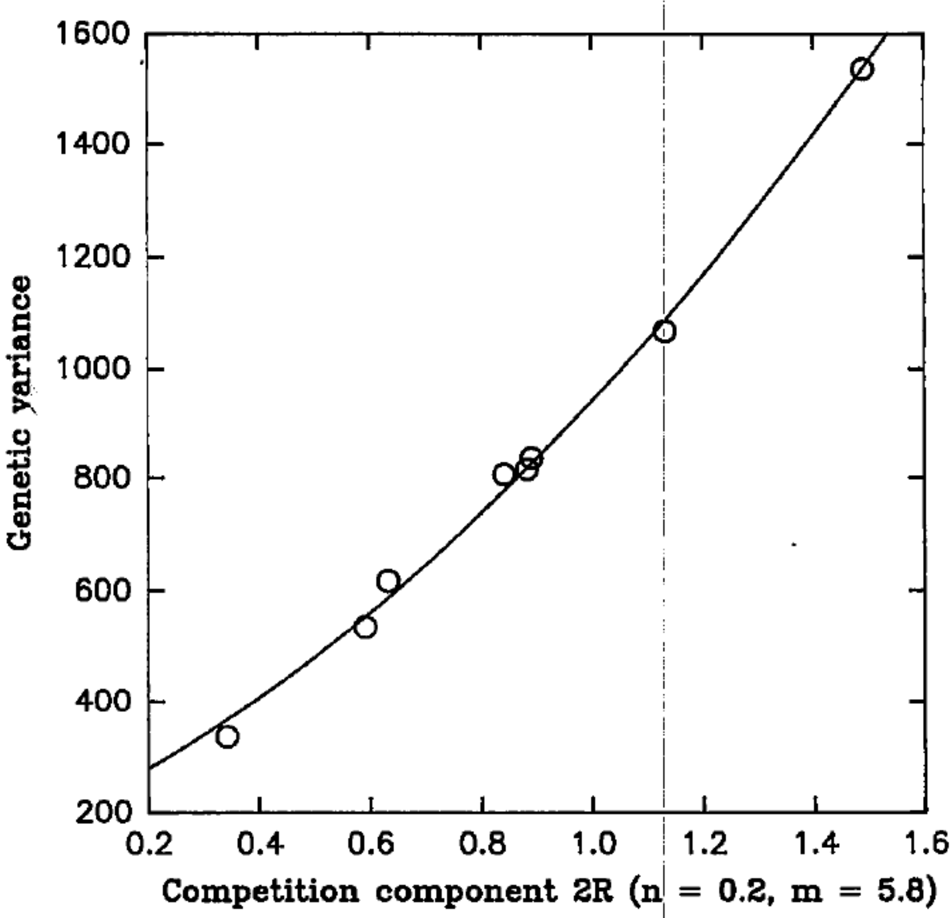


Fig. 3. 2R crop, symbol = actual, line = fitted

TABLE 1.

Plot Shape Experiment BN86-101 Johnson, Highleigh, 1986

Date Planted:	Rows 2-13 on 16-7-86 Rows 1, 14-9 on 17-7-86 Rows 20-30 on 21-7-86 Rows 31-42 on 22-7-86 Rows 43-55 on 23-7-86 Rows 56-70 on 24-7-86 Rows 71-75 on 25-7-86
Soil Conditions:	Soil moisture - excellent Tilth - good The drills were rolled with a three point linage drill roller at the end of each day's planting.
Fertiliser:	CK66 was applied at a rate of 430.6 kg/ha.
Area:	Experiment with guard rows and guard ends = 3.7159 ha
Lorsban:	Applied at a rate of 21 ml of concentrate/100 L.m.
Suscon:	Applied at a rate of 30.11 kg/ha
Equipment:	A hodge single row planter was used. This was equipped with a 13 tooth drive sprocket and two trailers.
Note:	A planting error was made in row 2. Cane intended for planting in plots (24-24) and (16-33) was planted together in a 9.2 metre. This meant that all subsequent plots were planted at a starting position 4.6 metres south of their intended location.
Plot Shapes:	1. 4 rows x 9.2 m 2. 2 rows x 9.2 m 3. 1 row x 9.2 m 4. 4 rows x 4.6 m

Planting Supervised by G. Park and N. Berding

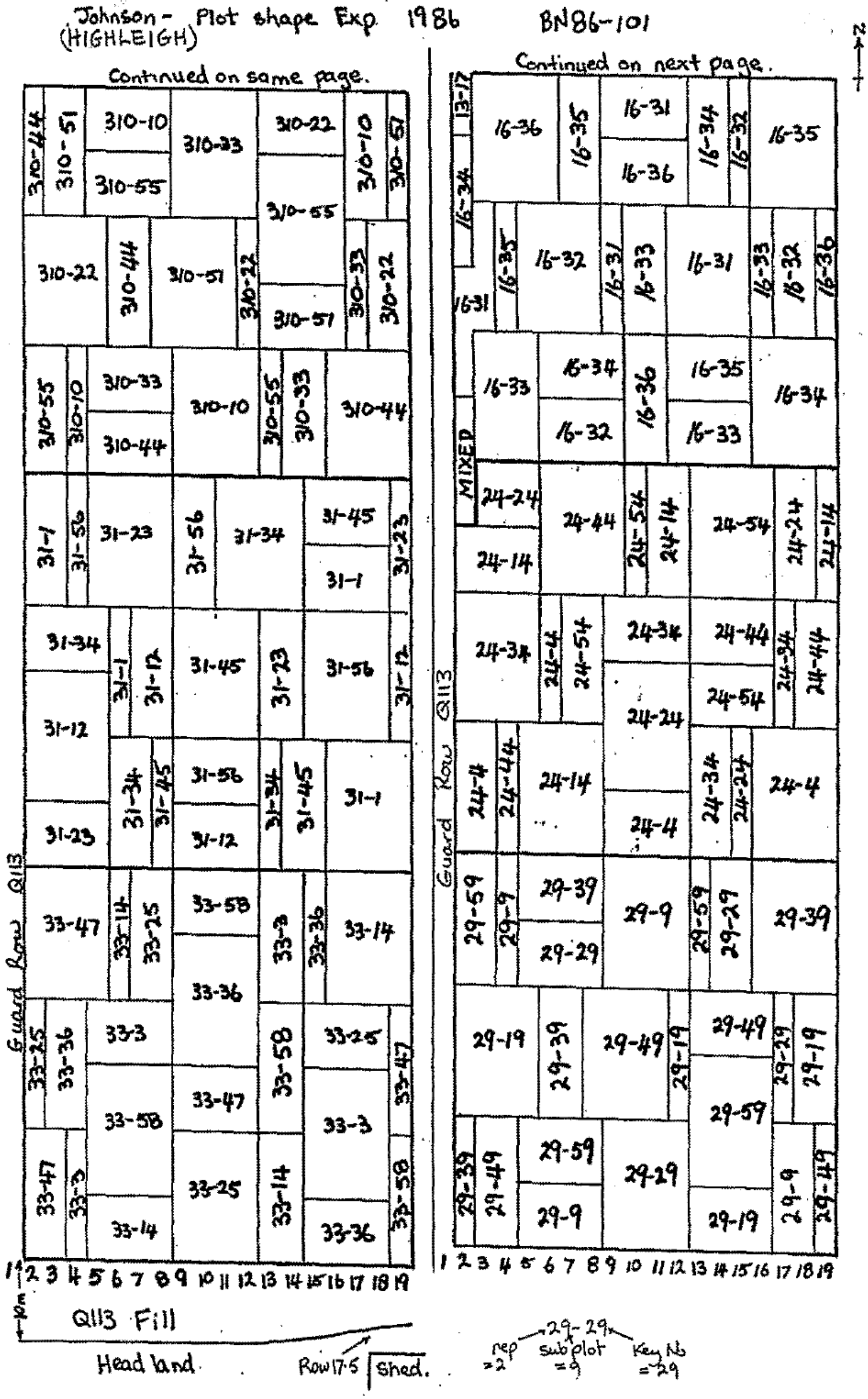
Row Spacing: 1·5 m

TABLE 1. continued 2/2

JOHNSON, HIGHLEIGH, 1986 - BN86-101

Key number	Clone	Source	Parentage
17	78N898	A5/6	71N382 x 67N1509
53	79N322	A5/6	Q79 x H49-104
14	79N483	A5/6	72N424 x TSF168 (F168)
29	80N614	A5/6	72N424 x 67C444
10	80N633	A5/6	H49-104 x Q99
52	80N637	A5/6	58N829 x 66N2008
44	80N639	A5/6	58N829 x 66N2008
22	80N655	H4	63N1700 x H44-2818
59	80N677	A5/6	75N353 x 59S55
38	80N696	A5/6	68N1797 x CP53-19
48	80N709	A5/6	Q117 x Q99
42	80N731	A5/6	65N980 x 66N2008
15	80N739	A5/6	68N1797 x CP53-19
41	80N740	A5/6	71N437 x CP53-19
46	80N810	A5/6	58N829 x 66N2008
43	80N928	A5/6	59S55 x Co331
31	80N935	A5/6	Q113 x 58N1868
45	80N966	A5/6	60N1853 x Q99
56	80N987	H4	Q90 x H50-3511
28	80N992	H4	Q113 x 61N1232
2	80N1038	H4	(Q135) 69C587 x 61N1232
3	80N1066	A5/6	CP55-14 x H49-3666
11	80N1080	A5/6	60N1853 x 67N1509
24	81N21	H4	Q113 x Q117
60	81N25	A5/6	60N1853 x TSF168 (F168)
25	81N70	H4	Q102 x 59S55
13	81N84	A5/6	Q113 x 69N2915
19	81N114	A5/6	60N1853 x 61N567
30	81N285	F2	67N1691 x CP53-19
12	82N465	M3	65N980 x H49-104
33	82N737	H3	55N689 x Q117
8	82N1005	H3	Q90 x 61N1232
57	82N1076	L7	58N829 x 66N2008
34	82N1138	L7	F158 x 61N1232
37	82N1159	L7	63N1700 x 62C366
35	82N1254	L7	Q113 x H58-8255
49	82N1278	M3	Q113 x 70C516
27	82N1433	F2	Q63 x 59S55
47	82N1592	M3	Q113 x 70C516
18	82N1645	F2	Q101 x Co440
50	83N374	L2	Q117 x VESTA
32	83N451	M4	Q117 x 70N959
58	83N553	M4	Q113 x VESTA
36	83N640	M4	58N829 x 66N2008
4	83N670	M4	Q113 x 70C516
55	83N707	M4	Q90 x 75N178
20	83N730	M4	60N1853 x TSF168 (F168)
7	83N741	M4	59S55 x CP53-19
54	83N755	M4	Q107 x Q99
40	83N785	M4	Q113 x 67N1322
26	83N826	M4	Q113 x 73C487 (Q142)
21	83N827	M4	Q113 x 73C487 (Q142)
5	83N831	M4	67N1691 x CP53-19
9	83N832	M4	67N1691 x CP53-19
39	Q113	F3 (P1)	
6	Q114	Johnson	
1	Q117	F3 (P1)	
51	Q120	P1	
23	Q122	Q1, 3	
16	Q124	F3	

TABLE 2.


Johnson - Plot shape Exp 1986 BN86-101
(HIGHLEIGH)
N
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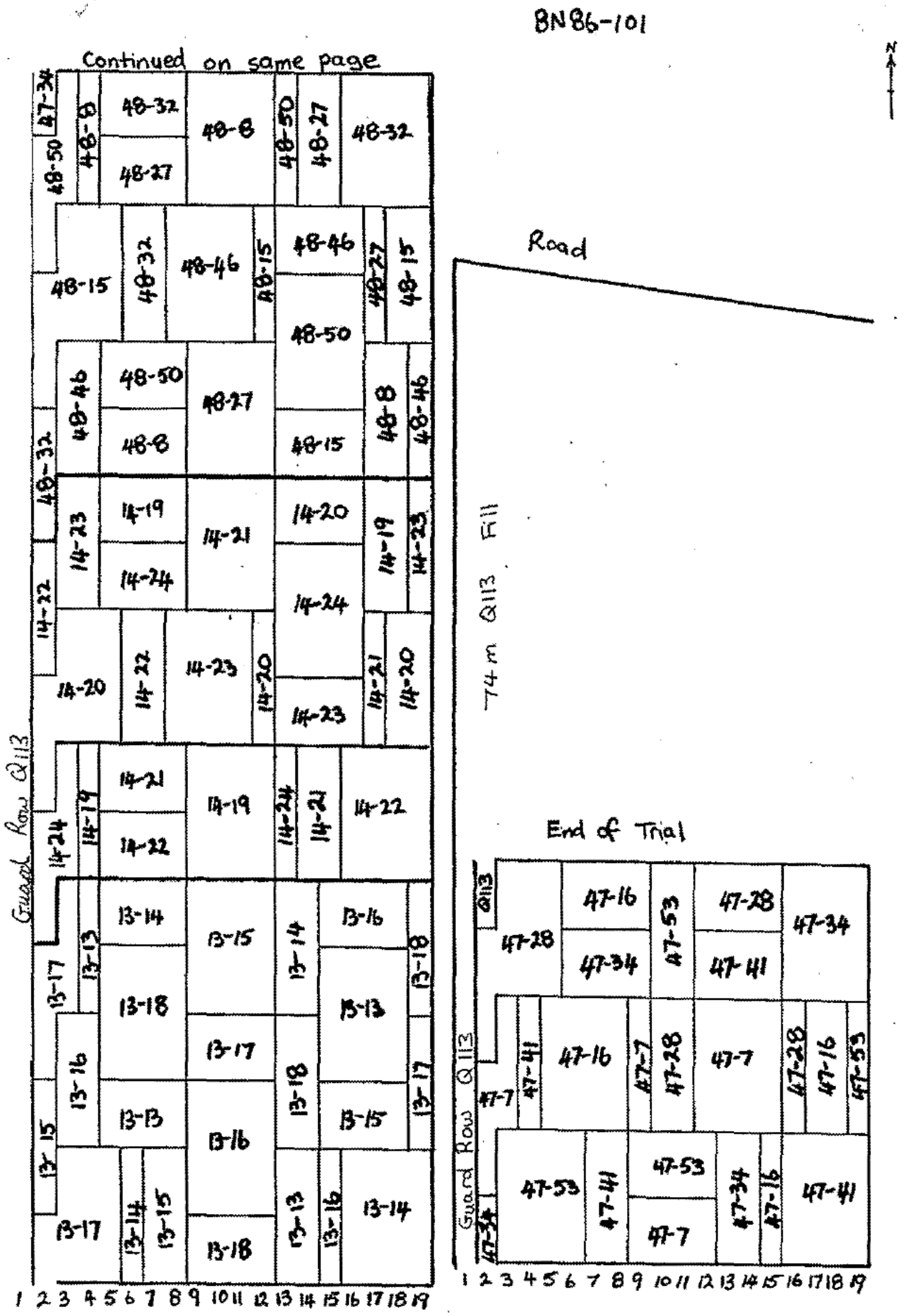
MIXED
Guard Row Q113
Guard Row Q113
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
10m
Q113 Fill
Head land
Row 17.5
Shed.
29-29
rep =2
sub plot =9
Key No =29


BN86-101
N
Continued on same page
Road
74 m Q113 Fill
Guard Row Q113
End of Trial
Guard Row Q113
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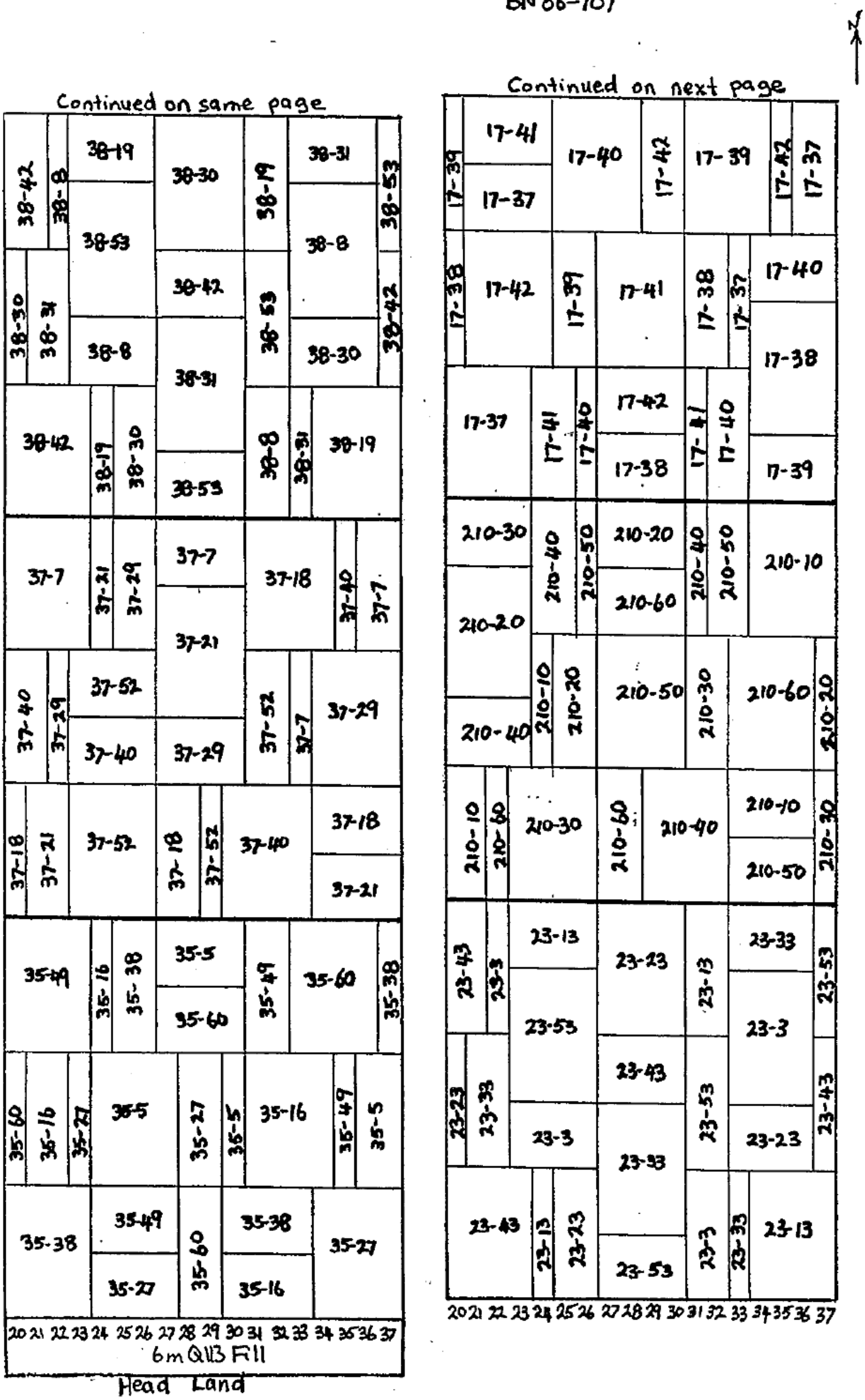
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

BN 86-101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38-42 38-8 38-19 38-53 38-30 38-19 38-31 38-8 38-53
38-30 38-31 38-8 38-42 38-31 38-53 38-30 38-42
38-42 38-19 38-30 38-53 38-8 38-31 38-19
37-7 37-21 37-29 37-7 37-21 37-18 37-40 37-7
37-40 37-29 37-52 37-40 37-29 37-52 37-7 37-29
37-18 37-21 37-52 37-18 37-52 37-40 37-18 37-21
35-49 35-16 35-38 35-5 35-60 35-49 35-60 35-38
35-60 35-16 35-27 35-5 35-27 35-5 35-16 35-49 35-5
35-38 35-49 35-27 35-60 35-38 35-16 35-27
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
6m QllB Fill
Head Land
Continued on next page
17-39 17-41 17-37 17-40 17-42 17-39 17-42 17-37
17-38 17-42 17-39 17-41 17-38 17-37 17-40 17-38
17-37 17-41 17-40 17-42 17-38 17-41 17-40 17-39
210-30 210-20 210-40 210-50 210-20 210-60 210-40 210-50 210-10
210-40 210-10 210-20 210-50 210-30 210-60 210-20
210-10 210-60 210-30 210-60 210-40 210-10 210-50 210-30
23-43 23-3 23-13 23-53 23-23 23-13 23-33 23-3 23-53
23-23 23-33 23-3 23-43 23-33 23-53 23-23 23-43
23-43 23-13 23-23 23-53 23-3 23-33 23-13
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

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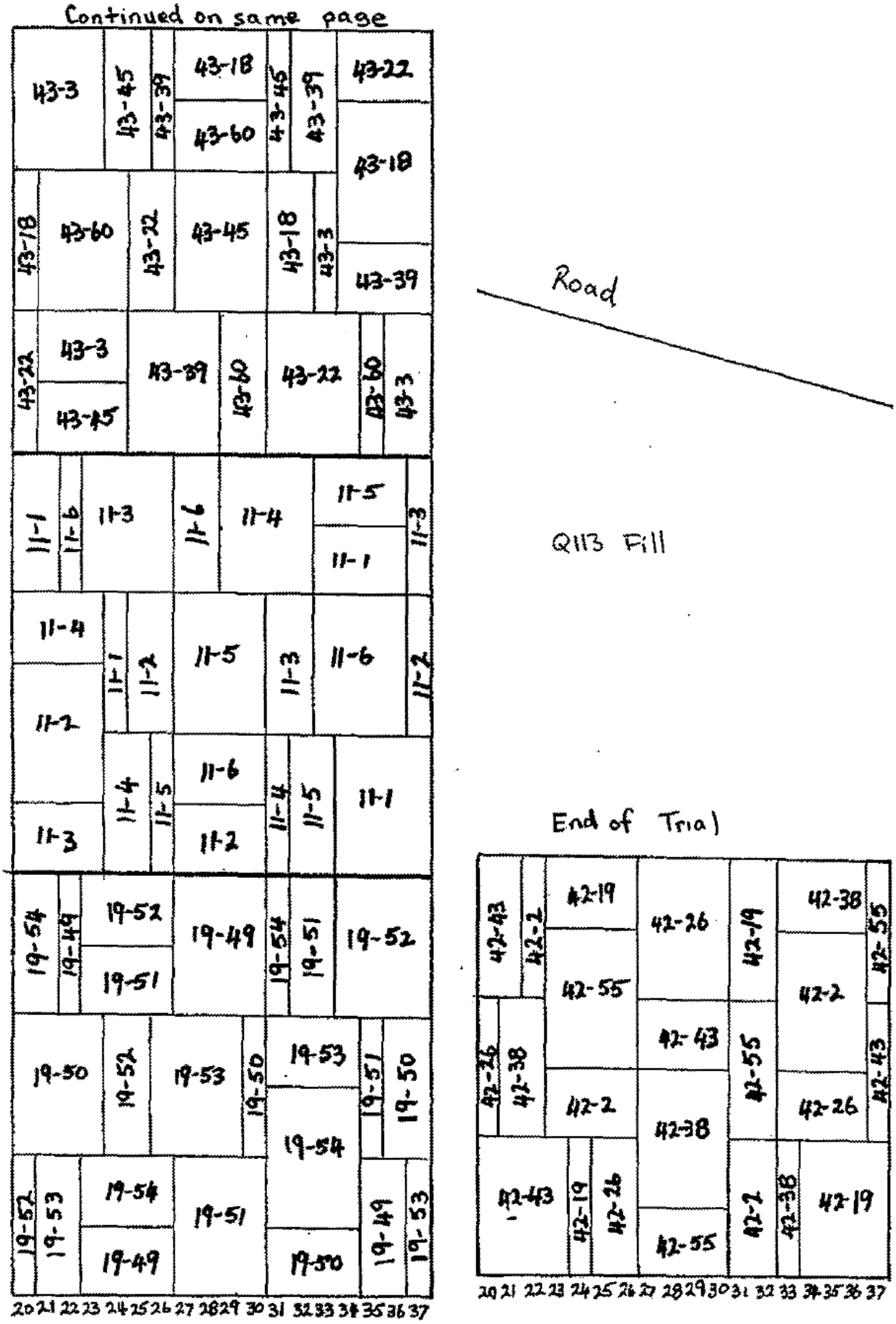
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11-1 11-6 11-3 11-6 11-4 11-5 11-1 11-3
11-4 11-2 11-1 11-2 11-5 11-3 11-6 11-2
11-3 11-4 11-5 11-6 11-2 11-4 11-5 11-1
19-54 19-49 19-52 19-51 19-49 19-54 19-51 19-52
19-50 19-52 19-53 19-50 19-53 19-54 19-51 19-50
19-52 19-53 19-54 19-49 19-51 19-50 19-49 19-53
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
Road
Q113 Fill
End of Trial
42-43 42-2 42-19 42-55 42-26 42-19 42-38 42-55
42-26 42-38 42-2 42-43 42-38 42-55 42-2 42-26 42-43
42-43 42-19 42-26 42-55 42-2 42-38 42-19
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

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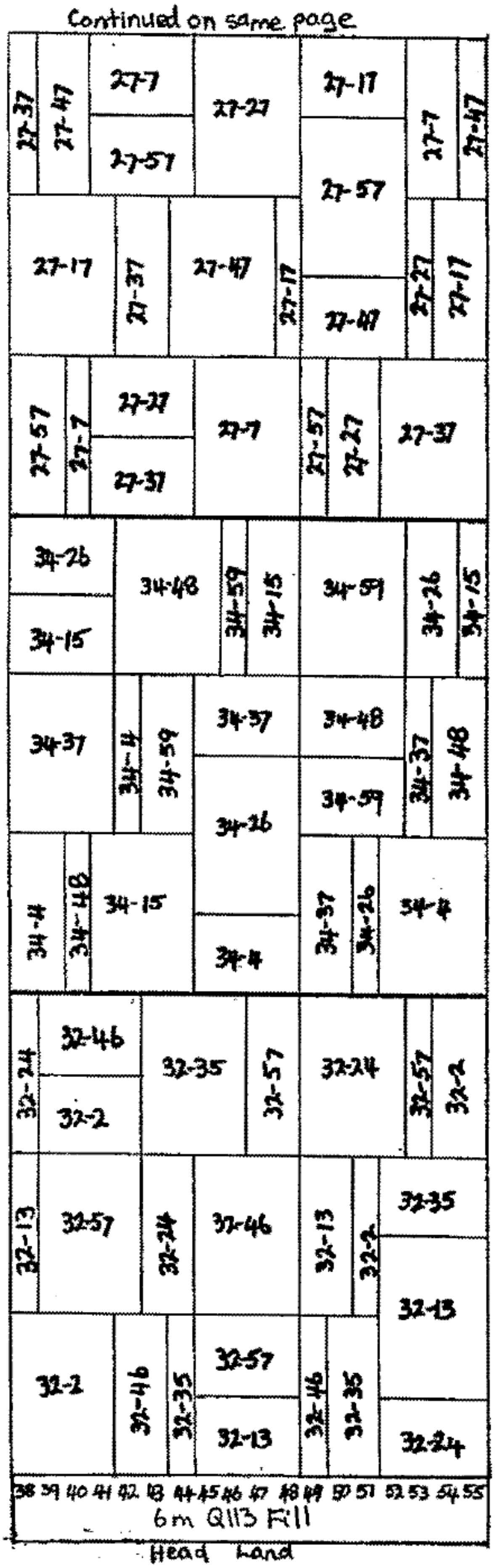
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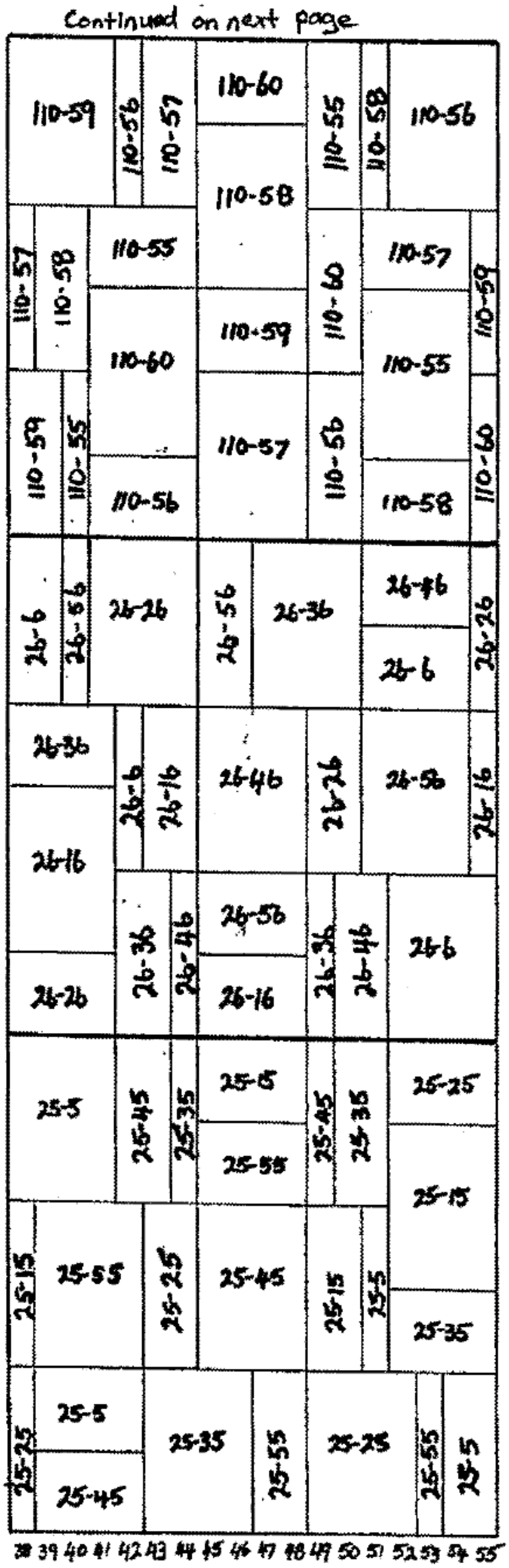
38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55
6m Q113 Fill
Head Land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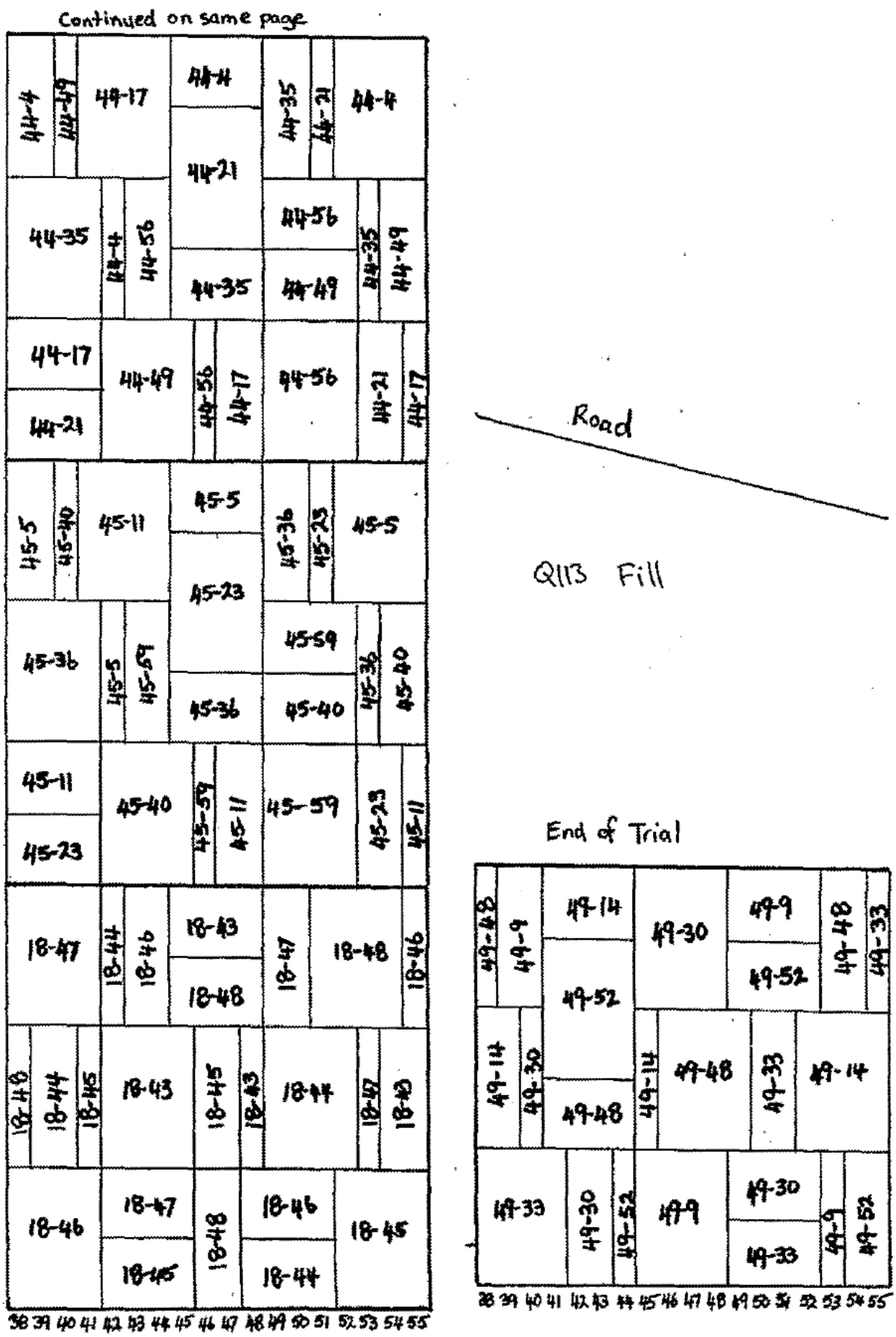
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Road
Q113 Fill
End of Trial
38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55
38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55

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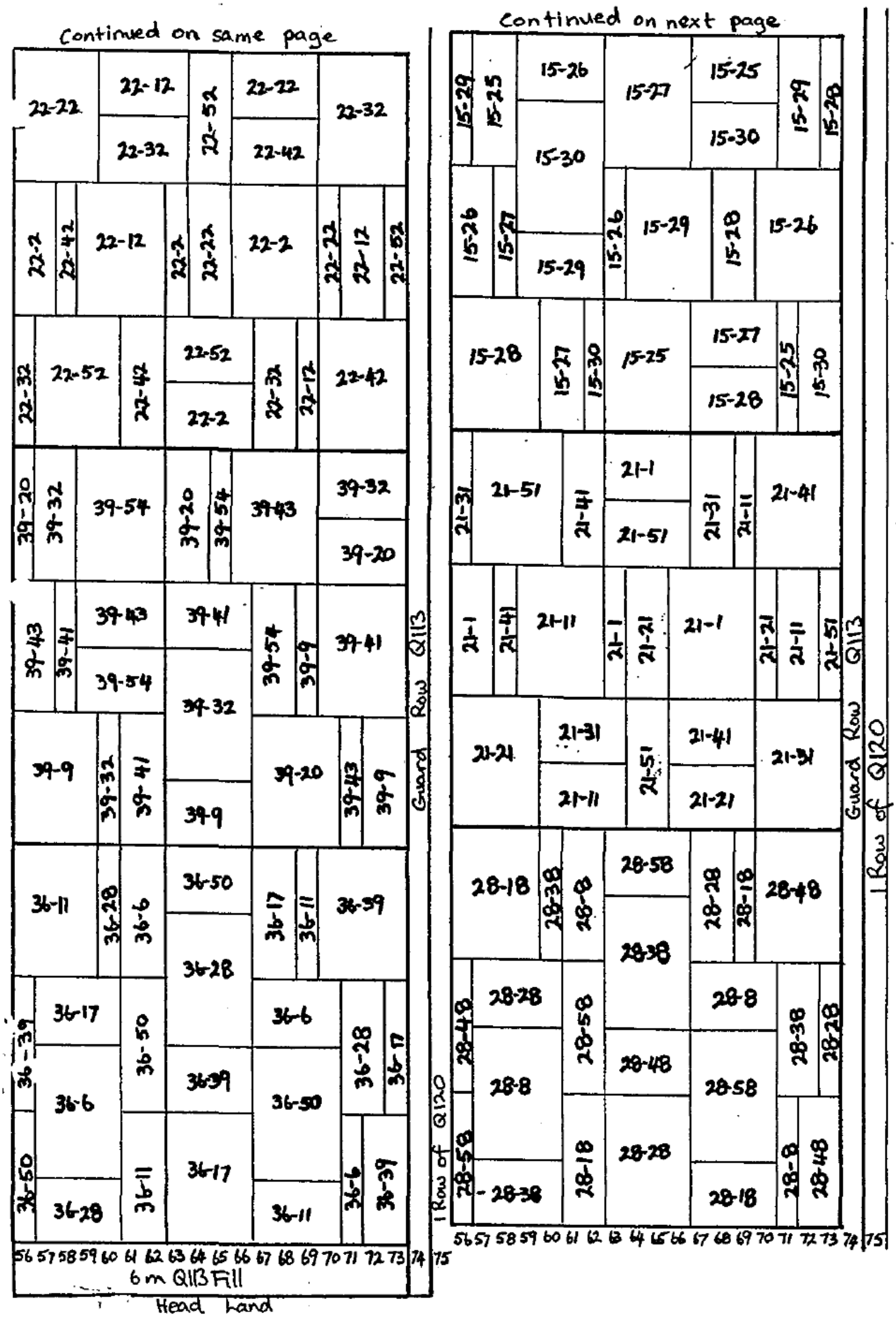
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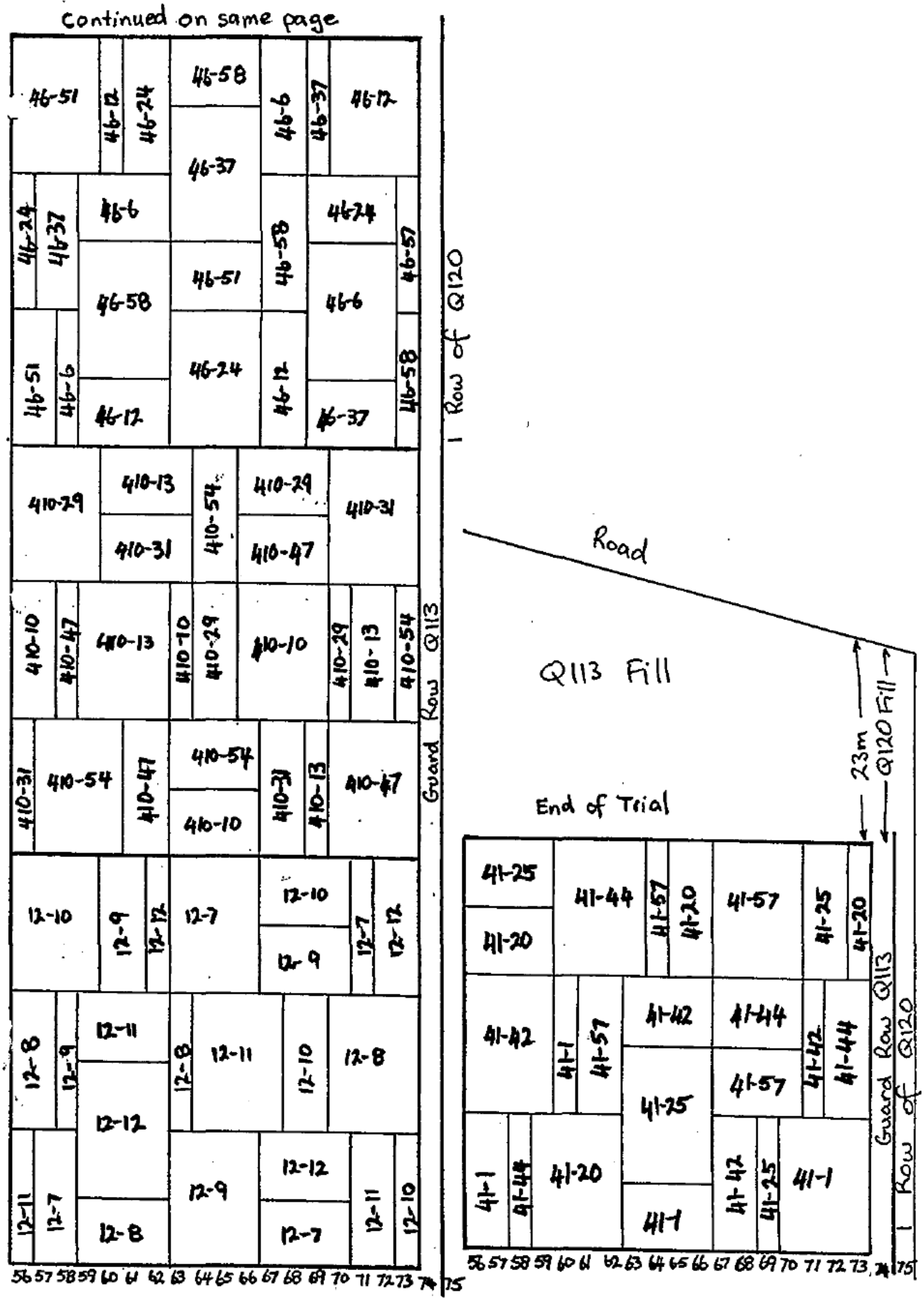
Guard Row Q113
1 Row of Q120
6 m Q113 Fill
Head Land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Row of Q120
Guard Row Q113
Road
Q113 Fill
23m
Q120 Fill
End of Trial
Guard Row Q113
Row of Q120
56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75

Table 3. Model used for competition analysis

g(1), g(2),...,g(p) represent the true yielding ability, g, of plants 1...p in each row. Lateral competetition (c, f) and end competition (c') are assumed to occur. Lateral competion is assumed to affect the adjoining row (c), and also the second row (f = far lateral) of the next plot. There are r rows per plot with p plants per row. Rows are labelled A, B, C, D. The plants in each of the four plot shapes may be represented as follows:

4-row plot	A	B	C	D
	½c'	½c'	½c'	½c'
	¼f ½c g(1)	¼f g(1)	g(1) ¼f	g(1) ½c ¼f
	¼f ½c g(2)	¼f g(2)	g(2) ¼f	g(2) ½c ¼f
	.	.	.	.
	.	.	.	.
	¼f ½c g(p)	¼f g(p)	g(p) ¼f	g(p) ½c ¼f
	½c'	½c'	½c'	½c'
Row total	pg+½pc+¼pf+c'	pg+¼pf+c'	pg+¼pf+c'	pg+½pc+¼pf+c'
/plant	g+½c+¼f+c'/p	g+¼f+c'/p	g+¼f+c'/p	g+½c+¼f+c'/p
4L	g+.5c+.25f+.05c'	g+.25f+.05c'	g+.25f+.05c'	g+.5c+.25f+.05c'
4S	g+.5c+.25f+ .1c'	g+.25f+ .1c'	g+.25f+ .1c'	g+.5c+.25f+ .1c'
Plot total	rpg + pc + pf + rc'			
/plant	g + c/r + f/r+ c'/p			
4L	g +.25c + .25f + .05c'			
4S	g +.25c + .25f + .1c'			

2-row plot	A	B
	½c'	½c'
	¼f ½c g(1) ¼f	¼f g(1) ½c ¼f
	¼f ½c g(2) ¼f	¼f g(2) ½c ¼f
	.	.
	.	.
	¼f ½c g(p) ¼f	¼f g(p) ½c ¼f
	½c'	½c'
Row total	pg + ½pc + ½pf + c'	pg + ½pc + ½pf + c'
/plant	g + ½c + ½f + c'/p	g + ½c + ½f + c'/p
Plot total	rpg + pc + pf + rc'	
/plant	g + c/r + f/r + c'/p	
2L	g + .5c + .5f + .05c'	

1-row	A
	½c'
	½f ½c g(1) ½c ½f
	½f ½c g(2) ½c ½f
	.
	.
	½f ½c g(p) ½c ½f
	½c'
Row total	pg + pc + pf + c'
/plant	g + c + f + c'/p
Plot total	pg + pc + pf + c'
/plant	g + c + f + c'/p
1L	g + c + f + .05c'

Table 4. Expected values of the mean squares for a split-plot model in a randomized complete block design.

Source of variation	df	Model I Fixed effects	Model II Random effects
V1 Blocks, R	r-1	$\sigma^2_e + b\sigma^2RA + ab\sigma^2_R$	$\sigma^2_e + b\sigma^2_{RA} + ab\sigma^2_R$
V2 A	a-1	$\sigma^2_e + b\sigma^2_{RA} + rb_{(A)}$	$\sigma^2_e + b\sigma^2_{RA} + r\sigma^2_{AB} + rb\sigma^2_A$
V3 Error(a)	(r-1)(a-1)	$\sigma^2_e + b\sigma^2_{RA}$	$\sigma^2_e + b\sigma^2_{RA}$
V4 B	b-1	$\sigma^2_e + ra_{(B)}$	$\sigma^2_e + r\sigma^2_{AB} + ra\sigma^2_B$
V5 AB	(a-1)(b-1)	$\sigma^2_e + r_{(AB)}$	$\sigma^2_e + r\sigma^2_{AB}$
V6 Error(b)	a(b-1)(r-1)	σ^2_e	σ^2_e

Let

$$Y_{ijk} = \mu + R_i + A_j + RA_{ij} + B_k + (AB)_{jk} + E_{ijk}$$

represent the observation in the *i*th block of a randomized complete block design, on the *j*th whole-unit treatment with the *k*th sub-unit treatment. Let $i = 1 \ldots r$ blocks, $j = 1 \ldots a$ whole-unit treatments, and $k = 1 \ldots b$ sub-unit treatments. Let RA_{ij} and E_{ijk} be normally and independently distributed about zero means with σ^2_e as the common variance of the *E*s, the sub-unit random components.

For the random model an error was synthesized for the main treatment (A), to give the following *quasi* F ratio:

$$F_{p,q} = (V2 + V6)/(V3 + V5) \qquad \text{(Steel \& Torrie, 1980, p357)}$$

where the effective degrees of freedom (p,q) are

$$p = (V2 + V6)^2/(V2^2/df2 + V6^2/df6) \qquad q = (V3 + V5)^2/(V3^2/df3 + V5^2/df5)$$

A normal F ratio (V4/V5) was used for treatment B in the random model.

If the AB interaction was not significant, an F ratio for B based on a combined error (V5 + V6) was presented for the fixed model.

Table 5. Expected values of the mean squares for a split-block model in a randomized complete block design.

Source of variation	df	Model I Fixed effects	Model II Random effects
V1 Blocks, R	r-1	$\sigma^2_e + b\sigma^2_{RA} + a\sigma^2_{RB} + ab\sigma^2_R$	$\sigma^2_e + b\sigma^2_{RA} + a\sigma^2_{RB} + ab\sigma^2_R$
V2 A	a-1	$\sigma^2_e + b\sigma^2_{RA} + rb_{(A)}$	$\sigma^2_e + b\sigma^2_{RA} + r\sigma^2_{AB} + rb\sigma^2_A$
V3 Error(a), RA	(r-1)(a-1)	$\sigma^2_e + b\sigma^2_{RA}$	$\sigma^2_e + b\sigma^2_{RA}$
V4 B	b-1	$\sigma^2_e + a\sigma^2_{RB} + ra_{(B)}$	$\sigma^2_e + a\sigma^2_{RB} + r\sigma^2_{AB} + ra\sigma^2_B$
V5 Error(b), RB	(r-1)(b-1)	$\sigma^2_e + r_{(AB)}$	$\sigma^2_e + a\sigma^2_{RB}$
V6 AB	(a-1)(b-1)	$\sigma^2_e + a\sigma^2_{RB}$	$\sigma^2_e + r\sigma^2_{AB}$
V7 Error(c), RAB	(r-1)(a-1)(b-1)	σ^2_e	σ^2_e

Let

$$Y_{ijk} = \mu + R_i + A_j + RA_{ij} + B_k + RB_{ik} + (AB)_{jk} + E_{ijk}$$

represent the observation in the *i*th block of a randomized complete block design, on the *j*th treatment in the *k*th crop (year). Let $i = 1...r$ blocks, $j = 1...a$ treatments, and $k = 1...b$ crops. Let RA_{ij}, RB_{ik} and E_{ijk} be normally and independently distributed about zero means with σ^2_e as the common variance of the *E*s, the **RAB** interaction component.

For the random model an error was synthesized for the main treatment (A), to give the following *quasi* F ratio:

$$F_{p,q} = (V2 + V7)/(V3 + V6) \qquad \text{(Steel \& Torrie, 1980, p357)}$$

where the effective degrees of freedom (p,q) are

$$p = (V2 + V7)^2/(V2^2/df2 + V7^2/df7) \qquad q = (V3 + V6)^2/(V3^2/df3 + V6^2/df6)$$

For treatment **B** the corresponding *quasi* F ratio for the random model was

$$F_{p,q} = (V4 + V7)/(V5 + V6)$$

If the **AB** interaction was not significant, an F ratio for **B** based on a combined error (V6 + V7) was presented for the fixed model.

Table 6. Mean, variance ratio (F) and CV% for RCB analysis of harvest data from four plot shapes. 60 clones x 4 replicates, P, 1R and 2R crops.

Character	Shape	P crop Mean	F	CV%	1R crop Mean	F	CV%	2R crop Mean	F	CV%
TCH	4L	106.338	13.6	7	109.798	13.4	10	85.038	13.3	11
CCS	4L	14.598	13.7	4	15.036	7.1	4	15.826	5.6	4
TSH	4L	15.490	11.9	9	16.539	12.6	11	13.477	13.3	12
NMG	4L	8.118	7.8	14	7.927	10.4	15	8.191	10.9	17
Appearance grade	4L	9.358	4.0	6	8.946	7.3	5	8.648	3.6	9
FIBRE	4L	12.396	15.1	5	13.060	14.2	6	13.595	10.8	6
TCH	4S	109.899	9.3	10	113.318	10.5	12	88.161	10.2	16
CCS	4S	14.158	6.1	8	14.984	6.3	6	15.721	4.0	5
TSH	4S	15.536	7.6	13	17.079	10.3	15	13.877	10.6	16
NMG	4S	7.966	6.3	18	7.630	9.8	19	7.780	9.5	22
Appearance grade	4S	9.456	2.9	6	8.967	3.3	6	8.621	5.1	9
TCH	2L	106.916	13.4	9	109.588	10.4	15	84.918	8.8	18
CCS	2L	14.518	6.9	6	15.012	8.8	4	15.755	4.3	4
TSH	2L	15.518	11.1	11	16.527	11.1	16	13.404	8.2	19
NMG	2L	8.486	6.4	17	7.576	9.1	20	8.022	6.4	25
Appearance grade	2L	9.450	3.1	6	8.967	4.1	6	8.777	4.5	8
TCH	1L	104.691	5.8	15	108.852	6.7	24	86.455	6.8	28
CCS	1L	14.257	3.3	9	14.968	4.1	6	15.455	3.0	7
TSH	1L	14.940	5.0	18	16.431	7.0	25	13.521	6.9	29
NMG	1L	8.980	3.7	23	7.998	5.8	31	8.398	6.0	35
Appearance grade	1L	9.488	1.9	7	8.985	3.3	6	8.660	2.5	11

Degrees of freedom = 59,177 F is significantly > 0 if 1.40 ($P<0.05$) or 1.61 ($P<0.01$)

Plot shapes:
- 4L = 4-row LONG
- 4S = 4-row SHORT
- 2L = 2-row LONG
- 1L = 1-row LONG

Crops:
- P = plant crop, 1987 harvest
- 1R = first ratoon, 1988
- 2R = second ratoon, 1989

Table 7. Variance ratios (F) and CV% for RCB analysis, of four plot shapes. 60 clones x 2 replicates, P, 1R, and 2R crops.

Character	Shape	P crop F	P crop CV%	1R crop F	1R crop CV%	2R crop F	2R crop CV%
TCH	4L	7.5	7.2	10.1	8.3	7.1	11.1
TCH	4L	6.3	8.0	5.3	11.1	6.0	12.4
CCS	4L	7.1	4.3	5.2	3.9	3.4	3.6
CCS	4L	6.9	4.3	3.2	4.6	3.6	3.8
TSH	4L	7.1	8.7	9.0	9.7	7.1	11.8
TSH	4L	5.0	9.1	5.2	12.1	7.1	11.9
NMG	4L	4.9	13.3	6.2	14.6	5.8	17.1
NMG	4L	3.2	15.2	4.7	15.5	5.8	16.6
Appearance grade	4L	2.6	5.6	4.3	4.9	2.3	9.6
Appearance grade	4L	1.9	7.7	3.3	5.3	2.0	9.1
FIBRE	4L	8.1	5.2	8.3	5.2	6.1	6.2
FIBRE	4L	7.5	5.5	6.5	6.2	5.7	5.6
TCH	4S	5.7	9.3	6.5	12.1	5.0	17.2
TCH	4S	4.9	10.4	4.6	13.2	6.1	15.1
CCS	4S	5.2	6.8	2.9	7.0	3.6	4.1
CCS	4S	3.4	7.1	4.5	4.8	1.7	5.1
TSH	4S	5.0	12.6	5.7	14.8	5.5	17.0
TSH	4S	3.9	12.7	4.8	15.0	5.6	16.4
NMG	4S	4.5	17.3	5.2	19.7	5.5	21.2
NMG	4S	3.3	17.6	4.9	18.5	4.4	23.0
Appearance grade	4S	2.0	5.0	2.2	6.2	2.8	9.1
Appearance grade	4S	1.6	7.1	2.1	5.9	2.9	8.6

Table 7 continued 2/2

Character	Shape	P crop F	P crop CV%	1R crop F	1R crop CV%	2R crop F	2R crop CV%
TCH	2L	10.7	7.4	5.6	14.2	4.5	17.8
TCH	2L	5.7	9.7	6.3	14.3	3.9	19.8
CCS	2L	5.6	4.9	6.3	3.9	2.7	4.4
CCS	2L	3.6	6.6	4.0	4.5	2.7	4.1
TSH	2L	11.8	8.0	5.8	15.6	4.1	19.3
TSH	2L	4.1	13.1	6.3	15.6	3.7	21.1
NMG	2L	7.8	11.6	5.2	18.8	3.7	24.7
NMG	2L	2.8	20.0	4.8	20.6	2.9	28.2
Appearance grade	2L	2.4	4.8	2.7	5.2	2.6	7.9
Appearance grade	2L	2.3	7.3	2.3	6.1	2.5	8.5
TCH	1L	4.4	13.3	5.2	20.1	4.2	26.0
TCH	1L	3.5	15.4	3.5	25.6	3.7	29.1
CCS	1L	1.4	10.5	2.5	5.9	4.6	4.2
CCS	1L	4.6	6.7	1.8	7.1	2.8	7.4
TSH	1L	2.8	17.8	4.8	22.1	4.5	26.3
TSH	1L	4.3	16.3	3.5	27.9	3.7	30.7
NMG	1L	2.0	23.0	4.3	26.8	3.9	32.3
NMG	1L	3.8	21.1	2.8	35.1	3.2	37.3
Appearance grade	1L	1.9	5.9	2.4	5.7	2.0	10.7
Appearance grade	1L	1.0	8.4	1.4	7.1	2.0	9.7

Degrees of freedom = 59,59 F is significantly > 0 if ≥1.54 (5%) or 1.61 (1%).

Plot shapes:
- 4L = 4-row LONG
- 4S = 4-row SHORT
- 2L = 2-row LONG
- 1L = 1-row LONG

Crops:
- P = plant crop, 1987 harvest
- 1R = first ratoon, 1988
- 2R = second ratoon, 1989

For each character, line 1 = replicates 1 and 2, line 2 = replicates 3 and 4.

Table 8. Variance ratios (F) for modified split plot and split plot analysis of variance, using fixed and random models. 60 clones on main plots, with 3 years (P, 1R, 2R crops) as subplots, Johnson trial.

Plot shape	F ratios for fixed model							F ratios for random model			
and	Modified split plot				Split plot		CombError	Modified split plot			Split
Character	Clone	Year	Clone *Year	Rep *Year	Year	Year *Clone	Year	Clone	Year df	F	Year
	A	B	AB	RB	B	AB	B	A	B	B	B
4-row LONG											
FIBRE	32.7	276.7	2.3	0.6	168.4	2.3		11.0	(2,40)	58.7	73.9
APPEARANCE	8.0	20.1	1.7	4.6	86.2	1.6		4.1	(2,9)	14.8	54.8
TCH	16.7	212.2	7.4	4.3	863.2	7.0		5.6	(2,9)	78.0	123.2
CCS	15.7	54.7	3.1	5.4	276.4	2.9		5.8	(2,8)	35.1	96.7
TSH	16.6	347.6	6.1	1.2	411.6	6.0		6.1	(2,20)	57.2	68.3
NMGYOT	14.3	1.3	4.3	3.5	4.3	4.1		5.5	(3,10)	0.7	1.1
AD-BC	2.0	0.6	1.4	0.5	0.3	1.4		1.7	(36,54)	0.7	0.2
AD-B	1.8	0.5	1.1	0.5	0.2	1.1	0.2	1.6	(50,54)	0.8	0.2
AD-C	1.7	1.3	1.5	0.9	1.2	1.5		1.35	(7,27)	0.9	0.8
4-row SHORT											
APPEARANCE	6.3	24.3	2.1	5.6	125.4	2.0		3.1	(2,8)	17.7	63.8
TCH	13.2	183.7	4.8	2.6	469.7	4.6		5.7	(2,11)	65.4	101.2
CCS	9.8	39.7	2.7	5.3	197.7	2.6		3.7	(2,8)	26.4	77.5
TSH	13.2	414.1	4.3	0.5	205.0	4.3		5.6	(2,52)	42.9	47.6
NMGYOT	12.1	0.6	4.1	7.3	4.2	3.7		4.9	(3,8)	0.5	1.1
AD-BC	1.9	9.4	1.0	0.1	1.2	1.0	1.2	1.6	(7,231)	2.0	1.2
AD-B	1.5	4.9	0.8	0.5	2.7	0.8		1.41	(4,47)	2.7	3.1
AD-C	1.8	2.2	1.2	0.5	1.2	1.2	1.1	1.45	(7,48)	1.2	0.9
df (treat)	59	2	118	6	2	118	2	61-97			2
df (error)	177	6	354	354	360	360	478	225-294			118
F.05	1.40	5.14	1.28	2.13	3.03	1.27	3.02				
F.01	1.61	10.92	1.41	2.88	4.67	1.40	4.66				

Table 8 continued 2/2

Plot shape and Character	F ratios for fixed model, Modified split plot: Clone	Year	Clone *Year	Rep *Year	Split plot: Year	Year *Clone	CombError: Year	F ratios for random model, Modified split plot: Clone	Year df	F	Split: Year
	A	B	AB	RB	B	AB	B	A	B	B	B
2-row LONG											
APPEARANCE	6.9	13.2	1.8	6.7	81.0	1.6		3.4	(2,8)	10.5	49.5
TCH	13.2	273.7	5.2	1.6	420.6	5.1		5.4	(2,16)	63.2	82.0
CCS	13.3	59.6	2.2	3.2	184.3	2.1	.	5.4	(2,10)	35.8	88.4
TSH	12.7	466.8	5.1	0.4	209.1	5.2		5.2	(2,58)	37.3	40.4
NMG	9.7	10.4	3.6	2.7	27.1	3.5		4.3	(2,11)	4.6	7.7
1-row LONG											
APPEARANCE	4.1	64.2	1.2	1.4	91.8	1.2	87.9	2.7	(2,17)	35.6	77.8
TCH	8.5	138.8	3.6	0.9	118.3	3.6		4.2	(2,28)	27.0	33.2
CCS	7.0	91.7	1.3	0.8	73.3	1.3	.	3.6	(2,30)	34.7	54.7
TSH	8.6	80.5	3.3	0.9	68.4	3.3		4.5	(2,28)	16.8	20.8
NMG	7.3	1.5	2.7	10.3	13.0	2.3		4.0	(2,7)	1.2	5.6
df (treat)	59	2	118	6	2	118	2	61-97			2
df (error)	177	6	354	354	360	360	478	225-294			118
F.05	1.40	5.14	1.28	2.13	3.03	1.27	3.02				
F.01	1.61	10.92	1.41	2.88	4.67	1.40	4.66				

NB. F ratios for treatment A (Clone) were the same for all fixed models
Quasi F ratios for treatment A (Clone) were very similar for both random models.
CombError = Combined error (interactions,AB + Error (c), RAB), used if interactions were not significant.
AD-BC = Lateral competition (A+D)-(B+C) where A B C D are the four rows of a plot.

Table 9. Factorial analysis of plot shapes (S = 4 or 9) and 60 clones (C), with 4 replications.

(a) 4 shapes ≡ 2 long rows		Crop P	1R	2R
F values				
Shapes	3df	7.1**	4.4**	2.9*
Clones	59	34.7**	36.5**	28.0**
Shapes x clones	177	1.1	1.0	1.2
Error	717			
Mean for shapes				
4-row Long (AD)	a	295.22	305.32	235.82
4-row Long (BC)	b	291.76	300.78	233.58
4-row Short	c	303.31	312.75	243.33
2-row Long	d	295.09	302.46	234.38
		c>>a,b,d	c>>b,d c>a	c>a,b,d

(b) 9 shapes ≡ 1 long row		Crop P	1R	2R
F values				
Shapes	8df	3.7**	2.1*	1.9
Clones	59	39.6**	35.9**	32.6**
Shapes x clones	472	1.1	1.3**	1.4**
Error	1617			
Mean for shapes				
4-row Long (A)	a	146.71	153.09	117.91
(B)	b	145.78	151.99	117.26
(C)	c	145.99	148.79	116.33
(D)	d	148.51	152.22	117.92
4-row Short (AD)	e	152.35	157.80	121.37
(BC)	f	150.96	154.95	121.96
2-row Long (A)	g	147.46	149.10	113.63
(B)	h	147.63	153.36	120.74
1-row Long	i	144.48	150.21	119.31
		e>>abcghi e>d	e>bcdgi	
		f>>bci f>a d>i	f>cg	

Table 10. Competition analysis (F and CV values from RCB) of weight (KG).

F or CV	Shape	Crop	Row A	B	C	D	ABCD	AD	BC	AD-BC	AD-2B	AD-2C
F	LongE~	P		2.96	3.74				5.58	1.48		
CV	LongE~	P		17	16				12	1891		
F	Long	P	5.32	3.87	4.74	5.84	13.61	9.21	6.65	1.22	1.41	1.04
F	Long	1R	5.47	4.26	5.99	7.10	13.38	9.28	8.78	1.74	1.38	1.63
F	Long	2R	7.03	3.56	4.27	5.84	13.27	10.37	6.47	2.26	1.70	2.03
CV	Long	P	14	14	13	13	7	10	10	1572`	2342**	2124*
CV	Long	1R	19	15	14	17	10	14	11	2011	3213**	2605*
CV	Long	2R	20	19	18	23	11	16	13	1938	3150**	2390
F	Short	P	3.78	4.52	3.19	4.67	9.35	6.32	5.74	1.15	1.44	1.03
F	Short	1R	4.13	3.18	4.57	5.17	10.53	7.51	5.86	1.55	1.16	1.81
F	Short	2R	5.36	4.04	4.10	5.07	10.23	7.33	6.62	1.52	1.09	1.71
CV	Short	P	18	15	17	17	10	13	12	596.5	649.7	1073**
CV	Short	1R	23	21	20	23	12	17	15	1064	1679**	1299
CV	Short	2R	28	24	24	28	16	22	18	874.2	1448**	1086

ABCD = A+B+C+D, AD-BC = A+D - (B+C)
Plot shapes (e.g. Row B) can be compared with those in Table 41 for 1L or 2L plots.

~ For LongE, ends were removed from rows B and C, and weight readjusted to 9.2m
This increased the error variance:

	df	B	C	BC	AD-BC
LongE	177	619.5	524.0	1150	1891
Long	177	387.2	365.3	844.1	1572
F(LongE/Long)		1.60*	1.43*	1.36	1.20

` Error variance is shown instead of CV for estimates of competition.
* Error variance for AD-2B or AD-2C is significantly higher ($P \leq .05$) than AD-BC. ** $P \leq 0.01$

There were 60 families x 4 replicates

	Treatments	Error	F > 0 if greater than P.05	P.01
df	59	177	1.40	1.61

Table 11. Effect of competition on error variance.

Shape	Crop	Error variance: A		B	C		D	AD		BC	AD-BC	Gvar AD-BC
4L	P	424.7		387.2	365.3		376.4	879.1		844.1	35.0	85.7
	1R	818.2	>>	508.9	437.3	<<	672.7	1739.0	>>	994.4	744.6	373.4
	2R	549.3		484.2	419.3	<<	723.5	1391.0	>>	975.1	415.9	609.5
4S	P	192.4	>>	126.8	170.1		167.9	415.8		329.2	86.6	21.8
	1R	330.6		260.8	229.5	<	318.8	724.8	>	554.9	169.9	146.3
	2R	280.6	>	216.4	217.3	<	300.2	722.2	>>	474.7	247.5	113.0

df = 177, F is significant if 1.282 ($P \leq 0.05$)
1.421 ($P \leq 0.01$)

Significant differences between error variances are shown by > (P.05), >> (P.01)
or < <<

Gvar = estimate of genetic variance due to competition.

Table 12a. Genotypic and error variances, with F values for clones for Johnson trial, plant crop, 1987. Harvest characters.

Character & crop	X/Y	General mean	Error df	Error Variance	CV%	Genotypic Variance	GCV%	Fclone
nmg4LP	X	8.117833	177	1.225151	13.63	2.087572	17.80	7.82
nmg4SP	Y	7.966000	177	2.034583	17.91	2.678031	20.54	6.27
nmg2LP	Y	8.485875	177	2.089209	17.03	2.823721	19.80	6.41
nmg1LP	Y	8.980083	177	4.399622	23.36	2.979665	19.22	3.71
tsh4LP	X	15.489542	177	1.789486	8.64	4.870845	14.25	11.89
tsh4SP	Y	15.535708	177	3.956764	12.80	6.482500	16.39	7.55
tsh2LP	Y	15.518000	177	2.875151	10.93	7.252492	17.35	11.09
tsh1LP	Y	14.939500	177	7.260191	18.04	7.258345	18.03	5.00
tch4LP	X	106.338333	177	61.521814	7.38	193.973688	13.10	13.61
tch4SP	Y	109.898750	177	117.398465	9.86	244.823952	14.24	9.34
tch2LP	Y	106.915833	177	88.257159	8.79	273.415371	15.47	13.39
tch1LP	Y	104.691250	177	249.799667	15.10	301.967304	16.60	5.84
App4LP	X	9.358333	177	0.348682	6.31	0.264772	5.50	4.04
App4SP	Y	9.456250	177	0.313236	5.92	0.146175	4.04	2.87
App2LP	Y	9.450000	177	0.371092	6.45	0.192290	4.64	3.07
App1LP	Y	9.487500	177	0.449035	7.06	0.096798	3.28	1.86
ccs4LP	X	14.598333	177	0.383024	4.24	1.217461	7.56	13.71
ccs4SP	Y	14.158333	177	1.123627	7.49	1.441544	8.48	6.13
ccs2LP	Y	14.518333	177	0.768676	6.04	1.140879	7.36	6.94
ccs1LP	Y	14.256667	177	1.644836	9.00	0.940843	6.80	3.29

Table 12b. Genotypic and error variances, with F values for clones for Johnson trial, first ratoon crop, 1988. Harvest characters.

Character & crop	X/Y	General mean	Error df	Error Variance	CV%	Genotypic Variance	GCV%	Fclone
nmg4L1R	X	7.927500	177	1.367252	14.75	3.199976	22.57	10.36
nmg4S1R	Y	7.630375	177	2.010503	18.58	4.435492	27.60	9.82
nmg2L1R	Y	7.576042	177	2.231452	19.72	4.504633	28.01	9.07
nmg1L1R	Y	7.998375	177	6.244888	31.24	7.546423	34.35	5.83
tsh4L1R	X	16.539167	177	3.251045	10.90	9.435563	18.57	12.61
tsh4S1R	Y	17.079292	177	6.096113	14.46	14.141839	22.02	10.28
tsh2L1R	Y	16.526958	177	6.640790	15.59	16.728351	24.75	11.08
tsh1L1R	Y	16.431292	177	17.005152	25.10	25.399542	30.67	6.97
tch4L1R	X	109.798333	177	113.397405	9.70	350.748188	17.06	13.37
tch4S1R	Y	113.318333	177	196.389471	12.37	467.694748	19.08	10.53
tch2L1R	Y	109.587917	177	252.778302	14.51	593.157109	22.22	10.39
tch1L1R	Y	108.852083	177	668.447633	23.75	955.741403	28.40	6.72
App4L1R	X	8.945833	177	0.190184	4.87	0.299576	6.12	7.30
App4S1R	Y	8.966667	177	0.291337	6.02	0.169150	4.59	3.32
App2L1R	Y	8.966667	177	0.253107	5.61	0.198835	4.97	4.14
App1L1R	Y	8.985417	177	0.294780	6.04	0.171057	4.60	3.32
ccs4L1R	X	15.036250	177	0.407663	4.25	0.626695	5.26	7.15
ccs4S1R	Y	14.983750	177	0.760228	5.82	1.008011	6.70	6.30
ccs2L1R	Y	15.011667	177	0.405684	4.24	0.790708	5.92	8.80
ccs1L1R	Y	14.967917	177	0.832315	6.10	0.638894	5.34	4.07

Table 12c. Genotypic and error variances, with F values for clones for Johnson trial, second ratoon crop, 1988. Harvest characters.

Character & crop	X/Y	General mean	Error df	Error Variance	CV%	Genotypic Variance	GCV%	Fclone
nmg4L2R	X	8.190500	177	1.868784	16.69	4.603777	26.20	10.85
nmg4S2R	Y	7.780417	177	2.808246	21.54	5.937958	31.32	9.46
nmg2L2R	Y	8.021500	177	4.111135	25.28	5.513297	29.27	6.36
nmg1L2R	Y	8.398042	177	8.570324	34.86	10.807671	39.15	6.04
tsh4L2R	X	13.476833	177	2.546887	11.84	7.823137	20.75	13.29
tsh4S2R	Y	13.876708	177	5.172322	16.39	12.397521	25.37	10.59
tsh2L2R	Y	13.403667	177	6.409060	18.89	11.541433	25.35	8.20
tsh1L2R	Y	13.520917	177	15.253185	28.89	22.656755	35.20	6.94
tch4L2R	X	85.037500	177	91.689589	11.26	281.358122	19.73	13.27
tch4S2R	Y	88.161250	177	199.517533	16.02	460.329206	24.34	10.23
tch2L2R	Y	84.917917	177	223.375846	17.60	438.046634	24.65	8.84
tch1L2R	Y	86.455000	177	576.742185	27.78	834.127034	33.41	6.79
App4L2R	X	8.647917	177	0.623358	9.13	0.408510	7.39	3.62
App4S2R	Y	8.620833	177	0.548564	8.59	0.559875	8.68	5.08
App2L2R	Y	8.777083	177	0.494215	8.01	0.428931	7.46	4.47
App1L2R	Y	8.660417	177	0.860411	10.71	0.315137	6.48	2.47
ccs4L2R	X	15.825833	177	0.360662	3.79	0.416783	4.08	5.62
ccs4S2R	Y	15.721250	177	0.525177	4.61	0.394359	3.99	4.00
ccs2L2R	Y	15.755000	177	0.456804	4.29	0.374884	3.89	4.28
ccs1L2R	Y	15.455417	177	1.228373	7.17	0.608587	5.05	2.98

Table 13a. Genotypic and error variances, with F values for clones for Johnson trial, plant crop, 1987. Weight (kg) for different plot shapes.

Character & crop	General mean	Error df	Error Variance	CV%	Genotypic Variance	GCV%	Fclone
a4LP crop	146.714708	177	424.658934	14.05	458.372539	14.59	5.32
b4LP crop	145.777208	177	387.174262	13.50	277.853320	11.43	3.87
c4LP crop	145.985458	177	365.278363	13.09	341.917588	12.67	4.74
d4LP crop	148.510542	177	376.385439	13.06	455.168011	14.37	5.84
bc4LP crop	291.761667	177	844.067679	9.96	1192.864547	11.84	6.65
ad4LP crop	295.224167	177	879.078955	10.04	1804.734175	14.39	9.21
abcd4LP	586.985833	177	1874.200965	7.38	5909.534449	13.10	13.61
a4SP crop	76.358333	177	192.350188	18.16	133.701365	15.14	3.78
b4SP crop	74.051875	177	126.784639	15.21	111.576604	14.26	4.52
c4SP crop	76.910208	177	170.141339	16.96	92.934085	12.53	3.18
d4SP crop	75.991667	177	167.927778	17.05	154.070951	16.33	4.67
ad4SP crop	152.350000	177	415.841620	13.39	553.194680	15.44	6.32
bc4SP crop	150.962083	177	329.207605	12.02	390.241012	13.09	5.74
abcd4SP	303.312083	177	893.646192	9.86	1865.118950	14.24	9.35
a2LP crop	147.458958	177	352.949792	12.74	407.540646	13.69	5.62
b2LP crop	147.633958	177	310.536492	11.94	604.467689	16.65	8.79
ab2LP crop	295.092917	177	672.174544	8.79	2081.800285	15.46	13.39
a1LP crop	144.475000	177	475.704802	15.10	574.952401	16.60	5.83
ad_bcLP	3.462500	177	1572.092302	1145.12	85.662994	267.30	1.22
tad_bcLP	3.381896	177	1891.353002	1285.96	225.594601	444.12	1.48
endBCkgLP	63.363333	177	341.225056	29.15	67.019297	12.92	1.79
trueBCLP	291.842271	177	1149.997399	11.62	1316.163973	12.43	5.58

trueBCLP = (bc4LP - endBCkgLP) * 9.2/7.2, where endBCkgLP is the weight of cane in the 1m end portions of each row. The formula adjusts the weight back to the normal row length.
tad_bcLP = competition computed using trueBCLP

Table 13b. Genotypic and error variances, with F values for clones for Johnson trial, 1R crop, 1988. Weight (kg) for different plot shapes.

Character & crop	General mean	Error df	Error Variance	CV%	Genotypic Variance	GCV%	Fclone
a4L1R crop	153.091583	177	818.191438	18.68	914.951365	19.76	5.47
b4L1R crop	151.987375	177	508.900731	14.84	415.011521	13.40	4.26
c4L1R crop	148.791583	177	437.307135	14.05	544.977581	15.69	5.98
d4L1R crop	152.224917	177	672.659306	17.04	1025.727458	21.04	7.10
bc4L1R crop	300.778958	177	994.354085	10.48	1934.918785	14.62	8.78
ad4L1R crop	305.316458	177	1738.852063	13.66	3597.585567	19.65	9.28
abcd4L1R	606.095417	177	3455.874985	9.70	10691.620099	17.06	13.38
a4S1R crop	78.608333	177	330.585593	23.13	258.992090	20.47	4.13
b4S1R crop	77.320833	177	260.765137	20.88	142.378825	15.43	3.18
c4S1R crop	77.625000	177	229.458427	19.51	204.616325	18.43	4.57
d4S1R crop	79.195833	177	318.801530	22.55	331.941761	23.01	5.16
ad4S1R crop	157.804167	177	724.840890	17.06	1180.107768	21.77	7.51
bc4S1R crop	154.945833	177	554.880438	15.20	674.532203	16.76	5.86
abcd4S1R	312.750000	177	1495.882863	12.37	3562.900047	19.09	10.53
a2L1R crop	149.098750	177	773.082983	18.65	1012.407992	21.34	6.24
b2L1R crop	153.361250	177	906.139782	19.63	1339.650445	23.87	6.91
ab2L1R crop	302.460000	177	1925.605959	14.51	4517.010188	22.22	10.38
a1L1R crop	150.212500	177	1273.077613	23.75	1820.359463	28.40	6.72
ad_bcL1R	4.537500	177	2010.537312	988.19	373.388606	425.86	1.74
ad_bcS1R	2.858333	177	1063.559793	1140.95	146.379896	423.28	1.55

Table 13c. Genotypic and error variances, with F values for clones for Johnson trial, 2R crop, 1989. Weight (kg) for different plot shapes.

Character & crop	General mean	Error df	Error Variance	CV%	Genotypic Variance	GCV%	Fclone
a4L2R crop	117.905167	177	549.315080	19.88	828.626371	24.41	7.03
b4L2R crop	117.255167	177	484.203170	18.77	309.809781	15.01	3.56
c4L2R crop	116.326000	177	419.262610	17.60	342.506108	15.91	4.27
d4L2R crop	117.921833	177	723.470735	22.81	875.288249	25.09	5.84
bc4L2R crop	233.578125	177	975.103591	13.37	1332.450350	15.63	6.47
ad4L2R crop	235.823958	177	1390.990727	15.82	3258.025291	24.20	10.37
abcd4L2R	469.402083	177	2794.017991	11.26	8571.406038	19.72	13.27
a4S2R crop	59.904167	177	280.555391	27.96	306.066855	29.20	5.36
b4S2R crop	61.463542	177	216.416386	23.93	164.709104	20.88	4.04
c4S2R crop	60.492708	177	217.320635	24.37	168.519827	21.46	4.10
d4S2R crop	61.466667	177	300.188889	28.19	305.131733	28.42	5.07
ad4S2R crop	121.370833	177	722.230720	22.14	1142.706073	27.85	7.33
bc4S2R crop	121.956250	177	474.682680	17.86	667.420339	21.18	6.62
abcd4S2R	243.327083	177	1519.649535	16.02	3507.247622	24.34	10.23
a2L2R crop	113.634375	177	632.310771	22.13	660.978958	22.62	5.18
b2L2R crop	120.742708	177	791.277932	23.30	1098.819565	27.45	6.55
ab2L2R crop	234.377083	177	1701.818367	17.60	3336.370351	24.64	8.84
a1L2R crop	119.308333	177	1098.281073	27.78	1588.110593	33.40	6.78
ad_bcL2R	2.245833	177	1938.170645	1960.28	609.545245	1099.32	2.26
ad_bcS2R	-0.585417	177	874.177266	-5050.50	113.005202	-1815.87	1.52

Table 14. Competition equations for long 4-row plots (kg, not adjusted).

Shape	Components		n	m	total competition`			Genotypic variance (Y)		
					b = x + n*w + m*z			P	1R	2R
	t	x	w	z	P	1R	2R			
abcd4L	4g +	1c +	1f +	.2c'	2.3903	2.4143	2.3611	5909.534	10691.620	8751.406
bc4L	2g	+	.5f +	.1c'	0.6952	0.7072	0.6806	1192.865	1934.919	1332.450
ad4L	2g +	1c +	.5f +	.1c'	1.6952	1.7071	1.6806	1804.734	3597.586	3258.025
ad_bc4L		1c			1.0000	1.0000	1.0000	85.663	373.389	609.545

` total competition was computed using solutions to equation (ii).
The equations solved were:

$$b = x + nw + mz$$
$$y = t^2g^2 + b^2c^2 + 2tbrgc$$

where g and c are genotypic standard deviations for true yield and total competition.
The variables (t,x,w,z) and the parameters (n,m) are indicated above.
The solutions (parameter ± standard deviation) were:

4-row LONG plots

	P	1R	2R
g	14.74 ± 0.00	17.39 ± 0.00	13.55 ± 0.03
c	9.26 ± 0.00	19.32 ± 0.00	24.32 ± 0.00
m	5.99 ± 0.00	6.77 ± 0.00	6.48 ± 0.05
n	0.19 ± 0.00	0.06 ± 0.00	0.07 ± 0.01
r	0.75 ± 0.00	0.57 ± 0.00	0.40 ± 0.00
Norm (Fit)	0.012	0.123	56.905

All solutions were obtained without any artificial constraints.
Low values for fit show that the fit was close to exact in P and 1R crops.

The general formulae are those on a plant per row basis in Table 3.
Solutions for 4S plots are shown in Table 20.

Table 15. Estimates of genetic variance in long 4-row plots.
(a) Normal (entire) rows, using solution to equations given in Table 14.

Crop	Shape	Genetic variance due to True yield	Competition	Covariance	Total actual	Error variance
P	abcd4L	3474.2	489.5	1945.8	5909.5	1874.2
	bc4L	868.5	41.4	282.9	1192.9	844.1
	ad4L	868.5	246.2	690.0	1804.7	879.1
	ad_bc4L	0	85.7	0	85.7	1572.1
1R	abcd4L	4839.7	2176.4	3675.5	10691.6	3455.9
	bc4L	1209.9	186.7	538.3	1934.9	994.4
	ad4L	1209.9	1088.2	1299.5	3597.6	1738.9
	ad_bc4L	0	373.4	0	373.4	2010.5
2R	abcd4L	2938.2	3297.8	2497.4	8751.4	2794.0
	bc4L	734.5	274.0	359.9	1332.5	975.1
	ad4L	734.5	1670.7	888.8	3258.0	1391.0
	ad_bc4L	0	591.5	0	609.5	1938.2

Estimated and actual total genetic variances were the same, except for a small difference in the 2R long plots, where the maximum error was 3 per cent.

(b) Ends weighed separately in inner rows, using solution to equations given in Table 19.

Crop	Shape	Genetic variance due to True yield	Competition	Covariance	Total actual	Error variance
P	AD	1306.10	285.86	212.77	1804.73	879.08
	BCt	1306.10	0.57	9.50	1316.16	1150.00
	AD_BCt	0.00	225.59	0.00	225.59	1891.35
	endBC	61.79	1.68	3.55	67.02	341.23

Estimated and actual total genetic variances were the same.
BCt = (BC - endBC) x 9.2/7.2, the weight (without ends) being readjusted to the normal row length of 9.2m

Table 16. Competition equations for short 4-row plots (kg, not adjusted).

Shape	Components		n	m	total competition\`			Genotypic variance (Y)		
					b = x + n*w + m*z			P	1R	2R
	t	x	w	z	P	1R	2R			
abcd4S	4g +	1c +	1f +	.4c'	3.0116	2.2732	2.4172	1865.119	3562.900	3507.248
bc4S	2g	+	.5f +	.2c'	1.0058	0.6366	0.7086	390.241	674.532	667.420
ad4S	2g +	1c +	.5f +	.2c'	2.0058	1.6366	1.7086	553.195	1180.108	1142.706
ad_bc4S		1c			1.0000	1.0000	1.0000	21.750	146.250	113.000

\` total competition was computed using solutions to equation (ii).
The equations solved were:

$$b = x + nw + mz$$
$$y = t^2g^2 + b^2c^2 + 2tbrgc$$

where g and c are genotypic standard deviations for true yield and total competition.
The variables (t,x,w,z) and the parameters (n,m) are indicated above.
The solutions (parameter ± standard deviation) were:

	4-row SHORT plots		
	P	1R	2R
g	8.22 ± 0.00	11.24 ± 0.00	10.81 ± 0.00
c	4.66 ± 0.00	12.09 ± 0.00	10.63 ± 0.00
m	4.53 ± 0.00	2.68 ± 0.00	3.04 ± 0.00
n	0.20 ± 0.00	0.20~± 0.00	0.20~± 0.00
r	0.64 ± 0.00	0.32 ± 0.00	0.44 ± 0.00
Norm (fit)	0.001	0.041	0.001

~ The constraint that n < 0.2 was active for ratoon crops.
Low values for fit show that the fit was close to exact in all crops.

The general formulae are those on a plant per row basis in Table 3.
Solutions for 4L plots are shown in Table 14.

Table 17. Estimates of genetic variance in short 4-row plots, using solution to equations given in Table 16.

Crop	Shape	Genetic variance due to True yield	Competition	Covariance	Total actual	Error variance
P	abcd4S	1080.8	197.3	587.0	1865.1	893.6
	bc4S	270.2	22.0	98.0	390.2	329.2
	ad4S	270.2	87.5	195.5	553.2	415.8
	ad_bc4S	0	21.8	0	21.8	596.5
1R	abcd4S	2021.4	755.3	786.9	3562.9	1495.9
	bc4S	505.4	59.2	110.2	674.5	554.9
	ad4S	505.4	391.5	283.2	1180.1	724.8
	ad_bc4S	0	146.2	0	146.3	1064.0
2R	abcd4S	1869.7	660.2	977.3	3507.2	1519.6
	bc4S	467.4	56.7	143.2	667.4	474.7
	ad4S	467.4	329.9	345.4	1142.7	722.2
	ad_bc4S	0	113.00	0	113.0	874.2

Estimated and actual total genetic variances were the same.

Table 18. Estimates of genetic variance in long or short 4-row plots, using solution to equations given in Tables 14 and 16. Results are expressed as per cent of total genetic variance.

Crop	Shape	Genetic variance due to True yield	Competition	Covariance	Total	Error variance
P	abcd4L	59	8	33	100	32
	bc4L	73	3	24	100	71
	ad4L	48	14	38	100	49
P	abcd4S	58	11	31	100	48
	bc4S	69	6	25	100	84
	ad4S	49	16	35	100	75
1R	abcd4L	45	20	34	100	32
	bc4L	63	10	28	100	51
	ad4L	34	30	36	100	48
1R	abcd4S	57	21	22	100	42
	bc4S	75	9	16	100	82
	ad4S	43	33	24	100	61
2R	abcd4L	34	38	29	100	32
	bc4L	55	21	27	100	73
	ad4L	23	51	27	100	43
2R	abcd4S	53	19	28	100	43
	bc4S	70	8	21	100	71
	ad4S	41	29	30	100	63

Table 19. Competition equations for total weight (kg) of border (AD) and inner (BCt) rows of the plant crop of 4L plots. The ends of the inner rows (endBC, 1m each end) were weighed separately. BCt = (BC - endBC) x 9.2/7.2, its weight being expressed on a normal 9.2m row length.

Shape	Components t	x	n w	m z	total competition\` b = x + nw + mz	Genotypic variance
AD	40g +	20c +	10f +	2c'	22.514	1804.734
BCt	40g	+	10f		1.005	1316.164
AD_BCt		20c			20.000	225.595
endBC	8.7g	+	2.174f +	2c'	1.727	67.019

\` total competition was computed using solutions to equation (ii). The equations solved were:

$$b = x + nw + mz$$
$$y = t^2g^2 + b^2c^2 + 2tbrgc$$

where g and c are genotypic standard deviations for true yield and total competition. The variables (t,x,w,z) and the parameters (n,m) are indicated above. The solutions (parameter ± standard deviation) were:

g	0.904 ± 0.00
c	0.751 ± 0.00
m	0.754 ± 0.00
n	0.101 ± 0.00
r	0.174 ± 0.00

This solution was obtained without any artificial constraint.
An exact fit (Norm = 0.0) was obtained.

The general formulae are those on a plot total basis in Table 3.
Solutions are shown in Table 16 for 4S plots and in Table 14 for normal 4L.

Table 20. Competition equations for eight plot shapes.

Shape	Components parameter / variable x	n / w	m / z	total competition, b = x + n*w + m*z` r < 1.0 P	1R	2R	r < 0.6 P	1R	2R	Genotypic variance (Y) P	1R	2R
4L	g + .25c + .25f + .05c'			0.442	0.432	0.591	0.453	0.436	0.583	369.35	668.23	535.71
4S	g + .25c + .25f + .1c'			0.633	0.563	0.882	0.655	0.571	0.874	436.58	836.32	815.75
2L	g + .5c + .5f + .05c'			0.692	0.732	0.890	0.703	0.736	0.875	514.82	1133.65	836.40
1L	g + c + f + .05c'			1.192	1.332	1.489	1.203	1.336	1.460	593.17	1852.28	1536.42
bc4L	g + .25f + .05c'			0.192	0.182	0.341	0.203	0.186	0.333	301.77	491.05	336.32
ad4L	g + .5c + .25f + .05c'			0.692	0.682	0.841	0.703	0.686	0.833	445.91	886.08	806.77
bc4S	g + .25f + .1c'			0.383	0.313	0.632	0.405	0.321	0.624	368.75	645.07	617.96
ad4S	g + .5c + .25f + .1c'			0.883	0.813	1.132	0.905	0.821	1.124	513.25	1088.04	1068.26

` total competition was computed using the following solutions to equation (iii):
parameters ± standard deviation

	r < 1.0 P	1R	2R	r < 0.6 P	1R	2R
g	16.57 ± 2.99	19.51 ± 5.15	13.19 ± 3.77	16.91 ± 3.05	20.07 ± 4.93	14.83 ± 3.96
c	6.86 ± 17.0	19.69 ± 14.1	17.49 ± 4.63	8.84 ± 14.6	20.96 ± 13.7	19.54 ± 5.28
m	3.83 ± 2.52	2.63 ± 1.52	5.83 ± 0.74	4.05 ± 2.86	2.71 ± 1.58	5.81 ± 0.09
n	0.00 ± 0.48˜	0.20 ± 0.36˜	0.20 ± 0.12	0.00 ± 0.49˜	0.20 ± 0.36˜	0.17 ± 0.14
r	1.00 ± 3.68˜	0.77 ± 1.35	1.00 ± 1.01˜	0.60 ± 1.97˜	0.60 ± 1.10˜	0.60 ± 0.78˜
Fit	68.2	151.8	58.9	73.3	153.0	71.7
	Figure 1	Figure 2	Figure 3			

˜ designated restrictions were operating (r < 1.0 or r < 0.6, and/or 0 < n < 0.2)

Fit = "Norm" used by SigmaPlot. The lower the value, the better the fit.

The general formulae are those on a plant per whole plot basis in Table 3.

Table 21. Estimates of genetic variance in eight plot shapes, using solution to equations given in Table 20, with r < 1.0.

Crop	Shape	Genetic variance due to True yield	Compet-ition	Covar-iance	Total estimated	actual	Error variance
P	4L	274.6	9.2	100.4	384.2	369.346	117.138
	4S	274.6	18.9	144.0	437.5	436.579	209.181
	2L	274.6	22.5	157.3	454.4	514.822	166.226
	1L	274.6	66.9	271.1	612.5	593.174	490.781
	bc4L	274.6	1.7	43.6	319.9	301.766	213.529
	ad4L	274.6	22.5	157.3	454.4	445.907	217.200
	bc4S	274.6	6.9	87.1	368.6	368.750	311.078
	ad4S	274.6	36.7	200.9	512.2	513.249	385.814
1R	4L	380.6	72.2	254.9	707.8	668.23	215.992
	4S	380.6	123.0	332.6	836.2	836.32	351.128
	2L	380.6	207.5	432.1	1020.2	1133.65	483.274
	1L	380.6	687.4	786.4	1854.5	1852.28	1295.403
	bc4L	380.6	12.8	107.3	500.7	491.05	252.353
	ad4L	380.6	180.1	402.5	963.3	886.08	428.276
	bc4S	380.6	38.0	185.0	603.6	645.07	530.642
	ad4S	380.6	256.4	480.3	1117.3	1088.04	668.294
2R	4L	174.0	106.8	272.6	553.3	535.713	174.626
	4S	174.0	238.0	407.0	819.0	815.747	353.454
	2L	174.0	242.4	410.7	827.1	836.400	426.632
	1L	174.0	678.3	687.1	1539.3	1536.417	1062.532
	bc4L	174.0	35.5	157.2	366.7	336.323	246.125
	ad4L	174.0	216.2	387.9	778.1	806.768	344.444
	bc4S	174.0	122.2	291.6	587.9	617.961	439.507
	ad4S	174.0	392.1	522.3	1088.4	1068.257	675.177

Similar estimates with r < 0.6 are given in Table 22.

Table 22. Estimates of genetic variance in eight plot shapes, using solution to equations given in Table 20, with $r < 0.6$

Crop	Shape	Genetic variance due to True yield	Competition	Covariance	Total estimated	actual	Error variance
P	4L	286.0	16.0	81.2	383.1	369.346	117.138
	4S	286.0	33.5	117.5	437.0	436.579	209.181
	2L	286.0	38.6	126.0	450.5	514.822	166.226
	1L	286.0	113.0	215.7	614.6	593.174	490.781
	bc4L	286.0	3.2	36.3	325.5	301.766	213.529
	ad4L	286.0	38.6	126.0	450.5	445.907	217.200
	bc4S	286.0	12.8	72.7	371.4	368.750	311.078
	ad4S	286.0	64.0	162.3	512.3	513.249	385.814
1R	4L	402.7	83.4	219.8	705.9	668.23	215.992
	4S	402.7	143.3	288.3	834.3	836.32	351.128
	2L	402.7	237.7	371.3	1011.7	1133.65	483.274
	1L	402.7	783.6	674.1	1860.4	1852.28	1295.403
	bc4L	402.7	15.1	93.7	511.5	491.05	252.353
	ad4L	402.7	206.5	346.0	955.2	886.08	428.276
	bc4S	402.7	45.3	162.1	610.1	645.07	530.642
	ad4S	402.7	296.2	414.5	1113.4	1088.04	668.294
2R	4L	220.0	129.8	202.8	552.6	535.713	174.626
	4S	220.0	291.4	303.9	815.4	815.747	353.454
	2L	220.0	292.5	304.4	817.0	836.400	426.632
	1L	220.0	813.7	507.8	1541.5	1536.417	1062.532
	bc4L	220.0	42.3	115.8	378.2	336.323	246.125
	ad4L	220.0	264.9	289.7	774.7	806.768	344.444
	bc4S	220.0	148.5	216.9	585.4	617.961	439.507
	ad4S	220.0	482.1	390.9	1093.0	1068.257	675.177

Table 23. Genetic variance for competition, expressed as per cent of true yield variance, for 8 plot shapes.

Shape	r < 1.0` Plant	1R	2R	r < 0.6 Plant	1R	2R
4L	3	19	61	6	21	59
4S	7	32	137	12	36	132
2L	8	55	139	13	59	133
1L	24	181	390	40	195	370
bc4L	1	3	20	1	4	19

` The estimates are based on competition equations solved with the genetic correlation between true yield and competition (r) restricted to < 1.0 or < 0.6

Table 24. Estimated gain from selection as per cent of mean, with 20% selected, and r < 1.0. Similar estimates with r < 0.6 are in Table 25.

(a) Gain in true yield (g)

Plot shape	Plant crop 1-rep	2-rep	4-rep	First ratoon crop 1-rep	2-rep	4-rep	Second ratoon crop 1-rep	2-rep	4-rep
4L	14.0	15.0	15.5	15.8	16.6	17.5	13.9	14.8	15.4
4S	13.0	14.2	15.0	14.7	15.9	16.6	13.2	14.3	15.0
2L	12.9	13.8	14.3	13.7	14.9	15.6	12.7	14.0	14.7
1L	11.9	13.5	14.6	12.7	14.3	15.3	12.1	13.6	14.5
bc4L	12.5	14.0	15.0	14.7	16.2	17.0	12.5	14.1	15.1
ad4L	13.1	14.3	15.1	14.8	16.2	17.1	12.9	14.0	14.7
bc4S	11.6	13.3	14.4	12.7	14.5	15.7	11.7	13.2	14.1
ad4S	11.9	13.5	14.5	13.7	15.2	16.2	12.4	13.8	14.8

(b) Gain in true yield + competition

Plot shape	Plant crop 1-rep	2-rep	4-rep	First ratoon crop 1-rep	2-rep	4-rep	Second ratoon crop 1-rep	2-rep	4-rep
4L	16.0	17.0	17.6	20.8	22.2	23.0	24.0	25.6	26.6
4S	16.4	17.9	18.8	22.4	24.3	25.4	28.5	30.9	32.4
2L	18.8	20.1	20.8	26.0	28.2	29.6	28.1	30.8	32.5
1L	17.2	19.5	21.2	30.5	34.2	36.7	36.0	40.3	43.2
bc4L	12.7	14.2	15.3	16.6	18.3	19.3	16.6	18.7	20.1
ad4L	16.5	18.1	19.0	22.6	24.7	26.0	28.4	30.8	32.2
bc4S	13.5	15.4	16.6	17.4	19.8	21.4	22.7	25.5	27.3
ad4S	16.3	18.4	19.8	24.0	26.7	28.4	30.5	34.0	36.2

Table 25. Estimated gain from selection as per cent of mean, with 20% selected. Equations were solved by restricting the genetic correlation between true yield and competition to 0.6

(a) Gain in true yield (g)

Plot shape	Plant crop 1-rep	2-rep	4-rep	First ratoon crop 1-rep	2-rep	4-rep	Second ratoon crop 1-rep	2-rep	4-rep
4L	13.9	14.8	15.3	15.6	16.6	17.2	14.2	15.2	15.7
4S	12.9	14.1	14.9	14.7	15.9	16.6	13.0	14.1	14.8
2L	13.4	14.4	15.0	14.1	15.4	16.2	12.6	13.8	14.6
1L	11.3	12.8	13.8	12.2	13.6	14.6	11.1	12.4	13.3
bc4L	12.5	14.0	14.9	15.0	16.4	17.3	13.3	14.8	15.8
ad4L	12.9	14.1	14.8	14.3	15.6	16.3	13.0	14.1	14.8
bc4S	11.8	13.4	14.5	13.2	15.1	16.4	12.2	13.8	14.9
ad4S	11.7	13.2	14.2	13.4	14.8	15.7	11.8	13.1	14.0

(b) Gain in true yield + competition

Plot shape	Plant crop 1-rep	2-rep	4-rep	First ratoon crop 1-rep	2-rep	4-rep	Second ratoon crop 1-rep	2-rep	4-rep
4L	16.3	17.4	18.0	21.5	22.9	23.7	24.4	26.1	27.0
4S	16.4	17.9	18.8	22.4	24.3	25.4	28.5	30.9	32.4
2L	17.3	18.6	19.4	24.2	26.4	27.8	27.6	30.4	32.1
1L	17.6	20.0	21.6	30.6	34.3	36.8	36.0	40.4	43.3
bc4L	13.4	14.9	16.0	17.1	18.7	19.7	18.1	20.2	21.5
ad4L	16.6	18.2	19.1	23.7	25.8	27.1	27.6	30.0	31.5
bc4S	13.6	15.4	16.7	16.7	19.1	20.7	21.8	24.6	26.5
ad4S	16.3	18.4	19.8	24.4	27.0	28.7	31.0	34.5	36.7

Table 26. Estimated gain from selection as per cent of mean, with 20% selected, for portions of 4L plots.

(a) Gain in true yield, for normal plots.

Plot shape	Plant crop 1-rep	2-rep	4-rep	First ratoon crop 1-rep	2-rep	4-rep	Second ratoon crop 1-rep	2-rep	4-rep
abcd4L	12.0	12.8	13.3	13.0	13.8	14.3	11.6	12.4	12.9
bc4L	10.7	12.1	12.9	12.7	14.0	14.7	11.3	12.7	13.7
ad4L	11.1	12.1	12.8	11.7	12.8	13.4	10.2	11.1	11.6

(b) Gain in true yield + competition, for normal plots.

Plot shape	Plant crop 1-rep	2-rep	4-rep	First ratoon crop 1-rep	2-rep	4-rep	Second ratoon crop 1-rep	2-rep	4-rep
abcd4L	16.0	17.0	17.6	20.8	22.2	23.0	24.3	25.9	26.8
bc4L	12.7	14.2	15.3	16.6	18.3	19.3	16.9	19.0	20.4
ad4L	16.5	18.1	19.0	22.6	24.7	26.0	28.6	31.0	32.4

(c) Gain in yield , ends weighed separately in inner rows

Plot shape	True yield 1-rep	2-rep	4-rep	True yield+competition 1-rep	2-rep	4-rep
ad4L	12.9	14.1	14.9	16.5	18.1	19.0
bc4Lt	12.7	14.5	15.7	12.7	14.5	15.8
ENDbc	7.0	9.1	11.4	7.3	9.6	12.0

bc4Lt = (bc4L - ENDbc) x 9.2/7.2 weight of the inner portion being adjusted to the normal row length of 9.2m.
ENDbc = weight (kg) of cane on 1m length at start and end of both inner rows.

Table 27. Realized gains from selection in 4-row short (4S), 2-row (2L) and 1-row (1L) plots. Gains were measured by performance in 4-row long plots.

Character and shape selected	Number of clones selected	Crop	bc4L	TCH	TSH	NMG
			Realized gain as per cent of General Mean			
tch4SP	12	p	16.8	18.7	20.1	22.1
		1r	19.3	19.6	20.1	21.1
		2r	17.5	20.1	19.0	18.5
		pr	17.9	19.4	19.8	20.6
tch4SP	6	p	15.7	18.4	22.9	23.0
		1r	22.7	25.1	27.6	26.4
		2r	15.4	18.5	18.0	11.3
		pr	18.2	20.9	23.1	20.1
tch4SP	4	p	17.0	21.0	29.1	33.2
		1r	29.6	31.6	36.2	35.7
		2r	18.5	22.9	25.1	20.1
		pr	22.0	25.4	30.5	29.6
tch4S1R	12	p	11.7	13.9	15.7	18.2
		1r	22.0	25.0	26.6	28.6
		2r	20.0	26.1	26.7	25.1
		pr	17.8	21.4	22.9	23.9
tch4S1R	6	p	16.9	18.2	16.7	18.5
		1r	25.5	29.0	27.2	26.8
		2r	19.8	27.1	24.0	19.6
		pr	20.9	24.6	22.7	21.6
tch4S1R	4	p	15.1	16.3	15.3	16.1
		1r	24.5	30.8	30.4	30.9
		2r	17.9	28.5	26.3	24.5
		pr	19.3	25.0	24.0	23.8
tch4S2R	12	p	9.2	11.1	11.1	13.1
		1r	19.0	22.6	23.5	25.9
		2r	21.2	27.4	27.8	27.7
		pr	16.1	19.9	20.5	22.2
tch4S2R	6	p	8.7	9.6	11.8	16.1
		1r	19.7	23.2	26.0	31.8
		2r	23.1	32.2	33.5	35.0
		pr	16.8	20.9	23.4	27.6
tch4S2R	4	p	13.6	14.1	16.1	21.4
		1r	23.9	27.5	30.8	38.1
		2r	24.2	36.1	38.7	45.0
		pr	20.3	25.2	28.1	34.8

Table 27 continued 2/10

Character	Number of clones selected	Crop	bc4L	TCH	TSH	NMG
			Realized gain as per cent of General Mean			
tsh4SP	12	p	12.5	14.5	18.5	22.1
		1r	18.7	19.7	22.6	25.3
		2r	16.4	20.4	21.7	23.1
		pr	15.9	18.0	20.9	23.5
tsh4SP	6	p	14.2	18.1	24.5	27.3
		1r	24.0	25.4	29.7	29.6
		2r	14.6	18.7	19.4	15.2
		pr	17.9	20.9	24.9	24.0
tsh4SP	4	p	17.0	21.0	29.1	33.2
		1r	29.6	31.6	36.2	35.7
		2r	18.5	22.9	25.1	20.1
		pr	22.0	25.4	30.5	29.6
tsh4S1R	12	p	10.1	12.5	15.2	18.1
		1r	20.0	24.0	26.2	29.6
		2r	19.1	25.0	26.5	26.2
		pr	16.2	20.2	22.5	24.6
tsh4S1R	6	p	14.7	16.5	22.2	25.6
		1r	26.1	28.7	32.4	33.1
		2r	15.9	22.2	22.6	16.5
		pr	19.2	22.5	26.0	25.0
tsh4S1R	4	p	21.1	22.4	31.1	36.9
		1r	32.7	33.7	38.7	39.7
		2r	17.4	24.2	25.5	19.6
		pr	24.3	27.0	32.2	32.0
tsh4S2R	12	p	9.2	11.1	11.1	13.1
		1r	19.0	22.6	23.5	25.9
		2r	21.2	27.4	27.8	27.7
		pr	16.1	19.9	20.5	22.2
tsh4S2R	6	p	10.4	12.0	14.9	19.2
		1r	21.7	25.4	29.2	35.2
		2r	27.1	35.5	38.7	42.3
		pr	19.2	23.5	27.2	32.2
tsh4S2R	4	p	10.5	11.7	15.4	19.7
		1r	22.3	25.8	30.3	36.0
		2r	24.4	35.6	39.0	39.7
		pr	18.8	23.6	27.8	31.8

Table 27 continued 3/10

Character	Number of clones selected	Crop	bc4L	TCH	TSH	NMG
		Realized gain as per cent of General Mean				
nmg4SP	12	p	9.7	12.1	18.0	23.7
		1r	16.4	17.8	22.0	26.6
		2r	14.8	19.3	22.3	26.3
		pr	13.6	16.2	20.7	25.6
nmg4SP	6	p	12.9	15.2	22.3	27.6
		1r	24.7	26.9	31.7	36.0
		2r	20.4	25.7	29.3	29.6
		pr	19.3	22.4	27.8	31.1
nmg4SP	4	p	13.0	16.9	24.8	27.7
		1r	25.2	27.2	32.0	32.1
		2r	17.1	18.9	21.9	16.6
		pr	18.6	21.2	26.6	25.4
nmg4S1R	12	p	7.6	9.8	13.2	17.3
		1r	17.9	21.7	24.3	29.0
		2r	14.0	20.8	22.9	25.0
		pr	13.2	17.3	20.1	23.7
nmg4S1R	6	p	14.3	16.4	22.6	26.7
		1r	25.9	28.3	32.9	35.6
		2r	16.8	24.8	27.7	25.2
		pr	19.2	23.1	27.8	29.1
nmg4S1R	4	p	16.1	17.7	25.7	32.5
		1r	28.2	29.9	36.1	41.0
		2r	17.4	27.3	30.9	32.8
		pr	20.9	24.9	31.0	35.3
nmg4S2R	12	p	7.0	8.7	11.5	16.6
		1r	13.3	15.8	18.4	24.3
		2r	20.7	24.6	27.5	32.8
		pr	13.2	15.8	18.8	24.6
nmg4S2R	6	p	9.9	10.0	11.2	17.0
		1r	15.1	17.1	19.0	25.8
		2r	21.0	28.0	30.6	41.4
		pr	14.9	17.7	19.8	28.1
nmg4S2R	4	p	6.2	5.6	7.8	14.8
		1r	15.5	18.1	21.5	30.9
		2r	23.2	30.8	33.8	44.7
		pr	14.4	17.3	20.5	30.2

Table 27 continued 4/10

Character	Number of clones selected	Crop	bc4L	TCH	TSH	NMG
		Realized gain as per cent of General Mean				
tch2LP	12	p	16.9	18.8	18.3	18.5
		1r	19.9	21.9	20.9	20.0
		2r	17.4	20.0	18.0	15.4
		pr	18.1	20.2	19.2	18.0
tch2LP	6	p	20.7	23.8	22.8	21.0
		1r	22.1	22.4	21.7	17.9
		2r	17.7	18.2	14.6	8.2
		pr	20.3	21.7	20.0	15.7
tch2LP	4	p	21.9	25.3	24.4	25.6
		1r	25.7	24.3	22.6	18.0
		2r	16.0	17.5	12.4	4.5
		pr	21.6	22.7	20.1	16.0
tch2L1R	12	p	12.3	13.9	15.5	17.5
		1r	23.2	25.7	26.9	28.5
		2r	19.3	24.1	24.1	21.9
		pr	18.3	21.1	22.2	22.6
tch2L1R	6	p	14.8	17.1	21.9	25.1
		1r	26.1	29.2	34.1	36.5
		2r	21.0	27.2	29.7	29.7
		pr	20.7	24.4	28.7	30.4
tch2L1R	4	p	17.2	19.3	25.9	28.5
		1r	28.8	31.5	37.7	38.1
		2r	15.3	23.1	25.4	20.7
		pr	20.9	24.8	30.1	29.0
tch2L2R	12	p	7.7	9.9	9.7	11.1
		1r	16.8	21.1	22.3	25.0
		2r	20.5	27.3	27.8	29.3
		pr	14.6	18.9	19.6	21.8
tch2L2R	6	p	11.1	13.1	15.1	16.5
		1r	22.2	26.5	30.3	33.2
		2r	25.7	32.7	35.1	34.3
		pr	19.3	23.5	26.5	28.0
tch2L2R	4	p	14.7	15.7	16.3	17.5
		1r	24.5	29.1	32.4	35.2
		2r	22.1	31.8	33.2	32.9
		pr	20.4	25.1	27.1	28.5

Table 27 continued 5/10

Character	Number of clones selected	Crop	bc4L	TCH	TSH	NMG
		Realized gain as per cent of General Mean				
tsh2LP	12	p	14.2	14.6	15.0	14.2
		1r	17.2	19.3	20.3	20.3
		2r	14.6	18.1	17.9	18.6
		pr	15.4	17.3	17.8	17.7
tsh2LP	6	p	17.5	19.8	23.9	22.9
		1r	24.2	27.2	31.8	31.3
		2r	17.2	22.0	23.3	19.0
		pr	19.9	23.1	26.6	24.4
tsh2LP	4	p	13.1	17.9	24.0	24.8
		1r	25.8	29.3	35.3	34.0
		2r	16.4	21.8	25.1	21.2
		pr	18.7	23.2	28.4	26.6
tsh2L1R	12	p	10.3	12.0	14.9	17.5
		1r	21.9	25.1	27.3	30.6
		2r	18.7	24.8	26.2	25.9
		pr	16.9	20.4	22.8	24.6
tsh2L1R	6	p	14.8	17.1	21.9	25.1
		1r	26.1	29.2	34.1	36.5
		2r	21.0	27.2	29.7	29.7
		pr	20.7	24.4	28.7	30.4
tsh2L1R	4	p	17.2	19.3	25.9	28.5
		1r	28.8	31.5	37.7	38.1
		2r	15.3	23.1	25.4	20.7
		pr	20.9	24.8	30.1	29.0
tsh2L2R	12	p	5.4	7.7	9.4	11.7
		1r	15.1	20.1	22.7	26.9
		2r	18.1	25.8	27.8	31.0
		pr	12.5	17.3	19.7	23.2
tsh2L2R	6	p	11.3	13.4	15.3	18.3
		1r	22.2	26.7	30.3	35.4
		2r	24.5	33.5	36.6	40.8
		pr	19.0	23.9	27.0	31.5
tsh2L2R	4	p	16.6	17.9	20.1	24.4
		1r	27.2	31.3	34.7	39.4
		2r	29.0	37.1	38.8	43.0
		pr	23.9	28.2	31.0	35.6

Table 27 continued 6/10

Character	Number of clones selected	Crop	bc4L	TCH	TSH	NMG
		Realized gain as per cent of General Mean				
nmg2LP	12	p	10.8	13.0	15.1	19.3
		1r	15.3	17.1	19.0	22.2
		2r	15.9	19.6	21.7	26.6
		pr	13.9	16.3	18.5	22.7
nmg2LP	6	p	11.4	12.9	20.2	27.7
		1r	15.8	15.9	20.8	26.0
		2r	18.1	18.7	22.7	29.7
		pr	14.9	15.6	21.2	27.8
nmg2LP	4	p	6.4	10.4	19.8	25.8
		1r	15.3	16.3	23.5	26.6
		2r	14.6	14.4	19.2	21.1
		pr	11.9	13.7	21.0	24.5
nmg2L1R	12	p	8.8	10.4	15.1	19.6
		1r	20.9	23.4	27.1	31.9
		2r	18.1	24.0	26.5	27.5
		pr	15.8	19.0	22.8	26.3
nmg2L1R	6	p	12.8	14.6	19.2	23.1
		1r	23.9	26.7	31.5	35.7
		2r	17.8	26.5	29.6	31.0
		pr	18.3	22.4	26.7	29.9
nmg2L1R	4	p	17.2	19.3	25.9	28.5
		1r	28.8	31.5	37.7	38.1
		2r	15.3	23.1	25.4	20.7
		pr	20.9	24.8	30.1	29.0
nmg2L2R	12	p	4.1	5.8	9.4	13.6
		1r	13.6	17.3	20.8	26.9
		2r	18.3	24.8	27.6	32.4
		pr	11.6	15.4	18.9	24.3
nmg2L2R	6	p	11.0	12.7	14.6	18.4
		1r	20.8	24.9	28.3	34.9
		2r	25.9	34.3	37.4	45.2
		pr	18.8	23.3	26.3	32.9
nmg2L2R	4	p	13.6	14.1	16.1	21.4
		1r	23.9	27.5	30.8	38.1
		2r	24.2	36.1	38.7	45.0
		pr	20.3	25.2	28.1	34.8

Table 27 continued 7/10

Character	Number of clones selected	Crop	bc4L	TCH	TSH	NMG
			Realized gain as per cent of General Mean			
tch1LP	12	p	14.7	17.4	18.3	16.5
		1r	18.6	21.4	22.7	20.0
		2r	10.5	15.3	15.2	10.0
		pr	14.9	18.3	19.0	15.5
tch1LP	6	p	19.6	21.7	26.4	31.4
		1r	30.2	30.9	33.7	34.3
		2r	22.6	27.1	27.2	23.8
		pr	24.3	26.6	29.2	29.8
tch1LP	4	p	17.0	21.0	29.1	33.2
		1r	29.6	31.6	36.2	35.7
		2r	18.5	22.9	25.1	20.1
		pr	22.0	25.4	30.5	29.6
tch1L1R	12	p	9.7	11.5	15.0	17.5
		1r	19.6	21.9	24.2	25.0
		2r	16.9	21.7	22.2	19.2
		pr	15.3	18.1	20.4	20.5
tch1L1R	6	p	16.3	19.0	25.3	28.7
		1r	28.1	30.8	35.6	36.5
		2r	19.9	25.5	27.8	23.9
		pr	21.6	25.1	29.8	29.6
tch1L1R	4	p	16.9	18.4	21.3	22.8
		1r	27.5	31.6	34.5	35.1
		2r	20.5	29.4	30.4	24.2
		pr	21.8	26.3	28.8	27.3
tch1L2R	12	p	9.8	12.1	15.5	18.4
		1r	18.8	21.5	24.2	25.9
		2r	18.5	24.7	26.5	25.3
		pr	15.5	19.1	21.9	23.2
tch1L2R	6	p	13.3	15.6	16.1	17.2
		1r	23.7	26.7	29.2	29.9
		2r	25.9	31.8	32.5	29.1
		pr	20.7	24.2	25.7	25.4
tch1L2R	4	p	14.9	17.5	20.0	21.3
		1r	26.3	31.5	35.9	37.7
		2r	25.3	33.6	35.9	35.4
		pr	22.0	27.2	30.5	31.4

Table 27 continued 8/10

Character	Number of clones selected	Crop	bc4L	TCH	TSH	NMG
			Realized gain as per cent of General Mean			
tsh1LP	12	p	15.0	17.7	18.7	17.1
		1r	19.4	22.3	23.9	22.5
		2r	14.3	19.3	19.6	16.5
		pr	16.4	19.8	20.9	18.6
tsh1LP	6	p	19.8	22.3	27.6	27.1
		1r	24.1	25.5	30.8	30.6
		2r	15.2	19.3	20.4	17.4
		pr	20.0	22.6	26.6	24.9
tsh1LP	4	p	19.1	21.5	29.8	35.4
		1r	31.4	33.7	40.1	42.2
		2r	22.1	28.4	31.0	30.8
		pr	24.5	27.9	33.9	36.1
tsh1L1R	12	p	11.5	13.5	17.4	17.7
		1r	18.0	20.6	23.6	23.7
		2r	12.5	17.1	17.8	14.9
		pr	14.2	17.1	19.8	18.7
tsh1L1R	6	p	16.3	19.0	25.3	28.7
		1r	28.1	30.8	35.6	36.5
		2r	19.9	25.5	27.8	23.9
		pr	21.6	25.1	29.8	29.6
tsh1L1R	4	p	15.1	18.8	25.2	26.3
		1r	27.0	29.4	33.8	31.5
		2r	11.7	17.6	19.5	10.0
		pr	18.5	22.3	26.7	22.5
tsh1L2R	12	p	8.4	10.7	13.4	15.6
		1r	16.8	19.8	22.9	25.1
		2r	18.5	24.8	26.8	27.8
		pr	14.3	18.0	20.8	22.8
tsh1L2R	6	p	13.3	15.6	16.1	17.2
		1r	23.7	26.7	29.2	29.9
		2r	25.9	31.8	32.5	29.1
		pr	20.7	24.2	25.7	25.4
tsh1L2R	4	p	14.9	17.5	20.0	21.3
		1r	26.3	31.5	35.9	37.7
		2r	25.3	33.6	35.9	35.4
		pr	22.0	27.2	30.5	31.4

Table 27 continued 9/10

Character	Number of clones selected	Realized gain as per cent of General Mean Crop	bc4L	TCH	TSH	NMG
nmg1LP	12	p	14.5	17.2	18.4	17.5
		1r	19.7	22.1	24.0	23.9
		2r	14.4	18.6	18.6	15.6
		pr	16.4	19.4	20.5	19.0
nmg1LP	6	p	19.2	22.1	26.6	29.9
		1r	27.6	27.6	32.0	32.5
		2r	19.2	23.7	24.1	22.9
		pr	22.2	24.6	27.8	28.4
nmg1LP	4	p	19.1	21.5	29.8	35.4
		1r	31.4	33.7	40.1	42.2
		2r	22.1	28.4	31.0	30.8
		pr	24.5	27.9	33.9	36.1
nmg1L1R	12	p	11.0	13.0	17.0	19.7
		1r	20.3	22.6	25.8	28.6
		2r	15.6	21.7	23.6	24.1
		pr	15.7	19.0	22.2	24.1
nmg1L1R	6	p	16.3	19.0	25.3	28.7
		1r	28.1	30.8	35.6	36.5
		2r	19.9	25.5	27.8	23.9
		pr	21.6	25.1	29.8	29.6
nmg1L1R	4	p	14.9	17.5	20.0	21.3
		1r	26.3	31.5	35.9	37.7
		2r	25.3	33.6	35.9	35.4
		pr	22.0	27.2	30.5	31.4
nmg1L2R	12	p	7.2	8.9	9.9	11.6
		1r	16.1	19.3	21.3	24.5
		2r	19.5	26.0	27.7	30.2
		pr	13.9	17.5	19.3	22.1
nmg1L2R	6	p	11.1	13.1	15.1	16.5
		1r	22.2	26.5	30.3	33.2
		2r	25.7	32.7	35.1	34.3
		pr	19.3	23.5	26.5	28.0
nmg1L2R	4	p	14.9	17.5	20.0	21.3
		1r	26.3	31.5	35.9	37.7
		2r	25.3	33.6	35.9	35.4
		pr	22.0	27.2	30.5	31.4

Table 27 continued 10/10

bc4L = weight (kg) of the middle two rows (b+c) of a 4-row long plot
Crops are plant (p), first ratoon (1r) and second ratoon(2r), upper case being used for crops selected and lower case for crops evaluated in 4-row long plots. pr = (p+1r+2r)/3
e.g nmg1L2R = selection was based on net merit grade in the second ratoon 1-row long plot.

Table 28. Realized gains from selection of 20% of clones in 4S, 2L and 1L plots, evaluated in 4L plots in the same crop. Results are based on clone means over all 4 replications. More detailed results are in Table 27.

Character selected	evaluated	Shape	Crop P	1R	2R
NMG	NMG	4S	23.7	29.0	32.8
		2L	19.3	31.9	32.4
		1L	17.5	28.6	30.2
TSH	TSH	4S	18.5	26.2	27.8
		2L	15.0	27.3	27.8
		1L	18.7	23.6	26.8
TCH	TCH	4S	19.6	25.0	27.4
		2L	18.8	25.7	27.3
		1L	17.4	21.9	24.7
TCH	bc4L	4S	16.8	22.0	21.2
		2L	16.9	23.2	20.5
		1L	14.7	19.6	18.5

Table 29. Means for different plot shapes, sorted into descending order.

Rank	K1= ccs4LP		K2=ccs4L1R		K3=ccs4L2R		K4= app4LP		K5=app4L1R		K6=app4L2R	
1	16	17.100	1	16.575	51	17.125	9	10.125	13	10.375	4	10.375
2	1	16.600	16	16.450	2	16.975	40	10.125	9	10.125	13	9.875
3	10	16.375	10	16.425	1	16.850	14	10.000	4	10.125	49	9.750
4	13	16.225	51	16.225	58	16.850	23	10.000	58	9.875	56	9.750
5	51	16.150	15	16.175	13	16.800	56	10.000	37	9.875	58	9.500
6	11	16.000	2	15.975	14	16.700	58	10.000	56	9.875	9	9.500
7	48	15.975	38	15.975	16	16.600	13	10.000	6	9.625	22	9.375
8	2	15.925	37	15.900	36	16.575	1	10.000	50	9.625	23	9.375
9	52	15.700	33	15.825	10	16.575	4	10.000	40	9.625	1	9.375
10	39	15.425	17	15.750	33	16.475	39	10.000	43	9.625	51	9.375
11	37	15.425	39	15.725	4	16.400	51	9.875	29	9.625	50	9.375
12	31	15.425	42	15.725	44	16.375	5	9.875	59	9.500	24	9.375
13	38	15.325	3	15.725	38	16.350	18	9.875	39	9.500	8	9.250
14	42	15.250	23	15.650	17	16.325	29	9.875	1	9.375	34	9.250
15	29	15.250	11	15.625	42	16.325	37	9.875	51	9.375	59	9.250
16	27	15.225	29	15.625	35	16.325	8	9.875	24	9.375	43	9.250
17	44	15.225	30	15.625	5	16.300	6	9.875	47	9.250	52	9.125
18	15	15.175	52	15.600	11	16.275	48	9.750	23	9.250	33	9.125
19	58	15.150	58	15.575	24	16.225	43	9.750	2	9.250	29	9.000
20	17	15.150	44	15.575	48	16.225	41	9.750	52	9.250	40	9.000
21	6	15.075	35	15.550	37	16.175	22	9.750	60	9.125	32	9.000
22	30	15.050	14	15.550	27	16.100	59	9.750	41	9.125	60	9.000
23	5	15.050	6	15.500	23	16.075	46	9.750	22	9.125	39	9.000
24	12	14.975	24	15.425	53	16.025	32	9.625	42	9.125	44	9.000
25	33	14.950	5	15.425	15	16.025	30	9.625	10	9.000	37	9.000
26	14	14.900	57	15.400	47	16.025	50	9.625	49	9.000	2	9.000
27	19	14.825	27	15.250	39	16.000	45	9.625	26	9.000	55	8.875
28	50	14.800	48	15.225	29	16.000	52	9.625	31	9.000	53	8.875
29	41	14.750	13	15.150	6	16.000	31	9.500	8	8.875	28	8.750
30	47	14.750	59	15.100	3	16.000	49	9.375	35	8.875	14	8.625
31	36	14.750	50	15.050	59	15.975	26	9.375	27	8.875	17	8.625
32	3	14.675	55	15.025	9	15.925	2	9.375	55	8.875	38	8.625
33	23	14.600	9	14.975	50	15.900	44	9.375	34	8.875	10	8.625
34	53	14.575	47	14.975	30	15.875	34	9.375	44	8.875	41	8.625
35	9	14.525	36	14.975	57	15.850	42	9.375	28	8.750	26	8.625
36	57	14.500	60	14.950	43	15.850	12	9.250	45	8.750	6	8.500
37	54	14.500	31	14.925	31	15.800	54	9.250	5	8.750	54	8.500
38	4	14.450	41	14.875	52	15.775	60	9.250	53	8.625	18	8.500
39	60	14.400	12	14.875	55	15.725	57	9.250	18	8.625	15	8.375
40	35	14.400	45	14.825	20	15.700	33	9.125	14	8.625	47	8.375
41	43	14.300	53	14.775	54	15.550	27	9.125	33	8.625	5	8.250
42	24	14.225	40	14.725	25	15.525	11	9.125	11	8.625	57	8.250
43	59	14.225	21	14.725	28	15.450	53	9.125	32	8.500	27	8.250
44	40	14.200	43	14.675	19	15.375	16	9.125	3	8.500	35	8.125
45	45	14.125	54	14.525	7	15.325	35	9.000	57	8.500	36	8.125
46	56	14.125	34	14.375	12	15.300	28	9.000	19	8.500	3	8.125
47	46	14.125	19	14.375	60	15.300	10	9.000	15	8.375	30	8.125
48	20	13.775	7	14.375	56	15.275	24	9.000	30	8.375	48	8.000
49	21	13.750	56	14.275	45	15.225	3	8.875	12	8.375	42	8.000
50	55	13.550	8	14.175	34	15.225	55	8.875	38	8.375	19	8.000
51	18	13.250	4	14.175	22	15.150	36	8.750	16	8.375	12	8.000
52	49	13.175	25	14.150	40	15.100	47	8.750	54	8.250	45	8.000
53	28	13.125	20	14.150	41	15.000	19	8.750	7	8.250	20	7.875
54	26	13.100	18	14.075	32	14.850	15	8.625	48	8.250	16	7.750
55	7	13.025	28	14.025	21	14.825	17	8.500	46	8.250	31	7.750
56	8	12.950	49	13.550	18	14.675	7	8.250	20	8.125	11	7.500
57	32	12.900	46	13.175	8	14.600	20	8.125	17	8.125	21	7.375
58	34	12.825	32	13.175	49	14.575	38	8.125	36	8.125	46	7.250
59	22	11.850	26	13.075	46	14.125	21	7.750	21	8.000	7	6.875
60	25	10.725	22	12.875	26	13.650	25	7.750	25	7.875	25	6.500
Mean		14.598		15.036		15.826		9.358		8.946		8.648

Table 29 continued 2/11

Rank	K1= tch4LP		K2=tch4L1R		K3=tch4L2R		K4= tsh4LP		K5=tsh4L1R		K6=tsh4L2R	
1	26	138.250	39	151.630	39	122.350	16	22.465	39	23.805	39	19.545
2	21	133.070	57	151.480	44	118.070	39	20.038	16	23.360	44	19.347
3	18	131.750	28	143.500	58	114.520	15	19.845	57	23.355	58	19.275
4	57	131.700	31	142.220	57	113.880	31	19.615	44	22.165	42	18.063
5	16	131.430	44	142.130	59	112.130	57	19.100	31	21.218	57	18.060
6	15	130.680	16	142.000	42	110.530	44	18.818	35	20.608	59	17.897
7	39	129.850	50	134.600	18	107.850	21	18.285	50	20.243	24	16.970
8	31	127.670	18	132.880	24	104.470	26	18.088	28	20.050	31	16.372
9	28	125.020	35	132.450	31	103.750	4	17.450	59	19.815	35	16.325
10	44	123.820	59	131.370	56	101.500	18	17.403	51	19.585	18	15.825
11	4	120.780	41	127.820	41	101.070	5	17.290	15	19.568	51	15.810
12	59	115.930	58	125.550	35	100.070	17	17.100	58	19.540	2	15.795
13	5	114.930	42	124.000	28	99.800	10	16.845	42	19.515	9	15.520
14	35	114.530	15	120.780	9	97.500	51	16.800	41	19.043	56	15.448
15	34	113.900	24	120.700	23	96.020	36	16.610	18	18.733	23	15.448
16	9	113.770	51	120.650	26	95.450	1	16.530	24	18.643	4	15.430
17	53	113.280	26	119.570	50	94.680	53	16.510	2	18.485	28	15.340
18	17	113.050	9	119.500	52	94.250	9	16.508	9	17.915	36	15.315
19	32	113.020	21	118.620	4	94.050	59	16.478	21	17.528	41	15.170
20	36	112.780	46	116.100	2	92.970	35	16.410	10	17.488	50	15.067
21	46	111.180	2	115.600	36	92.550	28	16.382	52	17.448	13	15.045
22	8	110.450	56	115.200	51	92.380	13	16.382	23	17.198	1	14.890
23	24	110.280	49	115.030	6	91.630	58	16.300	29	17.150	52	14.880
24	41	108.050	36	113.030	49	91.130	42	16.088	38	17.143	6	14.675
25	50	107.850	52	111.700	34	90.100	29	16.067	6	16.952	15	13.940
26	58	107.800	23	110.100	13	89.520	50	15.930	36	16.945	10	13.925
27	25	107.680	32	109.920	1	88.750	41	15.910	17	16.738	33	13.805
28	3	106.630	29	109.820	15	86.630	38	15.783	56	16.468	27	13.768
29	45	106.130	6	109.630	27	85.470	24	15.728	13	16.263	34	13.693
30	49	105.930	45	108.880	21	85.470	46	15.703	45	16.165	16	13.685
31	42	105.750	40	108.350	29	85.400	3	15.665	33	16.153	29	13.658
32	29	105.550	34	107.530	32	84.250	47	15.328	5	16.097	47	13.438
33	51	104.250	38	107.250	53	83.970	52	15.280	40	15.960	53	13.427
34	47	103.400	53	107.150	47	83.930	45	15.000	53	15.893	49	13.283
35	10	103.000	10	106.420	10	83.880	54	14.938	26	15.642	26	13.005
36	54	102.970	17	106.400	33	83.850	48	14.767	49	15.630	21	12.770
37	38	102.400	13	106.200	16	82.400	12	14.668	1	15.547	32	12.488
38	55	101.430	5	104.450	40	79.780	34	14.575	55	15.475	55	12.452
39	13	101.020	43	103.930	55	79.250	2	14.495	34	15.415	38	12.298
40	1	99.650	55	103.030	46	76.020	32	14.435	46	15.358	5	12.220
41	56	99.100	33	102.070	38	75.330	6	14.297	27	15.275	37	12.220
42	12	97.800	4	101.420	37	75.150	8	14.260	43	15.270	17	12.128
43	52	97.470	47	100.830	5	74.720	37	14.000	37	15.203	40	12.040
44	40	96.030	60	100.680	17	74.380	27	13.988	47	15.103	11	11.945
45	23	95.520	27	100.280	43	74.000	56	13.970	60	15.003	43	11.730
46	7	95.470	8	98.820	11	73.480	23	13.958	11	14.745	54	11.040
47	6	94.980	7	98.600	54	70.550	49	13.913	32	14.425	30	10.820
48	43	94.400	37	95.780	7	69.770	55	13.738	4	14.360	46	10.755
49	48	92.180	11	94.300	60	69.180	40	13.580	30	14.310	7	10.695
50	27	91.730	1	94.070	30	68.320	33	13.480	7	14.153	60	10.573
51	22	91.170	30	91.770	22	67.900	43	13.438	8	14.005	22	10.313
52	2	91.100	3	88.800	45	64.070	11	13.073	3	13.985	48	10.138
53	37	90.630	19	88.550	3	62.770	30	13.068	12	12.935	3	10.045
54	33	89.970	12	86.950	48	62.350	19	12.848	19	12.685	45	9.817
55	60	88.600	54	84.100	8	62.220	60	12.738	54	12.218	19	9.223
56	20	87.080	20	83.980	19	60.150	7	12.433	20	11.878	8	9.065
57	30	86.880	48	74.900	12	55.720	20	12.007	48	11.395	20	8.717
58	19	86.800	25	69.750	20	55.230	25	11.540	14	10.673	12	8.498
59	11	81.550	14	68.680	14	49.900	22	10.797	25	9.843	14	8.340
60	14	71.280	22	66.420	25	45.780	14	10.642	22	8.595	25	7.145
Mean		106.339		109.799		85.037		15.490		16.539		13.477

Table 29 continued 3/11

Rank	K1= nmg4LP		K2=nmg4L1R		K3=nmg4L2R		K4= ccs4SP		K5=ccs4S1R		K6=ccs4S2R	
1	16	12.557	39	12.250	58	13.155	16	16.950	51	16.850	51	17.150
2	39	11.420	16	11.100	44	12.500	48	16.300	16	16.750	1	16.975
3	31	10.710	44	10.975	39	12.333	1	16.225	1	16.675	13	16.900
4	44	10.235	57	10.790	4	11.725	10	15.900	10	16.250	14	16.700
5	1	10.077	58	10.575	59	11.685	13	15.850	39	16.100	10	16.700
6	15	9.995	50	10.552	24	11.355	35	15.850	2	16.100	24	16.625
7	4	9.918	51	10.420	51	10.815	14	15.675	58	16.075	58	16.600
8	5	9.913	59	10.190	13	10.668	2	15.475	33	16.050	25	16.550
9	51	9.862	31	10.170	56	10.510	29	15.475	3	15.975	33	16.450
10	57	9.765	35	9.653	2	10.458	38	15.425	29	15.950	55	16.375
11	13	9.660	9	9.650	57	10.330	51	15.350	48	15.900	3	16.375
12	18	9.313	42	9.530	1	10.310	37	15.350	35	15.875	31	16.325
13	58	9.285	2	9.520	9	10.265	24	15.125	37	15.875	48	16.325
14	9	9.208	24	9.423	23	10.240	6	15.100	38	15.850	2	16.275
15	26	9.140	41	9.363	50	9.977	42	15.075	17	15.800	4	16.225
16	10	9.070	15	9.280	42	9.955	52	15.000	57	15.725	11	16.200
17	59	8.970	13	9.153	52	9.305	11	14.950	14	15.725	52	16.150
18	29	8.760	28	9.123	28	9.255	3	14.925	24	15.675	27	16.125
19	48	8.748	6	9.070	35	9.188	15	14.875	5	15.650	16	16.125
20	41	8.740	10	8.950	18	9.150	58	14.825	11	15.625	44	16.075
21	50	8.635	29	8.805	36	9.010	44	14.800	31	15.625	23	16.050
22	46	8.560	18	8.625	33	8.965	23	14.750	30	15.625	42	16.000
23	53	8.530	56	8.618	6	8.930	33	14.675	42	15.575	39	15.975
24	42	8.403	23	8.518	41	8.882	19	14.600	52	15.575	29	15.975
25	36	8.375	52	8.463	31	8.840	60	14.475	23	15.550	5	15.950
26	52	8.365	1	8.420	10	8.760	57	14.450	15	15.525	37	15.950
27	6	8.190	40	8.193	49	8.695	27	14.450	13	15.475	34	15.925
28	17	8.095	37	8.155	53	8.648	59	14.375	50	15.425	36	15.925
29	24	8.010	38	7.940	34	8.618	41	14.350	6	15.425	6	15.900
30	35	7.987	5	7.823	15	8.400	43	14.350	9	15.350	19	15.900
31	2	7.960	33	7.783	29	8.175	53	14.325	44	15.225	57	15.850
32	54	7.953	21	7.725	47	7.823	9	14.300	59	15.100	17	15.825
33	3	7.940	43	7.700	55	7.683	39	14.175	41	15.050	20	15.800
34	21	7.925	4	7.535	16	7.680	31	14.150	55	15.050	59	15.800
35	28	7.785	36	7.443	38	7.668	30	14.050	36	14.975	9	15.700
36	37	7.738	47	7.435	27	7.648	4	14.025	27	14.925	43	15.700
37	56	7.657	53	7.383	32	7.508	45	13.950	43	14.875	35	15.525
38	23	7.630	55	7.350	37	7.465	17	13.925	19	14.825	28	15.525
39	12	7.625	17	7.215	5	7.423	36	13.900	60	14.550	53	15.475
40	38	7.580	45	7.098	43	7.405	28	13.900	45	14.525	50	15.475
41	40	7.575	34	7.080	17	7.338	47	13.800	47	14.525	21	15.450
42	47	7.540	49	7.060	40	7.130	20	13.750	28	14.450	38	15.425
43	45	7.490	27	6.983	26	7.070	56	13.700	21	14.425	47	15.325
44	30	7.268	11	6.925	54	6.630	12	13.625	34	14.400	41	15.250
45	43	7.240	26	6.903	22	6.523	54	13.575	53	14.400	56	15.250
46	32	7.220	60	6.890	21	6.450	32	13.275	8	14.375	30	15.200
47	34	7.075	30	6.585	11	6.308	40	13.250	20	14.350	15	15.175
48	11	7.053	3	6.537	30	6.275	34	13.200	40	14.300	45	15.125
49	33	7.030	46	6.343	60	6.120	18	13.125	7	14.100	60	15.025
50	8	6.993	7	5.928	48	6.093	25	12.975	56	13.850	7	15.000
51	27	6.895	8	5.895	3	5.733	7	12.725	18	13.775	22	14.950
52	49	6.713	32	5.838	14	5.200	49	12.650	4	13.675	8	14.850
53	55	6.655	12	5.573	46	5.063	8	12.550	54	13.625	12	14.800
54	60	6.238	19	5.570	19	5.017	46	12.475	12	13.575	32	14.800
55	19	6.208	54	5.267	8	4.963	22	11.975	49	13.350	18	14.750
56	14	5.953	48	5.245	45	4.928	50	11.875	26	12.950	40	14.725
57	7	5.385	14	5.082	7	4.858	21	11.775	22	12.875	49	14.450
58	20	5.140	20	4.630	20	4.548	55	11.625	32	12.850	26	14.425
59	22	4.883	25	3.828	12	4.510	5	10.975	46	12.650	46	14.075
60	25	4.233	22	3.533	25	3.278	26	10.925	25	11.800	54	13.775
Mean		8.118		7.928		8.191		14.158		14.984		15.721

Table 29 continued 4/11

Rank	K1= tch4SP		K2=tch4S1R		K3=tch4S2R		K4= tsh4SP		K5=tsh4S1R		K6=tsh4S2R	
1	16	151.180	57	177.000	57	134.050	16	25.640	57	27.847	57	21.228
2	57	143.280	39	154.830	39	130.630	57	20.695	39	24.933	58	20.953
3	44	138.820	28	153.800	58	126.220	44	20.550	16	24.595	39	20.885
4	31	137.930	41	153.050	59	120.920	31	19.485	31	23.455	42	19.273
5	21	135.900	31	149.750	42	120.500	41	19.358	41	22.913	44	19.080
6	41	135.550	18	147.570	41	119.570	15	18.980	35	22.673	59	19.068
7	18	134.750	16	147.250	35	119.250	39	18.958	58	22.485	35	18.610
8	26	134.730	35	142.680	44	118.750	58	18.728	28	22.280	23	18.307
9	39	133.530	44	142.020	18	116.200	35	18.353	44	21.640	31	18.240
10	4	130.850	58	140.050	23	114.070	4	18.130	42	21.268	41	18.153
11	15	127.850	59	139.680	31	112.000	10	17.878	59	21.070	28	17.245
12	58	126.020	42	136.680	28	111.350	18	17.600	9	20.978	18	17.098
13	28	125.180	9	136.600	9	108.000	51	17.440	18	20.360	9	16.940
14	59	121.330	21	128.250	21	106.920	59	17.425	2	19.757	1	16.903
15	45	117.350	50	127.350	52	102.670	28	17.408	50	19.660	21	16.667
16	53	116.400	2	122.750	36	100.920	42	17.250	51	19.358	52	16.545
17	35	115.780	23	119.930	4	99.630	3	16.952	1	18.995	51	16.507
18	9	115.150	46	117.230	56	99.600	38	16.835	21	18.765	4	16.163
19	8	114.550	15	116.680	1	99.400	29	16.680	23	18.677	24	16.103
20	3	114.400	36	116.500	6	99.070	53	16.662	10	18.565	36	16.052
21	42	114.380	13	115.950	26	98.650	1	16.433	15	18.153	2	15.883
22	51	113.300	51	114.780	2	98.150	9	16.400	13	17.953	10	15.875
23	10	112.600	45	114.500	24	97.130	45	16.380	38	17.850	6	15.783
24	50	112.430	10	113.950	51	96.300	13	16.280	24	17.695	56	15.227
25	32	111.820	1	113.850	10	95.180	21	16.233	52	17.635	13	14.650
26	36	110.720	52	113.150	47	94.220	48	15.642	36	17.475	47	14.460
27	17	109.730	24	113.130	32	93.250	24	15.578	5	17.395	33	14.417
28	49	109.680	38	112.750	50	92.380	37	15.558	29	17.287	50	14.273
29	5	109.320	56	112.330	33	87.630	36	15.433	37	16.913	26	14.190
30	38	109.030	5	111.150	13	86.500	2	15.333	6	16.820	32	13.637
31	29	107.850	32	110.500	29	85.150	17	15.300	45	16.628	29	13.617
32	34	106.800	43	109.970	40	84.200	23	15.105	43	16.382	55	13.372
33	47	105.700	6	109.250	53	83.970	32	14.818	33	16.267	53	12.987
34	7	105.570	29	108.630	7	82.770	26	14.728	55	16.173	16	12.883
35	54	105.130	53	108.280	55	81.800	52	14.653	17	16.080	27	12.773
36	46	104.880	55	107.330	15	80.950	47	14.565	11	15.858	38	12.513
37	55	103.880	7	106.970	38	80.280	8	14.317	53	15.572	43	12.453
38	40	103.130	37	106.350	16	79.650	54	14.230	56	15.563	7	12.448
39	13	102.820	49	104.630	43	79.400	34	14.140	7	15.205	40	12.445
40	23	102.570	4	103.430	27	79.270	43	13.887	30	15.035	34	12.395
41	24	102.130	26	103.350	49	78.170	49	13.845	47	15.030	15	12.163
42	1	101.380	47	103.080	34	77.670	19	13.808	46	14.933	11	11.918
43	37	101.320	40	102.900	17	74.250	30	13.713	27	14.743	17	11.738
44	2	99.250	17	101.550	46	73.470	40	13.665	40	14.720	37	11.662
45	30	98.530	33	101.380	37	73.130	6	13.628	34	14.398	49	11.288
46	25	98.180	11	101.250	11	72.970	7	13.468	3	14.295	30	11.047
47	56	98.080	34	99.930	45	72.950	56	13.425	8	14.120	45	10.983
48	52	97.520	27	98.470	30	72.600	50	13.423	4	14.118	8	10.423
49	43	96.880	8	98.000	8	70.350	27	13.227	32	14.047	46	10.360
50	48	96.150	30	96.350	22	63.900	46	13.068	49	13.975	48	10.353
51	19	94.630	60	96.000	5	63.770	33	12.997	60	13.970	5	10.168
52	27	91.720	3	89.430	48	63.370	11	12.670	26	13.383	19	9.953
53	12	90.280	19	87.970	19	62.670	25	12.640	48	13.248	22	9.557
54	6	90.100	54	87.150	60	60.380	12	12.372	19	13.053	60	9.073
55	22	89.300	48	83.350	54	59.700	60	12.343	54	11.887	3	8.560
56	33	88.850	20	78.330	12	52.550	55	12.153	20	11.258	54	8.267
57	60	85.450	12	74.480	3	52.320	5	12.025	14	10.567	12	7.742
58	11	85.100	22	74.280	25	45.650	20	11.648	12	10.140	25	7.550
59	20	84.750	25	74.200	14	43.980	14	11.352	22	9.563	14	7.317
60	14	72.530	14	67.200	20	39.230	22	10.660	25	9.102	20	6.185
Mean		109.900		113.320		88.160		15.536		17.079		13.877

Table 29 continued 5/11

Rank	K1=	nmg4SP	K2=	nmg4S1R	K3=	nmg4S2R	K4=	ccs2LP	K5=	ccs2L1R	K6=	ccs2L2R
1	16	14.310	57	12.642	58	12.982	16	16.800	16	16.900	51	17.000
2	44	11.283	39	12.247	39	12.495	1	16.750	51	16.650	13	16.900
3	31	10.343	16	11.515	59	12.117	10	16.300	1	16.425	48	16.825
4	35	10.255	58	11.402	23	11.547	48	16.300	29	16.325	10	16.800
5	58	10.165	31	10.780	57	11.392	29	15.900	35	16.175	1	16.750
6	39	10.128	35	10.725	4	11.105	2	15.775	58	16.100	58	16.675
7	4	10.005	41	10.490	44	10.953	11	15.625	13	16.000	2	16.575
8	57	10.005	59	10.267	1	10.930	13	15.600	11	15.925	39	16.525
9	51	9.918	9	9.970	35	10.490	37	15.575	10	15.925	24	16.525
10	15	9.763	51	9.932	9	10.405	17	15.525	2	15.875	30	16.375
11	1	9.758	28	9.885	42	10.350	35	15.475	37	15.875	14	16.350
12	41	9.740	2	9.665	31	10.295	24	15.450	24	15.850	33	16.325
13	59	9.653	1	9.475	41	10.290	38	15.375	38	15.825	4	16.300
14	48	9.298	10	9.460	2	10.100	52	15.350	33	15.800	16	16.300
15	18	9.227	18	9.455	51	10.060	42	15.325	17	15.775	38	16.300
16	28	9.058	44	9.430	18	10.050	51	15.250	57	15.775	44	16.250
17	29	9.043	50	9.413	52	9.920	5	15.225	14	15.775	23	16.225
18	13	8.958	42	9.105	6	9.890	58	15.200	42	15.725	52	16.125
19	10	8.888	23	8.835	13	9.710	39	15.175	23	15.625	11	16.100
20	42	8.853	13	8.542	56	9.655	44	15.150	5	15.550	42	16.050
21	24	8.803	29	8.215	24	9.632	57	15.100	55	15.475	7	16.025
22	9	8.795	38	8.190	28	9.600	14	15.075	15	15.475	50	16.000
23	3	8.660	37	8.077	10	9.485	30	15.025	30	15.400	53	15.975
24	2	8.382	24	8.007	21	8.265	33	15.025	31	15.300	29	15.925
25	38	8.380	15	7.958	50	8.245	12	15.000	21	15.275	59	15.925
26	37	8.375	6	7.950	29	8.225	4	14.900	36	15.275	5	15.900
27	53	8.265	5	7.830	33	8.048	9	14.875	39	15.175	15	15.875
28	23	8.105	52	7.818	36	8.023	19	14.625	52	15.175	19	15.850
29	45	8.087	21	7.510	47	7.895	23	14.575	59	15.125	37	15.850
30	32	7.733	43	7.503	32	7.525	36	14.575	50	15.075	55	15.850
31	6	7.620	36	7.497	53	7.403	53	14.550	12	15.075	6	15.775
32	52	7.593	55	7.315	26	7.310	3	14.550	3	15.025	3	15.775
33	36	7.533	33	7.253	34	7.235	60	14.525	9	15.000	27	15.750
34	17	7.382	56	7.210	43	7.173	47	14.475	44	14.975	9	15.750
35	47	7.298	30	7.090	55	7.160	43	14.425	41	14.950	35	15.725
36	43	7.200	53	6.903	27	6.838	15	14.425	6	14.825	31	15.650
37	19	7.188	45	6.882	40	6.705	41	14.325	48	14.825	47	15.625
38	54	7.080	40	6.780	38	6.678	31	14.325	53	14.725	57	15.600
39	30	7.077	17	6.710	49	6.383	59	14.250	43	14.650	12	15.600
40	34	7.060	11	6.707	17	6.048	50	14.250	28	14.650	36	15.550
41	56	6.998	4	6.640	48	6.020	40	14.150	27	14.650	56	15.525
42	40	6.995	47	6.552	16	5.820	56	14.150	40	14.650	43	15.450
43	21	6.968	3	6.262	37	5.738	27	14.125	45	14.600	20	15.400
44	8	6.775	7	6.190	15	5.680	28	14.100	47	14.600	60	15.375
45	49	6.652	34	6.053	11	5.605	55	14.050	20	14.575	41	15.350
46	11	6.650	48	5.985	22	5.520	7	13.975	34	14.525	34	15.325
47	33	6.608	46	5.825	19	5.493	45	13.875	8	14.350	45	15.300
48	60	6.460	27	5.822	5	5.443	6	13.800	60	14.325	28	15.300
49	14	6.445	49	5.780	30	5.385	21	13.575	4	14.325	25	15.225
50	26	6.275	60	5.747	8	5.330	54	13.525	19	14.125	21	15.200
51	27	6.250	19	5.555	7	5.153	18	13.500	7	14.100	32	15.175
52	46	6.238	32	5.340	45	5.118	46	13.350	18	13.900	18	14.975
53	7	6.138	8	5.340	60	4.803	20	13.275	56	13.875	40	14.925
54	50	5.708	26	5.030	3	4.565	49	13.100	25	13.750	22	14.900
55	5	5.570	14	4.572	14	4.460	25	12.575	32	13.625	54	14.900
56	12	5.535	54	4.555	46	4.223	26	12.375	49	13.575	17	14.850
57	25	5.507	20	3.953	54	3.970	34	12.250	46	13.525	8	14.825
58	20	5.155	22	3.548	25	3.573	8	12.000	26	13.225	46	14.525
59	55	5.153	12	3.463	12	3.460	22	11.875	22	12.600	49	14.425
60	22	4.622	25	2.967	20	2.860	32	11.475	54	12.475	26	13.100
Mean		7.966		7.630		7.781		14.518		15.012		15.755

Table 29 continued 6/11

Rank	K1= tch2LP		K2=tch2L1R		K3=tch2L2R		K4= tsh2LP		K5=tsh2L1R		K6=tsh2L2R	
1	16	152.600	57	176.800	57	140.350	16	25.660	16	28.358	57	21.997
2	26	140.700	16	167.950	59	125.930	57	20.817	57	27.895	39	20.123
3	57	138.150	39	160.850	39	121.830	35	20.513	35	25.845	59	20.048
4	18	134.630	35	159.700	35	121.450	44	20.145	39	24.347	44	19.210
5	21	134.530	59	148.450	44	118.350	39	18.728	59	22.405	35	19.118
6	44	133.280	44	147.130	42	116.550	21	18.292	44	21.965	58	19.030
7	35	132.570	28	144.030	58	114.200	4	18.110	50	21.448	42	18.605
8	28	128.070	50	142.380	41	113.230	18	18.093	42	21.218	52	17.950
9	41	125.380	41	140.080	52	111.400	28	18.050	28	21.080	24	17.708
10	39	123.400	42	134.800	28	109.400	41	17.955	41	20.845	41	17.375
11	4	121.880	18	134.250	24	106.630	24	17.917	31	20.375	28	16.725
12	31	121.330	31	133.350	18	106.130	38	17.735	58	19.813	51	16.525
13	59	117.800	21	129.430	6	101.000	26	17.428	21	19.705	23	16.353
14	15	117.380	9	128.270	50	100.900	31	17.375	51	19.523	50	16.138
15	36	116.600	58	123.380	23	100.650	42	17.290	9	19.200	18	15.990
16	24	116.430	36	121.130	56	100.150	9	17.285	23	18.810	6	15.935
17	9	116.380	23	120.380	26	98.400	5	17.168	18	18.642	56	15.522
18	38	115.400	52	117.580	51	97.330	1	17.068	36	18.535	36	15.125
19	53	114.730	51	117.150	36	96.980	36	16.993	29	18.490	13	15.073
20	50	114.400	24	115.850	9	93.230	58	16.885	24	18.475	9	14.672
21	45	114.300	2	114.950	21	93.000	15	16.852	2	18.212	4	14.548
22	42	112.900	56	114.930	29	90.080	59	16.770	52	17.845	29	14.422
23	5	112.430	46	113.430	15	89.650	53	16.715	45	16.475	10	14.300
24	3	111.730	49	112.680	4	89.450	29	16.542	10	16.335	15	14.257
25	58	111.030	45	112.680	13	89.180	17	16.453	38	16.265	21	14.132
26	8	110.050	29	112.500	31	88.930	10	16.413	6	16.233	1	13.890
27	47	109.950	26	110.880	27	88.030	50	16.307	55	16.058	27	13.838
28	49	108.950	6	108.430	32	87.180	3	16.243	5	16.055	31	13.733
29	32	107.230	32	105.350	47	86.830	47	15.913	56	15.912	2	13.730
30	17	106.350	8	104.550	49	86.180	45	15.850	15	15.847	47	13.550
31	34	104.830	55	103.880	10	84.850	52	15.702	13	15.795	7	13.327
32	29	104.080	5	103.350	34	84.800	51	15.015	46	15.352	32	13.238
33	46	103.000	47	102.850	7	83.030	13	14.938	1	15.315	16	13.150
34	52	102.600	38	102.820	2	82.830	48	14.688	49	15.297	26	12.992
35	1	101.950	7	102.800	1	82.830	23	14.555	37	15.055	34	12.932
36	40	101.680	15	102.630	46	80.600	12	14.480	47	15.007	49	12.420
37	55	101.550	10	102.250	16	80.580	55	14.403	8	14.985	33	12.355
38	10	100.700	34	99.830	40	79.400	2	14.385	17	14.815	55	11.925
39	23	99.430	40	99.180	33	75.830	37	14.375	11	14.708	46	11.880
40	25	98.980	13	98.550	55	75.180	40	14.255	26	14.648	40	11.855
41	51	98.580	4	97.000	38	71.750	49	14.230	40	14.575	38	11.670
42	54	98.050	53	96.450	53	70.630	46	13.975	7	14.552	53	11.318
43	12	96.300	27	96.200	5	68.780	54	13.273	34	14.492	5	10.940
44	13	95.630	60	95.130	37	66.530	56	13.240	32	14.378	11	10.545
45	7	94.330	37	95.030	43	66.300	8	13.160	53	14.225	37	10.543
46	56	93.680	43	94.100	8	66.280	7	13.155	27	14.090	30	10.435
47	37	92.380	17	93.780	19	65.150	60	12.958	4	13.905	19	10.307
48	6	91.250	1	93.470	11	65.130	19	12.918	33	13.862	43	10.270
49	2	91.100	11	92.400	30	63.750	34	12.858	43	13.773	48	10.203
50	48	90.280	33	87.680	54	62.230	43	12.855	60	13.630	8	9.813
51	22	89.780	30	87.230	17	60.730	6	12.713	30	13.418	54	9.273
52	60	89.430	19	83.250	48	60.530	30	12.698	19	11.760	60	9.115
53	43	89.350	12	77.730	22	59.750	27	12.608	12	11.720	22	8.930
54	27	89.230	54	76.880	60	59.230	25	12.388	3	11.410	17	8.905
55	19	88.350	20	76.350	45	57.000	32	12.245	20	11.170	45	8.688
56	30	84.780	3	75.630	3	54.200	33	12.188	25	10.430	3	8.650
57	33	80.900	25	75.280	25	53.480	11	11.730	54	9.770	25	8.150
58	20	77.300	22	68.280	14	45.300	22	10.705	48	9.588	14	7.405
59	11	74.880	48	64.680	12	45.150	14	10.573	14	9.065	12	7.062
60	14	70.150	14	57.400	20	40.800	20	10.258	22	8.618	20	6.305
Mean		106.918		109.590		84.920		15.518		16.527		13.404

Table 29 continued 7/11

Rank	K1= nmg2LP		K2=nmg2L1R		K3=nmg2L2R		K4= ccs1LP		K5=ccs1L1R		K6=ccs1L2R	
1	16	14.352	16	12.735	59	13.063	16	16.350	51	16.950	1	17.425
2	35	11.875	57	12.725	58	12.957	10	16.300	1	16.525	33	16.700
3	44	11.720	39	12.110	57	12.847	1	16.175	13	16.425	10	16.575
4	1	10.830	35	12.060	39	12.765	38	16.075	10	16.400	13	16.525
5	4	10.823	59	11.125	24	11.807	14	15.750	58	16.375	14	16.475
6	39	10.792	58	10.422	44	11.637	11	15.700	15	16.225	39	16.475
7	57	10.615	44	10.407	51	11.432	29	15.650	38	16.175	4	16.425
8	24	10.395	50	10.380	52	11.153	39	15.325	16	16.000	44	16.425
9	5	10.365	51	9.932	42	11.002	35	15.300	21	15.875	50	16.350
10	28	10.295	41	9.902	35	10.840	52	15.150	44	15.875	53	16.325
11	18	10.133	42	9.617	13	10.727	24	15.125	55	15.825	2	16.325
12	58	10.070	31	9.592	41	10.525	50	15.050	14	15.750	43	16.300
13	9	9.908	28	9.270	56	10.525	58	15.025	33	15.750	58	16.300
14	29	9.720	9	9.235	4	10.495	15	15.025	57	15.750	42	16.300
15	41	9.580	2	9.028	23	10.295	43	14.975	29	15.675	15	16.250
16	38	9.525	23	9.017	28	9.875	21	14.975	9	15.625	24	16.200
17	59	9.480	29	8.832	50	9.785	48	14.950	42	15.450	3	16.125
18	42	9.427	24	8.827	6	9.712	23	14.925	39	15.425	23	16.075
19	48	9.352	21	8.420	1	9.682	2	14.900	2	15.350	6	15.900
20	10	9.345	13	8.408	18	9.137	41	14.850	35	15.325	16	15.900
21	50	9.283	18	8.277	2	9.023	42	14.775	30	15.325	35	15.900
22	3	9.077	36	8.070	10	8.942	19	14.775	31	15.275	29	15.875
23	53	8.995	10	7.935	9	8.850	13	14.775	24	15.250	47	15.850
24	13	8.980	52	7.925	32	8.517	44	14.700	6	15.200	36	15.850
25	52	8.953	6	7.897	36	8.250	33	14.675	48	15.200	55	15.825
26	36	8.928	1	7.855	27	8.210	53	14.600	11	15.175	9	15.700
27	31	8.833	37	7.727	47	7.907	12	14.600	47	15.150	30	15.700
28	51	8.787	56	7.700	34	7.837	6	14.425	52	15.150	31	15.675
29	17	8.492	38	7.650	29	7.670	59	14.350	23	15.125	11	15.675
30	47	8.462	5	7.493	31	7.628	36	14.300	50	15.075	59	15.650
31	15	8.412	55	7.392	33	7.555	57	14.275	43	15.025	48	15.650
32	45	8.365	47	7.085	49	7.547	9	14.225	36	15.025	41	15.625
33	21	8.257	40	6.977	7	7.380	60	14.200	12	14.950	52	15.500
34	2	8.255	49	6.957	15	7.300	47	14.200	5	14.875	57	15.500
35	40	8.207	45	6.915	40	7.190	28	14.175	56	14.850	21	15.500
36	26	8.205	4	6.782	38	7.175	51	14.125	37	14.850	27	15.425
37	37	8.190	15	6.777	53	7.135	17	14.050	59	14.850	34	15.275
38	55	8.075	11	6.630	21	7.062	46	13.975	4	14.775	49	15.250
39	23	7.977	17	6.605	55	6.970	56	13.950	28	14.725	18	15.250
40	12	7.677	43	6.600	26	6.927	54	13.950	49	14.625	22	15.225
41	46	7.457	34	6.585	30	6.750	45	13.925	45	14.525	37	15.125
42	56	7.435	53	6.292	5	6.628	27	13.875	3	14.425	56	15.125
43	49	7.267	33	6.280	16	6.577	18	13.825	41	14.400	40	15.125
44	60	7.175	8	6.267	43	6.575	55	13.775	40	14.375	60	15.125
45	7	7.170	46	6.172	19	6.272	37	13.775	53	14.350	19	15.050
46	43	7.162	27	6.105	48	6.207	3	13.750	7	14.300	38	14.975
47	6	6.977	26	5.942	37	6.067	31	13.700	8	14.275	12	14.975
48	30	6.960	60	5.925	22	5.555	4	13.600	17	14.200	17	14.975
49	54	6.847	7	5.870	60	5.522	20	13.575	34	14.175	51	14.875
50	19	6.665	30	5.812	8	5.492	7	13.550	32	14.175	45	14.775
51	34	6.665	32	5.802	46	5.375	40	13.350	60	14.150	8	14.725
52	11	6.622	19	5.252	11	5.255	30	13.300	19	14.125	20	14.350
53	33	6.532	12	4.905	54	5.165	34	13.075	20	14.075	26	14.275
54	8	6.375	3	4.735	3	4.523	8	12.875	18	13.825	5	14.250
55	14	6.242	48	4.395	14	4.430	25	12.475	27	13.750	54	13.925
56	27	6.025	20	4.242	17	4.370	32	12.400	54	13.500	7	13.875
57	32	5.897	14	4.107	25	4.312	49	12.275	25	13.450	32	13.500
58	25	5.487	25	3.777	45	3.970	22	11.725	46	13.350	28	13.475
59	22	4.835	54	3.602	12	3.802	5	11.700	22	12.975	25	13.225
60	20	4.338	22	3.190	20	3.098	26	10.200	26	12.450	46	12.325
Mean		8.486		7.576		8.021		14.257		14.968		15.455

Table 29 continued 8/11

Rank	K1= tch1LP		K2=tch1L1R		K3=tch1L2R		K4= tsh1LP		K5=tsh1L1R		K6=tsh1L2R	
1	57	156.520	57	201.250	35	150.750	16	23.250	57	31.790	35	23.990
2	16	141.500	35	178.450	57	146.570	57	22.340	16	27.470	39	23.180
3	31	140.400	31	178.250	39	140.020	39	20.730	35	27.360	44	23.150
4	44	136.750	39	172.270	44	139.880	44	20.020	31	27.240	57	22.720
5	39	135.350	16	171.930	42	136.430	15	19.690	39	26.630	42	22.070
6	18	133.150	44	162.880	18	135.500	21	19.330	44	25.940	18	20.580
7	15	130.800	18	150.550	59	129.180	31	19.250	36	21.710	59	20.170
8	21	129.170	41	146.930	36	125.350	35	18.720	41	21.340	36	19.790
9	36	125.900	36	144.550	52	119.550	18	18.360	50	21.220	58	18.990
10	28	124.820	50	140.570	58	116.480	36	18.010	21	20.900	52	18.470
11	45	123.000	52	138.080	16	115.200	24	17.810	52	20.880	16	18.440
12	35	122.470	42	133.680	31	112.320	28	17.660	15	20.860	24	17.940
13	17	121.720	59	132.630	24	110.700	29	17.180	58	20.740	50	17.600
14	8	119.030	21	131.180	41	108.900	41	17.130	18	20.650	31	17.570
15	24	119.030	15	128.800	55	108.700	45	17.120	42	20.580	55	17.220
16	41	115.030	32	127.520	50	107.600	17	16.630	59	19.720	41	16.870
17	3	114.670	58	126.830	47	104.900	42	16.330	9	18.990	47	16.610
18	59	111.770	28	123.170	56	100.000	59	16.030	55	18.670	2	16.170
19	26	111.550	9	121.550	2	98.750	38	16.020	24	18.490	13	16.010
20	47	110.870	24	120.130	49	98.030	10	15.830	28	18.140	33	15.430
21	42	110.130	55	118.850	21	97.820	47	15.800	32	18.110	21	15.240
22	29	109.970	2	117.420	13	96.720	3	15.780	2	18.030	56	15.140
23	32	109.750	23	114.850	28	96.180	53	15.710	29	17.980	23	14.960
24	34	107.950	29	114.850	29	93.850	58	15.570	10	17.480	49	14.950
25	53	107.600	45	112.300	23	93.130	1	15.420	23	17.380	29	14.850
26	49	106.170	56	111.420	33	92.580	52	15.320	13	17.190	10	14.180
27	25	104.720	47	107.220	26	90.400	8	15.240	56	16.550	1	14.080
28	58	103.280	10	106.680	27	90.230	2	15.090	45	16.410	53	13.940
29	4	102.000	49	103.630	6	87.680	50	14.550	47	16.350	4	13.810
30	5	101.770	13	103.070	9	87.500	9	14.520	1	16.290	27	13.810
31	9	101.630	46	99.470	38	86.950	4	14.130	38	15.860	6	13.770
32	55	101.470	40	99.450	40	86.780	34	14.100	51	15.330	9	13.740
33	52	101.450	1	98.170	10	85.500	55	13.990	49	15.310	15	13.640
34	38	99.830	38	97.820	53	85.150	54	13.990	30	14.850	28	13.370
35	2	99.670	60	97.450	15	84.770	13	13.720	40	14.410	40	13.140
36	54	98.720	30	96.930	4	83.700	32	13.690	6	14.310	26	13.040
37	7	97.650	43	94.750	1	80.800	56	13.680	43	14.270	38	12.930
38	10	97.300	53	94.570	11	76.450	48	13.680	60	13.870	11	12.040
39	56	97.300	7	94.020	32	76.270	12	13.590	37	13.850	37	11.140
40	50	97.100	6	93.320	7	74.630	25	13.470	53	13.630	43	10.840
41	40	96.570	37	92.750	37	74.280	43	13.330	4	13.590	34	10.710
42	1	95.300	4	91.850	34	69.930	7	13.200	7	13.580	51	10.480
43	22	93.650	51	90.220	51	69.570	49	13.140	33	12.980	7	10.420
44	46	93.150	27	90.050	46	68.450	46	12.930	46	12.940	32	10.370
45	13	93.100	34	87.350	43	66.650	37	12.810	11	12.610	30	9.780
46	37	92.750	19	86.400	22	63.600	40	12.800	27	12.430	22	9.750
47	12	92.400	8	85.700	30	61.580	27	12.090	34	12.320	46	9.060
48	48	91.500	17	84.250	60	59.970	51	11.990	19	12.260	60	9.050
49	43	88.920	11	82.800	19	59.050	5	11.840	8	12.250	19	8.840
50	30	87.150	26	82.450	17	57.970	19	11.830	17	12.200	17	8.820
51	27	85.450	33	82.070	3	52.180	23	11.780	5	11.900	3	8.400
52	51	85.320	5	80.800	8	48.000	26	11.710	12	10.800	54	7.100
53	60	82.420	3	74.100	54	47.270	60	11.690	3	10.630	8	7.080
54	19	79.870	12	72.270	12	43.850	30	11.610	26	10.430	12	6.690
55	23	79.000	22	70.470	45	42.920	33	11.430	54	9.410	45	6.410
56	33	77.720	54	70.300	14	36.250	11	11.080	22	9.330	14	5.970
57	6	76.250	20	55.250	48	33.300	6	11.000	14	8.230	48	5.250
58	20	74.070	14	52.170	5	32.970	22	10.950	20	7.740	5	4.970
59	11	70.650	25	48.380	20	25.550	14	10.590	25	6.780	20	3.670
60	14	67.200	48	44.030	25	22.070	20	10.070	48	6.670	25	2.840
Mean		104.690		108.852		86.455		14.939		16.431		13.521

Table 29 continued 9/11

Rank	K1= nmg1LP		K2=nmg1L1R		K3=nmg1L2R		K4=ad_bcLP		K5ad_bcL1R		K6ad_bcL2R	
1	16	14.825	57	15.485	35	15.463	15	42.000	28	80.300	57	82.800
2	39	13.035	39	13.800	39	15.178	44	38.000	35	47.500	58	72.500
3	44	12.640	35	13.717	44	14.810	32	34.300	57	46.800	55	66.500
4	57	12.495	44	13.598	57	14.092	57	32.500	32	46.000	28	57.000
5	15	12.425	31	13.530	42	14.003	35	31.500	36	46.000	36	56.000
6	18	11.700	16	13.487	59	13.462	28	27.300	52	42.300	39	48.300
7	35	11.608	58	11.102	18	13.188	16	26.800	49	41.300	51	48.000
8	24	11.420	50	10.740	58	12.867	9	26.300	9	41.000	32	40.800
9	31	11.243	15	10.610	36	12.062	26	25.200	44	37.800	33	32.800
10	29	11.010	36	10.532	24	11.795	36	23.300	24	35.000	35	32.500
11	28	10.683	41	10.513	52	11.740	51	20.300	41	31.500	59	30.000
12	21	10.590	59	10.142	50	11.363	58	20.000	55	30.800	27	29.300
13	1	10.587	18	10.078	41	11.203	2	19.800	45	29.500	52	29.000
14	41	10.453	55	9.995	13	11.125	24	19.000	51	29.300	49	26.000
15	36	10.297	42	9.972	55	10.888	27	18.000	27	25.300	6	24.800
16	10	10.208	52	9.938	47	10.828	45	17.800	58	24.800	41	21.800
17	58	10.075	9	9.913	56	10.675	52	17.500	34	23.800	46	19.800
18	42	9.973	21	9.632	16	10.490	49	17.500	33	23.000	24	18.500
19	59	9.972	2	9.435	1	10.385	40	16.500	59	21.300	2	17.500
20	38	9.805	32	9.420	4	10.355	29	16.000	23	20.000	42	17.300
21	53	9.735	29	9.377	23	10.215	33	16.000	46	20.000	15	15.800
22	45	9.680	1	9.270	31	10.160	42	14.800	21	19.300	17	14.200
23	47	9.480	24	9.167	33	10.135	34	13.200	42	18.800	29	13.300
24	50	9.338	13	9.097	49	10.070	31	12.500	39	17.500	31	12.800
25	52	9.305	10	9.085	2	10.043	18	12.500	60	17.000	45	8.300
26	3	9.285	56	8.592	10	9.230	55	11.800	54	15.000	19	7.500
27	17	9.235	23	8.510	29	9.138	5	11.000	2	13.500	47	6.700
28	2	9.163	28	8.373	53	9.100	1	11.000	10	10.500	34	5.000
29	9	9.080	51	8.275	6	8.600	3	10.200	29	10.500	50	3.700
30	48	8.990	38	8.118	21	8.578	54	8.800	31	9.200	56	3.500
31	4	8.948	47	8.052	9	8.565	41	8.700	6	7.800	44	3.500
32	54	8.863	49	7.583	38	8.380	23	5.500	47	7.700	23	3.300
33	55	8.685	4	7.445	15	8.265	30	3.300	53	5.000	38	1.800
34	8	8.428	43	7.240	26	7.795	21	1.200	17	4.200	18	0.000
35	43	8.375	40	7.190	27	7.725	43	0.800	56	2.500	10	-1.300
36	56	8.290	30	7.110	40	7.713	7	0.300	22	-6.000	9	-3.500
37	34	8.133	45	7.083	28	7.073	59	0.200	26	-6.500	16	-6.500
38	12	7.972	37	7.028	37	6.990	11	-0.500	40	-8.800	60	-7.500
39	7	7.818	6	6.928	34	6.745	8	-0.500	7	-9.800	13	-10.800
40	40	7.808	33	6.623	22	6.535	48	-6.000	5	-10.000	21	-11.200
41	32	7.773	53	6.190	43	6.525	6	-6.700	50	-12.500	43	-17.500
42	46	7.685	60	5.905	11	6.310	10	-7.000	15	-14.000	40	-20.300
43	49	7.573	11	5.773	32	6.193	46	-8.500	19	-14.500	7	-21.500
44	37	7.438	7	5.758	51	6.110	4	-8.800	1	-16.800	1	-21.800
45	25	7.403	34	5.608	30	5.775	47	-9.500	30	-17.500	5	-22.800
46	23	7.330	19	5.583	7	5.448	56	-10.000	13	-20.500	4	-24.500
47	13	7.327	27	5.290	19	5.283	14	-10.800	8	-20.800	25	-28.500
48	51	7.093	8	5.265	60	5.138	37	-13.000	16	-23.200	53	-30.800
49	14	7.087	5	5.183	3	4.823	13	-16.300	38	-25.000	20	-33.000
50	11	6.977	46	5.098	17	4.265	60	-17.000	4	-25.500	22	-33.500
51	19	6.907	17	4.795	14	4.195	25	-18.800	18	-27.300	12	-36.800
52	6	6.900	12	4.708	46	4.190	22	-19.300	11	-29.000	54	-37.500
53	33	6.805	26	4.538	54	4.083	50	-21.800	43	-31.800	26	-38.500
54	27	6.598	3	4.335	8	3.770	19	-22.700	37	-38.000	11	-40.800
55	60	6.532	14	4.188	12	3.638	39	-24.500	25	-42.300	48	-43.800
56	5	6.488	54	3.990	48	3.568	20	-27.300	14	-44.500	3	-45.000
57	22	6.003	22	3.813	45	2.783	53	-27.500	3	-45.000	8	-45.500
58	30	5.990	48	3.280	5	2.425	12	-29.000	12	-45.300	37	-48.500
59	26	5.740	20	2.620	20	1.473	17	-33.500	48	-46.300	14	-51.000
60	20	5.508	25	2.203	25	0.870	38	-84.500	20	-48.500	30	-53.300
Mean		8.980		7.998		8.398		3.465		4.540		2.248

Table 29 continued 10/11

Rank	K1=ad_bcSP		V2ad_bcS1R		V3ad_bcS2R		K4= ad4LP		K5= ad4L1R		K6= ad4L2R	
1	41	36.820	11	43.500	36	42.000	26	394.210	57	441.500	39	361.800
2	9	24.650	57	41.500	15	41.000	15	381.690	28	436.100	57	355.800
3	39	21.050	24	40.250	57	33.500	57	379.800	39	427.300	58	352.300
4	28	20.080	53	35.750	39	29.500	16	376.140	44	411.100	44	327.600
5	27	16.870	39	32.250	24	23.500	18	369.840	31	397.100	59	324.500
6	57	16.550	28	32.000	21	23.380	21	367.900	35	389.400	42	313.600
7	42	16.320	9	31.500	28	21.630	44	360.790	16	380.400	28	304.000
8	21	14.920	36	31.000	12	15.500	28	358.650	59	373.300	18	297.600
9	35	14.900	12	30.000	41	14.000	31	358.540	41	368.600	24	297.600
10	8	14.880	35	28.250	4	13.500	39	346.110	50	365.300	31	292.700
11	11	14.550	42	23.750	44	12.750	35	331.850	58	358.900	35	292.400
12	31	13.950	21	23.000	50	12.630	32	329.100	18	353.100	41	289.800
13	59	13.300	13	22.500	42	11.870	4	328.940	42	351.600	36	283.400
14	6	12.350	41	18.000	31	11.380	9	327.090	24	350.600	56	281.900
15	58	10.650	58	16.000	49	9.250	36	322.840	9	350.400	51	279.000
16	17	10.130	6	15.500	10	9.250	5	322.690	51	347.600	52	274.600
17	4	9.900	16	13.000	53	9.250	34	320.940	49	338.100	9	267.300
18	32	9.380	15	11.500	5	9.000	59	320.090	21	337.000	23	266.600
19	1	9.270	44	11.000	6	9.000	24	313.830	36	335.000	2	265.400
20	10	9.150	47	10.500	23	7.630	58	307.550	46	330.500	6	265.300
21	15	9.130	51	10.250	56	6.630	8	304.630	52	329.500	49	264.500
22	47	6.800	7	8.250	59	6.250	46	302.660	26	326.800	50	263.300
23	29	6.420	52	7.750	38	4.870	41	302.590	32	326.400	32	252.900
24	48	5.650	10	7.500	16	4.620	45	301.830	15	326.400	55	252.000
25	55	5.300	49	7.250	11	4.620	49	301.090	2	325.800	34	251.200
26	50	5.220	56	6.500	2	3.130	3	299.480	56	319.300	27	250.600
27	52	4.450	27	5.250	33	3.120	29	299.330	45	315.300	33	247.800
28	49	3.870	46	5.000	27	2.750	42	299.300	23	313.900	4	247.300
29	23	2.850	55	3.750	52	2.620	53	298.850	34	308.600	15	246.900
30	7	2.600	4	2.500	35	2.370	51	297.840	29	308.400	26	244.300
31	38	1.600	2	2.250	29	2.370	17	295.330	6	306.500	29	242.300
32	51	0.380	50	1.500	17	1.500	54	288.640	55	299.800	13	241.700
33	24	0.150	17	-1.250	46	0.750	25	287.840	10	299.000	47	235.000
34	36	-0.130	59	-2.000	13	-0.750	50	286.830	53	298.300	1	234.100
35	44	-0.200	25	-2.250	47	-1.000	55	285.780	17	295.800	10	230.900
36	22	-0.530	34	-2.250	7	-2.000	10	280.770	40	294.600	21	230.300
37	40	-1.730	29	-4.750	8	-2.120	47	280.600	33	293.300	16	224.200
38	2	-3.880	26	-5.250	20	-4.750	1	280.480	27	289.400	46	219.700
39	46	-4.920	43	-6.000	9	-5.130	52	277.740	60	286.400	53	216.400
40	60	-5.350	1	-6.750	54	-5.750	40	273.250	38	283.500	17	212.400
41	12	-5.730	14	-7.000	51	-6.750	13	270.650	5	283.300	40	210.000
42	56	-6.650	31	-7.250	37	-6.880	56	268.560	13	282.900	38	208.800
43	45	-7.400	32	-8.000	58	-11.880	23	266.350	47	282.100	43	195.400
44	5	-7.780	8	-8.500	18	-12.250	7	263.650	43	271.000	5	194.900
45	37	-8.250	38	-9.750	19	-12.500	27	262.160	7	267.300	60	187.200
46	34	-8.730	22	-10.000	32	-14.380	2	261.300	4	267.100	37	183.100
47	54	-9.170	37	-10.500	14	-15.380	43	260.900	8	262.400	11	182.400
48	53	-9.280	19	-13.750	26	-17.250	6	258.740	1	251.300	7	181.900
49	19	-9.630	40	-15.500	55	-17.750	33	256.340	11	245.800	45	180.900
50	33	-10.730	20	-15.750	25	-19.500	12	255.380	37	245.400	54	175.900
51	43	-11.830	5	-16.250	1	-19.880	48	251.460	30	244.500	22	170.700
52	14	-13.530	33	-18.250	60	-20.630	37	243.610	54	239.600	19	169.800
53	16	-14.200	30	-18.500	34	-21.380	22	241.980	19	237.100	30	162.100
54	3	-14.750	60	-23.000	22	-21.880	30	241.350	3	222.600	3	150.800
55	13	-15.900	23	-29.500	30	-27.380	38	240.360	12	217.400	48	150.200
56	18	-18.500	45	-30.000	43	-28.630	60	236.040	20	207.500	8	149.000
57	20	-19.880	54	-32.000	40	-31.380	19	228.200	48	183.500	20	135.900
58	30	-21.950	48	-33.000	3	-32.880	20	226.800	22	180.400	12	135.400
59	26	-22.300	3	-34.750	48	-37.380	11	224.840	25	171.400	14	112.300
60	25	-27.950	18	-35.250	45	-42.870	14	191.410	14	167.300	25	112.100
Mean		1.387		2.858		-0.587		295.225		305.330		235.830

Table 29 continued 11/11

Rank	K1=	bc4LP	K2=	bc4L1R	K3=	bc4L2R
1	39	370.610	39	409.800	44	324.100
2	26	368.960	16	403.600	39	313.500
3	21	366.650	57	394.800	18	297.600
4	18	357.340	31	387.900	42	296.400
5	16	349.390	18	380.400	59	294.500
6	57	347.300	50	377.800	26	282.800
7	31	346.040	44	373.400	31	279.900
8	15	339.690	28	355.900	58	279.800
9	4	337.690	59	352.000	24	279.100
10	28	331.400	35	341.900	56	278.400
11	17	328.830	15	340.400	57	273.000
12	53	326.350	41	337.100	4	271.800
13	38	324.860	58	334.100	9	270.800
14	44	322.790	26	333.300	41	268.000
15	59	319.840	42	332.900	23	263.400
16	5	311.690	51	318.400	35	259.900
17	46	311.160	21	317.800	50	259.500
18	50	308.580	56	316.800	1	255.900
19	34	307.690	24	315.600	13	252.400
20	25	306.590	2	312.300	2	247.900
21	8	305.130	46	310.500	53	247.100
22	9	300.840	9	309.400	28	247.000
23	35	300.350	38	308.500	34	246.200
24	36	299.590	40	303.400	52	245.600
25	32	294.850	13	303.400	21	241.600
26	24	294.830	43	302.800	6	240.600
27	41	293.840	6	298.800	49	238.500
28	47	290.100	29	297.900	10	232.100
29	3	289.230	49	296.900	37	231.600
30	10	287.770	23	293.900	15	231.200
31	58	287.550	53	293.300	51	231.000
32	13	286.900	5	293.300	16	230.700
33	42	284.550	4	292.600	40	230.300
34	12	284.380	17	291.500	29	229.000
35	45	284.080	36	289.000	47	228.300
36	49	283.590	10	288.500	36	227.400
37	29	283.330	52	287.300	11	223.100
38	54	279.890	45	285.800	27	221.300
39	56	278.560	34	284.900	5	217.600
40	51	277.590	37	283.400	30	215.300
41	55	274.030	8	283.100	33	215.000
42	1	269.480	32	280.400	54	213.400
43	6	265.490	7	277.000	43	212.900
44	7	263.400	11	274.800	32	212.100
45	22	261.230	47	274.400	38	207.100
46	23	260.850	33	270.300	22	204.200
47	52	260.240	60	269.400	7	203.400
48	43	260.150	55	269.000	46	199.900
49	48	257.460	1	268.000	17	198.200
50	40	256.750	3	267.600	3	195.800
51	37	256.610	27	264.100	60	194.700
52	20	254.050	12	262.600	8	194.500
53	60	253.040	30	262.000	48	193.900
54	19	250.950	20	256.000	55	185.500
55	27	244.160	19	251.600	45	172.700
56	2	241.550	48	229.800	12	172.100
57	33	240.340	54	224.600	20	168.900
58	30	238.100	25	213.600	14	163.300
59	11	225.340	14	211.800	19	162.300
60	14	202.160	22	186.400	25	140.600
Mean		291.763		300.797		233.578

Table 30. Efficiency of mass selection in different plot shapes, based on all 4 replicates.

Table 30a. Best 6 (or 12) clones in 4-row long plots which were also in the best 6 (or 12) group in 4S, 2L and 1L plots.

Character	Best group	Plant crop 4S	Plant crop 2L	Plant crop 1L	1R crop 4S	1R crop 2L	1R crop 1L	2R crop 4S	2R crop 2L	2R crop 1L
bc4L vs tch	6	3	5	4	4	3	4	3	4	4
	12	9	9	8	10	11	9	8	8	8
tch4L vs tch	6	3	5	3	4	4	5	5	5	4
	12	10	10	9	11	11	9	10	10	9
ad_bc4L vs tch	6	2	2	2	2	2	2	3	2	2
	12	6	6	7	5	5	6	6	6	6
ad_bc4L ad_bc4S	6	2			2			3		
	12	4			6			4		
tsh4L vs tsh	6	5	4	5	5	5	6	6	5	4
	12	8	7	8	9	10	8	9	9	9
nmg4L vs nmg	6	4	4	4	4	4	4	4	5	3
	12	9	8	7	9	11	9	7	8	6
ccs4L vs ccs	6	4	3	4	5	3	4	4	4	3
	12	8	8	6	7	6	6	7	8	8

Table 30b. Number of clones which must be selected in 4S, 2L and 1L plots, in order to include the best 6 (or 12) clones in 4-row long plots.

Character	Best group	Plant crop 4S	Plant crop 2L	Plant crop 1L	1R crop 4S	1R crop 2L	1R crop 1L	2R crop 4S	2R crop 2L	2R crop 1L
bc4L vs tch	6	9	10	19	15	12	10	21	17	27
	12	27	30	29	19	36	18	23	26	36
tch4L vs tch	6	11	14	19	9	12	18	8	7	10
	12	14	14	29	15	15	18	23	26	18
ad_bc4L vs tch	6	25	29	23	31	29	18	35	40	23
	12	26	41	52	39	31	29	40	40	43
ad_bc4L ad_bc4S	6	35	29	23	43	29	18	49	40	23
	12	59	41	52	43	31	29	49	40	43
tsh4L vs tsh	6	7	21	7	9	11	6	6	7	9
	12	57	25	52	21	30	32	21	29	42
nmg4L vs nmg	6	11	31	13	17	8	8	21	14	20
	12	55	31	56	18	14	29	21	21	44
ccs4L vs ccs	6	17	16	36	26	22	19	14	11	49
	12	34	38	47	26	27	48	28	40	49

Table 31. Efficiency of mass selection for harvest characters, based on two replicates. Results were evaluated by 4-row long plots in the two replicates which were not selected. For example, selection (x) based on replicates 3 and 4 was evaluated in 4-row long plots (y) in replicates 1 and 2.

(a) Best 6 (or 12) clones in y = 4-row long plots which were also in the best 6 (or 12) group in each plot shape in the other two replicates. High numbers show efficient selection.

Crop	Blocks selected (x)	Group	tch Rank in 4L	4S	2L	1L	tsh Rank in 4L	4S	2L	1L	nmg Rank in 4L	4S	2L	1L
Plant	3+4	6	4	4	3	3	5	4	4	4	3	3	3	4
		12	10	10	8	8	7	7	7	8	8	7	7	6
	1+2	6	4	4	4	3	5	4	2	3	3	4	1	3
		12	10	9	10	9	7	6	8	8	8	7	6	8
1R	3+4	6	4	3	4	3	4	4	4	4	3	3	3	3
		12	9	8	9	7	8	7	8	6	8	7	7	6
	1+2	6	4	3	4	5	4	4	5	5	3	4	4	4
		12	9	9	9	10	8	9	8	7	8	8	9	7
2R	3+4	6	5	3	4	3	5	4	4	3	4	3	4	2
		12	9	7	9	8	7	6	7	7	7	7	7	6
	1+2	6	5	4	4	3	5	4	3	3	4	3	3	1
		12	9	7	7	7	7	8	7	7	7	7	8	6
Mean		6	4.3	3.5	3.8	3.3	4.7	4.0	3.7	3.7	3.3	3.3	3.0	2.8
Mean		12	9.8	8.3	8.7	8.2	7.3	7.2	7.5	7.2	7.7	7.2	7.3	6.5

If selection had no effect, clones in common would 0.6 / 6, and 2.4 / 12

4L = 4-row long plots
4S = 4-row short
2L = 2-row long
1L = 1-row long

1R = first ratoon crop
2R = second ratoon

Table 31 continued (2/2)

(b) Number of clones which must be selected in two replicates of each plot shape (x), in order to include the best 6 (or 12) clones in 4-row long plots in the other two replicates (y). Low numbers show efficient selection.

Crop	Blocks selected (x)	Group	tch Rank in 4L	4S	2L	1L	tsh Rank in 4L	4S	2L	1L	nmg Rank in 4L	4S	2L	1L
Plant	3+4	6	10	11	21	11	7	13	23	10	15	13	35	50
		12	25	18	21	50	40	50	29	59	25	25	35	60
	1+2	6	10	28	13	20	15	31	31	53	20	23	31	53
		12	24	28	40	27	26	34	32	55	29	60	42	60
1R	3+4	6	11	13	9	30	18	15	33	11	13	19	14	18
		12	31	19	41	30	37	22	33	30	33	23	38	39
	1+2	6	15	11	25	7	17	24	11	33	23	18	8	25
		12	31	44	26	52	18	24	22	33	23	18	17	28
2R	3+4	6	12	20	21	12	10	21	19	10	9	22	16	26
		12	27	33	21	26	43	36	34	35	21	34	24	33
	1+2	6	8	12	17	15	7	12	14	12	25	17	26	27
		12	27	24	38	42	27	25	35	36	31	21	26	36
Mean		6	11	16	18	16	12	19	22	22	18	19	22	33
Mean		12	28	28	31	38	32	32	31	41	27	30	30	43

4L = 4-row long plots
4S = 4-row short
2L = 2-row long
1L = 1-row long

1R = first ratoon crop
2R = second ratoon

Table 32. Efficiency of mass selection for weight (kg), based on two replicates. Results were evaluated by bc4L (middle of 4-row long plots) in the two replicates which were not selected. For example, selection (x) based on replicates 3 and 4 was evaluated in 4-row long plots (y) in replicates 1 and 2.

(a) Best 6 (or 12) clones in y = bc4L (middle of 4-row long plots) which were also in the best 6 (or 12) group in each plot shape in the other two replicates. High numbers show efficient selection.

Crop	Blocks selected (x)	Group	Rank in 4L a	4L b	4L c	4L d	4L ad	4L bc	4S	4S ad	4S bc	2L ab	2L a	1L
P	3+4	6	2	2	2	1	3	3	2	3	3	3	2	2
		12	6	7	8	9	8	8	9	9	9	7	7	8
	1+2	6	2	2	4	3	3	3	3	2	3	4	3	2
		12	9	7	7	8	10	8	8	6	7	7	7	6
1R	3+4	6	3	3	4	5	4	4	3	2	4	4	5	3
		12	8	8	8	6	8	10	8	8	9	10	8	8
	1+2	6	3	4	3	3	4	4	3	3	3	4	4	4
		12	6	9	8	8	8	10	9	7	10	9	9	9
2R	3+4	6	3	2	4	2	2	3	4	3	2	2	2	2
		12	7	7	7	6	6	8	6	7	6	7	7	5
	1+2	6	5	3	3	4	6	3	3	2	3	4	3	2
		12	8	6	7	8	8	8	8	8	7	7	6	7
Mean		6	3.0	2.7	3.3	3.0	3.7	3.3	3.0	2.5	3.0	3.5	3.2	2.5
Mean		12	7.3	7.3	7.5	7.5	8.0	8.7	8.0	7.5	8.0	7.8	7.3	7.2

If selection had no effect, clones in common would 0.6 / 6, and 2.4 / 12

4L = 4-row long plots, rows a b c d
4S = 4-row short, rows a b c d
2L = 2-row long
1L = 1-row long

1R = first ratoon crop
2R = second ratoon

Table 32 continued (2/2)

(b) Number of clones which must be selected in two replicates of each plot shape (x), in order to include the best 6 (or 12) clones in y=bc4L (middle of 4-row long plots) in the other two replicates (y). Low numbers show efficient selection.

Crop	Blocks selected (x)	Group	Rank in 4L a	4L b	4L c	4L d	4L ad	4L bc	4S	4S ad	4S bc	2L ab	2L a	1L
P	3+4	6	29	33	19	38	31	25	30	23	45	32	42	27
		12	53	33	24	49	50	25	34	23	47	32	42	50
	1+2	6	19	22	28	11	11	13	29	21	41	13	16	20
		12	34	58	31	27	26	50	31	28	41	40	38	44
1R	3+4	6	25	38	17	34	12	21	13	14	11	9	14	30
		12	37	38	25	41	36	21	19	19	28	41	47	30
	1+2	6	23	8	11	26	19	8	15	19	15	25	23	11
		12	26	16	26	26	19	17	39	29	46	28	24	22
2R	3+4	6	19	51	14	35	22	36	34	26	51	20	35	26
		12	32	51	23	35	26	36	34	26	51	24	35	39
	1+2	6	8	34	22	12	6	18	24	16	36	17	26	18
		12	38	34	27	47	41	30	24	40	36	20	26	42
Mean		6	21	31	19	26	17	20	24	20	33	19	26	22
Mean		12	37	38	26	38	33	30	30	28	42	31	35	38

4L = 4-row long plots, rows a b c d
4S = 4-row short, rows a b c d
2L = 2-row long
1L = 1-row long

1R = first ratoon crop
2R = second ratoon

Table 33. Efficiency of mass selection for weight (kg), based on two replicates. Results were evaluated by ad4L (border of 4-row long plots) in the two replicates replicates which were not selected. For example, selection (x) based on replicates 3 and 4 was evaluated in 4-row long plots (y) in replicates 1 and 2.

(a) Best 6 (or 12) clones in y = 4-row long plots which were also in the best 6 (or 12) group in each plot shape in the other two replicates. High numbers show efficient selection.

Crop	Blocks selected (x)	Group	Rank in 4L a	4L b	4L c	4L d	4L ad	4L bc	4S	4S ad	4S bc	2L ab	2L a	1L
P	3+4	6	1	3	2	3	2	3	4	4	4	3	3	3
		12	7	9	9	11	9	10	10	9	10	8	9	8
	1+2	6	3	3	3	2	2	3	5	4	5	5	5	4
		12	8	7	7	8	9	8	8	7	7	9	8	8
1R	3+4	6	3	3	4	5	4	4	3	2	4	4	5	3
		12	6	6	8	6	7	8	7	7	7	8	7	7
	1+2	6	3	3	3	3	4	4	3	3	3	3	2	3
		12	6	8	7	8	7	8	9	9	9	8	8	8
2R	3+4	6	4	4	4	3	3	6	3	3	3	4	4	3
		12	7	7	8	6	8	8	7	8	6	9	8	8
	1+2	6	3	1	1	3	3	2	3	2	3	3	1	2
		12	7	6	4	8	8	6	8	8	6	7	5	7
Mean		6	2.8	2.8	2.8	3.2	3.0	3.7	3.5	3.0	3.7	3.7	3.3	3.0
Mean		12	6.8	7.2	7.2	7.8	8.0	8.0	8.2	8.0	7.5	8.2	7.5	7.7

If selection had no effect, clones in common would 0.6 / 6, and 2.4 / 12

4L = 4-row long plots, rows a b c d
4S = 4-row short, rows a b c d
2L = 2-row long
1L = 1-row long

1R = first ratoon crop
2R = second ratoon

Table 33 continued (2/2)

(b) Number of clones which must be selected in two replicates of each plot shape (x), in order to include the best 6 (or 12) clones in ad4L plots in the other two replicates (y). Low numbers show efficient selection.

Crop	Blocks selected (x)	Group	Rank in 4L a	4L b	4L c	4L d	4L ad	4L bc	4S	4S ad	4S bc	2L ab	2L a	1L
P	3+4	6	29	24	23	11	14	13	13	13	12	21	22	11
		12	36	24	24	33	27	19	39	25	52	24	22	50
	1+2	6	19	22	28	15	11	13	7	14	8	10	11	20
		12	19	52	28	37	22	36	37	34	41	21	30	26
1R	3+4	6	25	38	17	34	12	21	13	14	11	9	14	30
		12	38	39	35	41	36	29	27	19	46	41	47	30
	1+2	6	46	16	26	44	46	17	44	49	31	26	23	52
		12	46	44	50	51	46	50	44	49	36	26	23	52
2R	3+4	6	19	11	8	35	23	6	20	18	22	21	21	12
		12	40	38	34	48	43	31	42	46	42	31	22	35
	1+2	6	26	23	44	38	29	32	27	28	42	39	35	20
		12	38	29	49	46	40	39	27	28	42	39	35	38
Mean		6	27	22	24	30	23	17	21	23	21	21	21	24
Mean		12	36	38	37	43	36	34	36	34	43	30	30	39

4L = 4-row long plots, rows a b c d
4S = 4-row short, rows a b c d
2L = 2-row long
1L = 1-row long

1R = first ratoon crop
2R = second ratoon

Table 34. Multiple regression analysis showing prediction of yield (kg) by different plot shapes.

Crop	Y = middle rows (bc) of 4-row long t-value for shape					%var`	Y = outer rows (ad) of 4-row long t-value for shape					%var
	short 4-row	long 2-row	long 1-row	short bc	short ad		short 4-row	long 2-row	long 1-row	short bc	short ad	
P	12.5					73	15.3					80
		14.0				77		16.1				81
			10.4			65			12.9			74
				11.9		71				13.3		75
					10.4	65					12.8	74
	1.8	3.8				78	3.0	3.8				84
			3.2	4.9		75			4.8	5.2		82
			3.5		3.5	70			4.6		4.5	80
				4.3	2.4	73				4.3	3.8	80
			2.4	3.3	1.2	75			3.5	3.1	2.2	83
1R	15.7					81	17.9					84
		16.1				82		20.3				88
			11.9			71			14.1			77
				12.4		72				12.0		71
					13.5	76					16.9	83
	2.8	3.3				83	2.7	4.8				89
			3.8	4.3		77			5.5	3.4		81
			2.5		4.4	78			3.1		5.6	85
				3.9	5.0	80				2.9	7.3	85
			1.3	3.1	3.2	81			2.2	2.0	4.6	86
2R	13.5					76	18.9					86
		12.1				71		20.3				87
			10.4			65			14.5			78
				11.1		68				12.8		73
					12.7	73					18.9	86
	3.5	1.4				76	3.5	4.6				89
			3.6	4.4		73			6.3	4.7		84
			1.6		4.6	74			3.1		6.8	88
				4.3	2.5	75				2.2	7.7	87
			1.3	2.2	2.6	76			2.8	1.9	4.6	88

` %var = "percent variance accounted for"
df = 55 - 58, t is significant if > 2.004 (5%) or > 2.668 (1%)

Table 35. Multiple regression analysis showing prediction of harvest characters by different plot shapes. Y = 4-row long plot.

Character	P crop t-value for shape short 4-row	P crop long 2-row	P crop long 1-row	%var`	1R crop t-value for shape short 4-row	1R crop long 2-row	1R crop long 1-row	%var`	2R crop t-value for shape short 4-row	2R crop long 2-row	2R crop long 1-row	%var
tch	16.2			82	20.0			87	20.6			88
		18.0		85		22.3		89		19.8		87
			13.1	74			14.6	78			14.5	78
	2.9	4.6		86	3.4	5.1		91	4.5	3.8		90
	6.3		3.4	85	6.9		2.2	88	7.9		3.1	89
		7.1	2.6	86		7.9	1.1	89		7.3	3.0	88
	2.4	3.5	2.0	87	3.2	4.4	0.2	91	3.8	3.0	2.0	91
ccs	7.5			48	16.3			82	9.8			62
		12.8		73		13.4		75		12.5		72
			7.2	46			9.1	58			6.0	38
	1.6	7.7		74	5.7	2.9		84	3.5	6.2		77
	3.2		2.7	53	9.1		2.1	83	7.0		2.8	66
		7.8	1.1	74		6.4	1.4	75		9.0	2.0	74
	1.2	6.7	0.4	74	5.5	2.2	0.8	84	3.1	5.5	1.5	77
tsh	11.7			70	21.2			88	20.0			87
		14.4		78		21.2		88		18.5		85
			10.1	63			15.4	80			14.2	77
	2.5	5.5		80	4.6	4.6		91	4.7	3.4		89
	4.6		2.7	73	7.4		2.9	90	8.0		3.4	89
		6.5	1.5	78		6.9	2.1	89		7.0	3.5	88
	2.0	4.5	0.7	80	4.1	3.5	1.0	91	3.9	2.5	2.5	90
nmg	9.5			60	20.2			87	16.9			83
		10.7		66		20.4		88		16.2		82
			6.7	43			12.9	74			11.1	68
	2.9	4.4		70	4.1	4.3		90	3.8	3.2		85
	5.2		1.1	60	8.4		2.2	88	7.7		2.2	84
		6.3	0.4	65		8.1	1.1	88		7.3	2.4	83
	3.0	4.3	-0.8	70	3.9	3.6	0.4	90	3.3	2.6	1.5	85

` %var = "percent variance accounted for"
df = 55 - 58, t is significant if > 2.004 (5%) or > 2.668 (1%)

Table 36. Correlations between variety means for Row weight (KG) and competition effects.

DF = 58

		abcd LP	abcd L1R	abcd L2R	ad_bc LPR	ad_bc LP	ad_bc L1R	ad_bc L2R
abcdLP	1	1.0000						
abcdL1R	2	0.7135	1.0000					
abcdL2R	3	0.5578	0.8483	1.0000				
ad_bcLPR	4	0.3925	0.6614	0.6738	1.0000			
ad_bcLP	5	0.3549	0.4141	0.4226	0.6889	1.0000		
ad_bcL1R	6	0.3257	0.5812	0.6136	0.9271	0.5244	1.0000	
ad_bcL2R	7	0.3280	0.6453	0.6373	0.8905	0.3683	0.7755	1.0000
ad_2bLPR	8	0.3646	0.6608	0.6520	0.9297	0.6358	0.8292	0.8603
ad_2bLP	9	0.3509	0.4171	0.4155	0.6533	0.8692	0.5036	0.3960
ad_2bL1R	10	0.3012	0.5825	0.6148	0.8880	0.5193	0.9006	0.7827
ad_2bL2R	11	0.2780	0.6431	0.5947	0.7903	0.2887	0.6681	0.9306
ad_2cLPR	12	0.3576	0.5495	0.5836	0.9087	0.6311	0.8797	0.7724
ad_2cLP	13	0.2316	0.2601	0.2779	0.4818	0.7970	0.3587	0.2000
ad_2cL1R	14	0.2835	0.4603	0.4861	0.7765	0.4218	0.8961	0.6088
ad_2cL2R	15	0.3310	0.5508	0.5864	0.8624	0.3965	0.7722	0.9231
abcdSP	16	0.9048	0.7663	0.6058	0.3913	0.3774	0.3066	0.3276
abcdS1R	17	0.6489	0.9345	0.8308	0.6360	0.4067	0.5533	0.6197
abcdS2R	18	0.5362	0.8182	0.9378	0.6715	0.4028	0.6206	0.6389
ad_bcSPR	19	0.3814	0.5699	0.5743	0.4888	0.1589	0.4929	0.5170
ad_bcSP	20	0.2224	0.4403	0.4981	0.4923	0.1899	0.5176	0.4822
ad_bcS1R	21	0.2806	0.4456	0.4449	0.3902	0.1354	0.3952	0.4052
ad_bcS2R	22	0.4350	0.5433	0.5128	0.3748	0.0910	0.3607	0.4323
ad_2bSPR	23	0.3404	0.5166	0.5084	0.4079	0.1194	0.4161	0.4358
ad_2bSP	24	0.1526	0.2869	0.3082	0.3146	0.0861	0.2937	0.3647
ad_2bS1R	25	0.2897	0.4806	0.4698	0.4061	0.1637	0.4202	0.3989
ad_2bS2R	26	0.3753	0.4813	0.4576	0.2813	0.0360	0.3015	0.3181
ad_2cSP	27	0.2086	0.4273	0.4986	0.4836	0.2188	0.5428	0.4216
ad_2cS1R	28	0.2059	0.3085	0.3174	0.2837	0.0777	0.2792	0.3154
ad_2cS2R	29	0.3893	0.4746	0.4452	0.3741	0.1207	0.3317	0.4374
ad4LP	30	0.9738	0.7339	0.5978	0.5158	0.5581	0.4165	0.3806
bc4LP	31	0.9620	0.6395	0.4710	0.2173	0.0863	0.1941	0.2422
ab2LP	32	0.9211	0.7465	0.5794	0.4060	0.3537	0.3605	0.3267
ad4L1R	33	0.6798	0.9819	0.8610	0.7759	0.4727	0.7249	0.7269
bc4L1R	34	0.7175	0.9662	0.7815	0.4672	0.3103	0.3518	0.4967
ab2L1R	35	0.6671	0.9463	0.7995	0.6473	0.4042	0.5814	0.6207
ad4L2R	36	0.5375	0.8579	0.9772	0.7855	0.4402	0.7055	0.7863
bc4L2R	37	0.5398	0.7598	0.9471	0.4461	0.3590	0.4210	0.3562
ab2L2R	38	0.5455	0.8228	0.9331	0.7190	0.4556	0.6481	0.6825
a4LP	39	0.9209	0.7066	0.6463	0.5180	0.5619	0.4200	0.3797
b4LP	40	0.8712	0.5431	0.3860	0.1140	0.0029	0.1098	0.1480
adSP	41	0.8632	0.7954	0.6671	0.4744	0.3849	0.4054	0.4151
bcSP	42	0.8843	0.6733	0.4872	0.2635	0.3398	0.1668	0.1995
a2LP	43	0.9086	0.6988	0.5140	0.3872	0.3663	0.3548	0.2826
a1LP	44	0.8638	0.6828	0.5023	0.4355	0.3864	0.3592	0.3704
a4L1R	45	0.6018	0.9203	0.8736	0.7093	0.4448	0.6543	0.6636
b4L1R	46	0.7116	0.9224	0.7346	0.4233	0.2734	0.3448	0.4318
adS1R	47	0.6289	0.9172	0.8288	0.6482	0.3831	0.5792	0.6385
bcS1R	48	0.6139	0.8694	0.7555	0.5608	0.3993	0.4680	0.5376
a2L1R	49	0.6236	0.9025	0.7732	0.6341	0.4291	0.5713	0.5848
a1L1R	50	0.6081	0.8862	0.7724	0.6500	0.4347	0.5585	0.6267
a4L2R	51	0.4852	0.7693	0.9433	0.6857	0.4028	0.6161	0.6740
b4L2R	52	0.5325	0.6742	0.8895	0.4399	0.3824	0.4319	0.3175
adS2R	53	0.5684	0.8371	0.9321	0.6693	0.3679	0.6222	0.6557
bcS2R	54	0.4550	0.7333	0.8762	0.6249	0.4182	0.5730	0.5700
a2L2R	55	0.4573	0.7295	0.8737	0.6522	0.4364	0.5907	0.6010
a1L2R	56	0.4794	0.8031	0.8854	0.6362	0.3709	0.5589	0.6384
		1	2	3	4	5	6	7

Table 36 continued (2/6)

		ad_2b LPR	ad_2b LP	ad_2b L1R	ad_2b L2R	ad_2c LPR	ad_2c LP	ad_2c L1R
ad_2bLPR	8	1.0000						
ad_2bLP	9	0.7192	1.0000					
ad_2bL1R	10	0.9209	0.5378	1.0000				
ad_2bL2R	11	0.8685	0.3585	0.7595	1.0000			
ad_2cLPR	12	0.6910	0.4669	0.6988	0.5664	1.0000		
ad_2cLP	13	0.3026	0.3941	0.3077	0.0979	0.6020	1.0000	
ad_2cL1R	14	0.5651	0.3651	0.6141	0.4375	0.8837	0.3372	1.0000
ad_2cL2R	15	0.7229	0.3762	0.6900	0.7182	0.8729	0.2769	0.6974
abcdSP	16	0.3596	0.3458	0.2768	0.2929	0.3608	0.2796	0.2737
abcdS1R	17	0.6355	0.4019	0.5602	0.6179	0.5281	0.2647	0.4325
abcdS2R	18	0.6386	0.3994	0.5933	0.5967	0.5941	0.2606	0.5210
ad_bcSPR	19	0.4430	0.1544	0.4683	0.4587	0.4570	0.1065	0.4165
ad_bcSP	20	0.3960	0.1914	0.4236	0.3632	0.5174	0.1189	0.5073
ad_bcS1R	21	0.3947	0.1823	0.3996	0.3894	0.3181	0.0284	0.3091
ad_bcS2R	22	0.3299	0.0267	0.3646	0.3967	0.3615	0.1363	0.2823
ad_2bSPR	23	0.3814	0.0997	0.4039	0.4201	0.3681	0.0996	0.3427
ad_2bSP	24	0.2445	0.0706	0.2522	0.2699	0.3404	0.0734	0.2757
ad_2bS1R	25	0.4231	0.1881	0.4168	0.4337	0.3173	0.0738	0.3369
ad_2bS2R	26	0.2532	-0.0257	0.3081	0.3150	0.2650	0.0985	0.2324
ad_2cSP	27	0.3970	0.2356	0.4334	0.3220	0.4991	0.1189	0.5431
ad_2cS1R	28	0.2757	0.1342	0.2895	0.2573	0.2440	-0.0197	0.2110
ad_2cS2R	29	0.3240	0.0688	0.3322	0.3798	0.3669	0.1399	0.2629
ad4LP	30	0.4781	0.5227	0.3935	0.3169	0.4708	0.3993	0.3541
bc4LP	31	0.2031	0.1202	0.1695	0.2121	0.1970	0.0141	0.1791
ab2LP	32	0.4091	0.3480	0.3827	0.3074	0.3333	0.2328	0.2636
ad4L1R	33	0.7525	0.4703	0.7028	0.7000	0.6701	0.3037	0.5984
bc4L1R	34	0.4975	0.3203	0.3848	0.5281	0.3534	0.1855	0.2457
ab2L1R	35	0.6514	0.4259	0.5920	0.6062	0.5321	0.2310	0.4510
ad4L2R	36	0.7596	0.4422	0.7084	0.7330	0.6806	0.2778	0.5574
bc4L2R	37	0.4322	0.3388	0.4194	0.3334	0.3859	0.2537	0.3358
ab2L2R	38	0.6948	0.4495	0.6528	0.6307	0.6234	0.2980	0.5099
a4LP	39	0.4716	0.5251	0.3949	0.2989	0.4826	0.4036	0.3591
b4LP	40	0.0213	-0.1353	0.0577	0.1018	0.2001	0.1713	0.1402
adSP	41	0.4216	0.3571	0.3549	0.3538	0.4537	0.2796	0.3735
bcSP	42	0.2591	0.3060	0.1638	0.1988	0.2240	0.2582	0.1354
a2LP	43	0.3773	0.3516	0.3525	0.2599	0.3325	0.2516	0.2841
a1LP	44	0.4202	0.3728	0.3666	0.3275	0.3787	0.2630	0.2779
a4L1R	45	0.6967	0.4667	0.6341	0.6385	0.6027	0.2566	0.5404
b4L1R	46	0.3679	0.2569	0.2437	0.4116	0.4143	0.1943	0.3771
adS1R	47	0.6490	0.3920	0.5863	0.6326	0.5366	0.2329	0.4528
bcS1R	48	0.5586	0.3773	0.4740	0.5411	0.4678	0.2811	0.3658
a2L1R	49	0.6142	0.4396	0.5506	0.5485	0.5487	0.2605	0.4749
a1L1R	50	0.6517	0.4238	0.5792	0.6202	0.5370	0.2900	0.4228
a4L2R	51	0.6530	0.3979	0.6097	0.6156	0.6058	0.2624	0.4960
b4L2R	52	0.3336	0.3238	0.3556	0.1793	0.4854	0.3155	0.4207
adS2R	53	0.6299	0.3489	0.5997	0.6106	0.5996	0.2574	0.5172
bcS2R	54	0.6029	0.4353	0.5413	0.5346	0.5431	0.2454	0.4877
a2L2R	55	0.6103	0.4101	0.5706	0.5446	0.5880	0.3103	0.4897
a1L2R	56	0.6533	0.3769	0.6095	0.6327	0.5080	0.2287	0.3922
		8	9	10	11	12	13	14

Table 36 continued (3/6)

		ad_2c L2R	adcd SP	adcd S1R	adcd S2R	ad_bc SPR	ad_bc SP	ad_bc S1R
ad_2cL2R	15	1.0000						
abcdSP	16	0.3145	1.0000					
abcdS1R	17	0.5287	0.7672	1.0000				
abcdS2R	18	0.5874	0.6288	0.8686	1.0000			
ad_bcSPR	19	0.5010	0.3616	0.5646	0.5875	1.0000		
ad_bcSP	20	0.5350	0.3090	0.5236	0.5910	0.7177	1.0000	
ad_bcS1R	21	0.3615	0.2385	0.4302	0.4490	0.8914	0.4756	1.0000
ad_bcS2R	22	0.4051	0.3727	0.4879	0.4731	0.8705	0.4598	0.6649
ad_2bSPR	23	0.3872	0.3489	0.5147	0.5332	0.8934	0.6403	0.7849
ad_2bSP	24	0.4098	0.2261	0.3738	0.4025	0.6181	0.8005	0.4204
ad_2bS1R	25	0.3030	0.2922	0.4556	0.4858	0.8073	0.4641	0.8633
ad_2bS2R	26	0.2738	0.3361	0.4373	0.4263	0.7644	0.3992	0.5948
ad_2cSP	27	0.4630	0.2769	0.4779	0.5578	0.5586	0.8343	0.3601
ad_2cS1R	28	0.3299	0.1332	0.3054	0.3096	0.7573	0.3736	0.8882
ad_2cS2R	29	0.4324	0.3203	0.4217	0.4069	0.7676	0.4098	0.5763
ad4LP	30	0.3901	0.8948	0.6747	0.5738	0.3771	0.2436	0.2820
bc4LP	31	0.2371	0.8540	0.5728	0.4539	0.3600	0.1816	0.2596
ab2LP	32	0.2978	0.9241	0.7178	0.5939	0.3836	0.2725	0.2944
ad4L1R	33	0.6461	0.7200	0.9199	0.8371	0.5973	0.4933	0.4693
bc4L1R	34	0.3890	0.7842	0.8996	0.7445	0.4994	0.3424	0.3874
ab2L1R	35	0.5427	0.7467	0.9387	0.8196	0.5846	0.4746	0.4709
ad4L2R	36	0.7244	0.5759	0.8367	0.9278	0.6028	0.5322	0.4684
bc4L2R	37	0.3266	0.5983	0.7492	0.8711	0.4809	0.4032	0.3706
ab2L2R	38	0.6346	0.5900	0.8274	0.9356	0.6165	0.5426	0.4886
a4LP	39	0.4075	0.8740	0.6665	0.5943	0.3065	0.2531	0.1775
b4LP	40	0.1738	0.7831	0.4855	0.3701	0.3235	0.1408	0.1921
adSP	41	0.4170	0.9701	0.8174	0.7113	0.5053	0.5305	0.3339
bcSP	42	0.1700	0.9583	0.6491	0.4834	0.1643	0.0242	0.1078
a2LP	43	0.2638	0.9095	0.6786	0.5377	0.3319	0.2253	0.2562
a1LP	44	0.3597	0.8528	0.6719	0.5104	0.3831	0.2730	0.2817
a4L1R	45	0.5903	0.6667	0.8751	0.8415	0.5279	0.4395	0.3913
b4L1R	46	0.3879	0.7839	0.8539	0.7175	0.4796	0.3699	0.3541
adS1R	47	0.5490	0.7179	0.9687	0.8621	0.7253	0.5760	0.6409
bcS1R	48	0.4529	0.7591	0.9470	0.7957	0.3037	0.4067	0.1173
a2L1R	49	0.5350	0.6990	0.8803	0.7768	0.5371	0.4398	0.4201
a1L1R	50	0.5395	0.7075	0.9022	0.8014	0.5583	0.4612	0.4294
a4L2R	51	0.6344	0.5464	0.7583	0.8923	0.5397	0.5117	0.3797
b4L2R	52	0.4150	0.5749	0.6659	0.8164	0.4678	0.4497	0.3344
adS2R	53	0.6048	0.6321	0.8665	0.9754	0.7214	0.6216	0.5512
bcS2R	54	0.5216	0.5781	0.8073	0.9582	0.3706	0.5079	0.2834
a2L2R	55	0.5703	0.4938	0.7225	0.8573	0.5730	0.5122	0.4524
a1L2R	56	0.5487	0.5581	0.8018	0.8773	0.5889	0.4480	0.4973
		15	16	17	18	19	20	21

Table 36 continued (4/6)

		ad_bc S2R	ad_2b SPR	ad_2b SP	ad_2b S1R	ad_2b S2R	ad_2c SP	ad_2c S1R
ad_bcS2R	22	1.0000						
ad_2bSPR	23	0.7912	1.0000					
ad_2bSP	24	0.4276	0.7460	1.0000				
ad_2bS1R	25	0.6252	0.8846	0.5254	1.0000			
ad_2bS2R	26	0.8694	0.8351	0.4304	0.6005	1.0000		
ad_2cSP	27	0.3288	0.3193	0.3374	0.2457	0.2309	1.0000	
ad_2cS1R	28	0.5437	0.5086	0.2254	0.5348	0.4490	0.3792	1.0000
ad_2cS2R	29	0.8897	0.5679	0.3263	0.5038	0.5479	0.3434	0.5059
ad4LP	30	0.4082	0.3311	0.1564	0.2969	0.3419	0.2384	0.2016
bc4LP	31	0.4370	0.3279	0.1376	0.2610	0.3894	0.1585	0.1967
ab2LP	32	0.3889	0.3639	0.1872	0.3216	0.3697	0.2556	0.2000
ad4L1R	33	0.5439	0.5342	0.3112	0.5047	0.4776	0.4882	0.3263
bc4L1R	34	0.5106	0.4624	0.2369	0.4198	0.4581	0.3195	0.2664
ab2L1R	35	0.5254	0.5229	0.3241	0.4721	0.4773	0.4468	0.3587
ad4L2R	36	0.5302	0.5277	0.3476	0.4866	0.4545	0.5159	0.3414
bc4L2R	37	0.4417	0.4349	0.2218	0.4033	0.4223	0.4291	0.2534
ab2L2R	38	0.5329	0.5643	0.3692	0.5085	0.5014	0.5124	0.3553
a4LP	39	0.3497	0.2606	0.1411	0.1967	0.2966	0.2675	0.1182
b4LP	40	0.4544	0.3106	0.1292	0.2051	0.4163	0.1020	0.1345
adSP	41	0.4495	0.4743	0.4057	0.3789	0.4014	0.4596	0.2141
bcSP	42	0.2536	0.1743	-0.0030	0.1677	0.2333	0.0403	0.0278
a2LP	43	0.3425	0.3313	0.1731	0.3132	0.3116	0.1943	0.1435
a1LP	44	0.4015	0.3381	0.2110	0.3058	0.3066	0.2342	0.1931
a4L1R	45	0.5042	0.4863	0.2948	0.4487	0.4382	0.4190	0.2469
b4L1R	46	0.4809	0.4396	0.2441	0.3901	0.4310	0.3560	0.2378
adS1R	47	0.5979	0.6536	0.4335	0.6250	0.5355	0.5054	0.5040
bcS1R	48	0.3001	0.2869	0.2616	0.1939	0.2693	0.3975	0.0197
a2L1R	49	0.4940	0.5056	0.3383	0.4453	0.4549	0.3793	0.2980
a1L1R	50	0.5186	0.5252	0.3573	0.4791	0.4489	0.3954	0.2828
a4L2R	51	0.4937	0.4986	0.3786	0.4145	0.4411	0.4553	0.2587
b4L2R	52	0.4175	0.3931	0.2649	0.3217	0.3798	0.4625	0.2672
adS2R	53	0.6558	0.6550	0.4520	0.5728	0.5829	0.5604	0.4014
bcS2R	54	0.2014	0.3359	0.3087	0.3371	0.1917	0.5136	0.1677
a2L2R	55	0.4915	0.5244	0.3522	0.4725	0.4593	0.4805	0.3276
a1L2R	56	0.5252	0.5417	0.3163	0.5242	0.4705	0.4125	0.3555
		22	23	24	25	26	27	28

Table 36 continued (5/6)

		ad_2c S2R	ad4 LP	bc4 LP	ab2 LP	ad4 L1R	bc4 L1R	ab2 L1R
ad_2cS2R	29	1.0000						
ad4LP	30	0.3748	1.0000					
bc4LP	31	0.3797	0.8748	1.0000				
ab2LP	32	0.3166	0.9035	0.8783	1.0000			
ad4L1R	33	0.4790	0.7182	0.5865	0.7159	1.0000		
bc4L1R	34	0.4408	0.7122	0.6740	0.7444	0.8998	1.0000	
ab2L1R	35	0.4484	0.6903	0.5930	0.7637	0.9365	0.9044	1.0000
ad4L2R	36	0.4773	0.5841	0.4443	0.5545	0.8905	0.7633	0.8119
bc4L2R	37	0.3576	0.5664	0.4704	0.5666	0.7412	0.7407	0.7109
ab2L2R	38	0.4387	0.5949	0.4483	0.5991	0.8474	0.7412	0.8402
a4LP	39	0.3177	0.9540	0.8173	0.8668	0.6959	0.6797	0.6681
b4LP	40	0.3845	0.7739	0.9275	0.7915	0.4852	0.5898	0.4859
adSP	41	0.3900	0.8597	0.8075	0.8932	0.7677	0.7864	0.7867
bcSP	42	0.2135	0.8674	0.8431	0.8895	0.6087	0.7215	0.6424
a2LP	43	0.2917	0.8955	0.8613	0.9769	0.6741	0.6913	0.7150
a1LP	44	0.3963	0.8605	0.8077	0.8688	0.6616	0.6715	0.6834
a4L1R	45	0.4484	0.6422	0.5115	0.6485	0.9314	0.8514	0.8791
b4L1R	46	0.4156	0.6980	0.6785	0.7026	0.8612	0.9519	0.8538
adS1R	47	0.5172	0.6513	0.5585	0.6913	0.9113	0.8715	0.9278
bcS1R	48	0.2588	0.6419	0.5377	0.6848	0.8449	0.8517	0.8651
a2L1R	49	0.4158	0.6577	0.5393	0.6867	0.8970	0.8572	0.9446
a1L1R	50	0.4629	0.6454	0.5212	0.7024	0.8803	0.8424	0.9161
a4L2R	51	0.4282	0.5285	0.3994	0.5012	0.7947	0.6898	0.7155
b4L2R	52	0.3559	0.5656	0.4558	0.5312	0.6713	0.6388	0.6403
adS2R	53	0.5715	0.5939	0.4984	0.6064	0.8535	0.7658	0.8339
bcS2R	54	0.1637	0.5055	0.3629	0.5342	0.7542	0.6620	0.7407
a2L2R	55	0.4078	0.5120	0.3599	0.4843	0.7550	0.6521	0.7246
a1L2R	56	0.4542	0.5156	0.4026	0.5892	0.8100	0.7468	0.8204
		29	30	31	32	33	34	35

		ad4L2R	bc4L2R	ab2L2R	a4LP	b4LP	adSP	bcSP
ad4L2R	36	1.0000						
bc4L2R	37	0.8574	1.0000					
ab2L2R	38	0.9361	0.8472	1.0000				
a4LP	39	0.6227	0.6255	0.6314	1.0000			
b4LP	40	0.3502	0.4065	0.3575	0.7187	1.0000		
adSP	41	0.6492	0.6362	0.6644	0.8435	0.7339	1.0000	
bcSP	42	0.4456	0.5078	0.4572	0.8426	0.7808	0.8603	1.0000
a2LP	43	0.4899	0.5057	0.5362	0.8511	0.7795	0.8681	0.8883
a1LP	44	0.5046	0.4548	0.5054	0.8120	0.7232	0.8297	0.8143
a4L1R	45	0.8831	0.7828	0.8755	0.6680	0.3997	0.7065	0.5689
b4L1R	46	0.7079	0.7109	0.6890	0.6667	0.6203	0.7931	0.7129
adS1R	47	0.8403	0.7390	0.8379	0.6155	0.4657	0.7869	0.5816
bcS1R	48	0.7537	0.6922	0.7363	0.6700	0.4657	0.7803	0.6757
a2L1R	49	0.7810	0.6940	0.8065	0.6490	0.4378	0.7354	0.6028
a1L1R	50	0.7918	0.6754	0.7847	0.6182	0.4351	0.7483	0.6052
a4L2R	51	0.9419	0.8629	0.9064	0.5979	0.3185	0.6176	0.4206
b4L2R	52	0.8006	0.9464	0.7982	0.6373	0.4168	0.6273	0.4693
adS2R	53	0.9278	0.8571	0.9351	0.5968	0.4310	0.7221	0.4777
bcS2R	54	0.8594	0.8251	0.8672	0.5472	0.2640	0.6449	0.4552
a2L2R	55	0.8659	0.8090	0.9355	0.5567	0.2903	0.5709	0.3652
a1L2R	56	0.8856	0.8076	0.8824	0.5382	0.3190	0.6118	0.4521
		36	37	38	39	40	41	42

Table 36 continued (6/6)

		a2LP	a1LP	a4L1R	b4L1R	adS1R	bcS1R	a2L1R
a2LP	43	1.0000						
a1LP	44	0.8670	1.0000					
a4L1R	45	0.6048	0.5879	1.0000				
b4L1R	46	0.6673	0.6400	0.8168	1.0000			
adS1R	47	0.6475	0.6488	0.8518	0.8235	1.0000		
bcS1R	48	0.6553	0.6388	0.8234	0.8133	0.8374	1.0000	
a2L1R	49	0.6682	0.6272	0.8710	0.8296	0.8641	0.8189	1.0000
a1L1R	50	0.6620	0.7253	0.8368	0.7863	0.8853	0.8396	0.8660
a4L2R	51	0.4322	0.4470	0.8748	0.6479	0.7493	0.6990	0.7111
b4L2R	52	0.4796	0.4414	0.7148	0.6612	0.6582	0.6134	0.6463
adS2R	53	0.5465	0.5380	0.8473	0.7352	0.8884	0.7570	0.7893
bcS2R	54	0.4867	0.4372	0.7719	0.6415	0.7644	0.7872	0.7033
a2L2R	55	0.4470	0.4309	0.8154	0.6218	0.7388	0.6338	0.7768
a1L2R	56	0.5284	0.5393	0.8175	0.6688	0.8186	0.7050	0.7559
		43	44	45	46	47	48	49

		a1L1R	a4L2R	b4L2R	adS2R	bcS2R	a2L2R	a1L2R
a1L1R	50	1.0000						
a4L2R	51	0.7025	1.0000					
b4L2R	52	0.5989	0.8199	1.0000				
adS2R	53	0.8166	0.8882	0.8041	1.0000			
bcS2R	54	0.7227	0.8318	0.7721	0.8716	1.0000		
a2L2R	55	0.6769	0.8773	0.7728	0.8576	0.7935	1.0000	
a1L2R	56	0.8676	0.8255	0.7235	0.8833	0.8049	0.7795	1.0000
		50	51	52	53	54	55	56

Correlation is significantly different from zero if > 0.260 (5%), > 0.335 (1%)
ad_2cL2R = A+D-2*C, 4-row long plots, second ratoon crop
ad_bcSPR = A+D-B-C, 4-row short plots, (P+1R+2R)/3 CROPS
a2L = row A, 2-row long plots
a1L1R = row A, 1-row long plots, first ratoon crop

Table 37a. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial. Competition vs row weights (kg) for different plot shapes.

Character & crop X	Y	Plots rP	Means (df =) rG	rP	rE
ad_bcLP	vs abcd4LP	0.172	0.860 ± 0.445	0.355 ±0.028	0.020 ±0.075
ad_bcLP	vs a4SP crop	0.107	1.017 ± 0.536	0.348 ±0.029	-0.044 ±0.075
ad_bcLP	vs b4SP crop	0.077	1.093 ± 0.568	0.357 ±0.028	-0.119 ±0.074
ad_bcLP	vs c4SP crop	0.151	0.621 ± 0.415	0.268 ±0.030	0.099 ±0.074
ad_bcLP	vs d4SP crop	0.135	1.020 ± 0.523	0.369 ±0.028	-0.031 ±0.075
ad_bcLP	vs ad4SP crop	0.140	1.038 ± 0.522	0.385 ±0.028	-0.049 ±0.075
ad_bcLP	vs bc4SP crop	0.136	0.887 ± 0.471	0.340 ±0.029	-0.003 ±0.075
ad_bcLP	vs abcd4SP	0.152	0.971 ± 0.490	0.378 ±0.028	-0.036 ±0.075
ad_bcLP	vs a2LP crop	0.212	0.832 ± 0.431	0.366 ±0.028	0.124 ±0.074
ad_bcLP	vs b2LP crop	0.146	0.824 ± 0.443	0.330 ±0.029	0.007 ±0.075
ad_bcLP	vs ab2LP crop	0.196	0.812 ± 0.423	0.354 ±0.028	0.094 ±0.074
ad_bcLP	vs a1LP crop	0.170	0.990 ± 0.497	0.387 ±0.028	0.014 ±0.075
tad_bcLP	vs abcd4LP	0.161	0.501 ± 0.224	0.288 ±0.030	0.061 ±0.075
tad_bcLP	vs a4SP crop	0.062	0.650 ± 0.270	0.279 ±0.030	-0.090 ±0.075
tad_bcLP	vs b4SP crop	0.025	0.588 ± 0.266	0.241 ±0.031	-0.141 ±0.074
tad_bcLP	vs c4SP crop	0.134	0.191 ± 0.274	0.157 ±0.032	0.146 ±0.074
tad_bcLP	vs d4SP crop	0.080	0.512 ± 0.256	0.240 ±0.031	-0.047 ±0.075
tad_bcLP	vs ad4SP crop	0.082	0.589 ± 0.247	0.278 ±0.030	-0.091 ±0.075
tad_bcLP	vs bc4SP crop	0.095	0.408 ± 0.245	0.217 ±0.031	0.018 ±0.075
tad_bcLP	vs abcd4SP	0.097	0.508 ± 0.236	0.259 ±0.030	-0.051 ±0.075
tad_bcLP	vs a2LP crop	0.181	0.482 ± 0.235	0.290 ±0.030	0.119 ±0.074
tad_bcLP	vs b2LP crop	0.104	0.495 ± 0.236	0.256 ±0.030	-0.030 ±0.075
tad_bcLP	vs ab2LP crop	0.155	0.480 ± 0.225	0.277 ±0.030	0.065 ±0.075
tad_bcLP	vs a1LP crop	0.089	0.554 ± 0.248	0.266 ±0.030	-0.061 ±0.075
ad_bcL1R	vs abcd4LP	0.208	0.491 ± 0.182	0.326 ±0.029	0.083 ±0.075
ad_bcL1R	vs a4SP crop	0.202	0.735 ± 0.194	0.419 ±0.027	0.018 ±0.075
ad_bcL1R	vs b4SP crop	0.076	0.476 ± 0.214	0.246 ±0.031	-0.078 ±0.075
ad_bcL1R	vs c4SP crop	0.047	0.067 ± 0.243	0.058 ±0.032	0.051 ±0.075
ad_bcL1R	vs d4SP crop	0.181	0.568 ± 0.198	0.339 ±0.029	0.029 ±0.075
ad_bcL1R	vs ad4SP crop	0.221	0.662 ± 0.181	0.405 ±0.027	0.030 ±0.075
ad_bcL1R	vs bc4SP crop	0.072	0.287 ± 0.213	0.167 ±0.032	-0.012 ±0.075
ad_bcL1R	vs abcd4SP	0.168	0.492 ± 0.189	0.307 ±0.029	0.014 ±0.075
ad_bcL1R	vs a2LP crop	0.170	0.600 ± 0.192	0.355 ±0.028	-0.002 ±0.075
ad_bcL1R	vs b2LP crop	0.202	0.557 ± 0.184	0.352 ±0.029	0.039 ±0.075
ad_bcL1R	vs ab2LP crop	0.206	0.566 ± 0.179	0.361 ±0.028	0.025 ±0.075
ad_bcL1R	vs a1LP crop	0.182	0.598 ± 0.190	0.359 ±0.028	0.012 ±0.075

Table 37a continued (2/2)

Character & crop		Plots	Means (df =)		
X	Y	rP	rG	rP	rE
ad_bcL2R	vs abcd4LP	0.229	0.432 ± 0.157	0.328 ±0.029	0.098 ±0.074
ad_bcL2R	vs a4S2R crop	0.251	0.671 ± 0.155	0.449 ±0.026	0.055 ±0.075
ad_bcL2R	vs b4S2R crop	0.043	0.386 ± 0.187	0.211 ±0.031	-0.138 ±0.074
ad_bcL2R	vs c4S2R crop	0.123	0.192 ± 0.206	0.155 ±0.032	0.098 ±0.074
ad_bcL2R	vs d4S2R crop	0.176	0.493 ± 0.171	0.328 ±0.029	0.006 ±0.075
ad_bcL2R	vs ad4S2R crop	0.247	0.590 ± 0.151	0.415 ±0.027	0.041 ±0.075
ad_bcL2R	vs bc4S2R crop	0.099	0.300 ± 0.182	0.199 ±0.031	-0.015 ±0.075
ad_bcL2R	vs abcd4SP	0.197	0.459 ± 0.160	0.328 ±0.029	0.019 ±0.075
ad_bcL2R	vs a2L2R crop	0.175	0.394 ± 0.173	0.283 ±0.030	0.057 ±0.075
ad_bcL2R	vs b2L2R crop	0.246	0.465 ± 0.157	0.352 ±0.029	0.115 ±0.074
ad_bcL2R	vs ab2L2R crop	0.234	0.425 ± 0.157	0.327 ±0.029	0.119 ±0.074
ad_bcL2R	vs a1L2R crop	0.236	0.510 ± 0.160	0.370 ±0.028	0.086 ±0.075
ad_bcL1R	vs ad_bcS1R	0.188	0.916 ± 0.311	0.395 ±0.027	0.064 ±0.075
ad_bcL2R	vs ad_bcS2R	0.269	0.786 ± 0.251	0.432 ±0.026	0.167 ±0.073
ad_bcL1R	vs ad_bcS2R	0.161	0.879 ± 0.330	0.361 ±0.028	0.042 ±0.075
ad_bcS1R	vs ad_bcL2R	0.191	0.850 ± 0.264	0.405 ±0.027	0.051 ±0.075
ad_bcL1R	vs ad_bcL2R	0.665	0.979 ± 0.098	0.775 ±0.013	0.592 ±0.049
ad_bcS1R	vs ad_bcS2R	0.531	1.060 ± 0.213	0.665 ±0.018	0.454 ±0.060

Table 37b. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial. Row weights (kg) for different plot shapes.

Character & crop X	Y	Plots rP	Means (df =) rG	rP	rE
ad_bcLP	vs abcd4L1R	0.243	0.944 ± 0.457	0.414 ±0.027	0.121 ±0.074
ad_bcLP	vs a4S1R crop	0.160	1.126 ± 0.558	0.407 ±0.027	-0.018 ±0.075
ad_bcLP	vs b4S1R crop	0.131	1.062 ± 0.552	0.365 ±0.028	-0.015 ±0.075
ad_bcLP	vs c4S1R crop	0.177	0.963 ± 0.489	0.379 ±0.028	0.044 ±0.075
ad_bcLP	vs d4S1R crop	0.183	0.763 ± 0.423	0.326 ±0.029	0.090 ±0.075
ad_bcLP	vs ad4S1R crop	0.197	0.932 ± 0.468	0.383 ±0.028	0.048 ±0.075
ad_bcLP	vs bc4S1R crop	0.180	1.019 ± 0.505	0.399 ±0.027	0.018 ±0.075
ad_bcLP	vs abcd4S1R	0.210	0.980 ± 0.479	0.407 ±0.027	0.044 ±0.075
ad_bcLP	vs a2L1R crop	0.211	1.056 ± 0.508	0.429 ±0.027	0.054 ±0.075
ad_bcLP	vs b2L1R crop	0.193	0.807 ± 0.429	0.346 ±0.029	0.087 ±0.075
ad_bcLP	vs ab2L1R crop	0.225	0.939 ± 0.460	0.404 ±0.027	0.094 ±0.075
ad_bcLP	vs a1L1R crop	0.196	1.109 ± 0.534	0.435 ±0.026	0.005 ±0.075
tad_bcLP	vs abcd4L1R	0.213	0.605 ± 0.219	0.352 ±0.029	0.094 ±0.075
tad_bcLP	vs a4S1R crop	0.096	0.742 ± 0.265	0.328 ±0.029	-0.098 ±0.074
tad_bcLP	vs b4S1R crop	0.055	0.508 ± 0.279	0.214 ±0.031	-0.055 ±0.075
tad_bcLP	vs c4S1R crop	0.114	0.484 ± 0.251	0.250 ±0.031	0.018 ±0.075
tad_bcLP	vs d4S1R crop	0.182	0.437 ± 0.239	0.269 ±0.030	0.127 ±0.074
tad_bcLP	vs ad4S1R crop	0.161	0.580 ± 0.233	0.312 ±0.029	0.018 ±0.075
tad_bcLP	vs bc4S1R crop	0.099	0.500 ± 0.246	0.250 ±0.031	-0.026 ±0.075
tad_bcLP	vs abcd4S1R	0.148	0.551 ± 0.230	0.297 ±0.030	-0.003 ±0.075
tad_bcLP	vs a2L1R crop	0.179	0.656 ± 0.234	0.354 ±0.028	0.037 ±0.075
tad_bcLP	vs b2L1R crop	0.132	0.512 ± 0.238	0.272 ±0.030	0.009 ±0.075
tad_bcLP	vs ab2L1R crop	0.172	0.589 ± 0.226	0.326 ±0.029	0.030 ±0.075
tad_bcLP	vs a1L1R crop	0.134	0.671 ± 0.241	0.334 ±0.029	-0.055 ±0.075
ad_bcL1R	vs abcd4L1R	0.410	0.832 ± 0.140	0.581 ±0.022	0.282 ±0.069
ad_bcL1R	vs a4S1R crop	0.335	1.010 ± 0.159	0.614 ±0.020	0.107 ±0.074
ad_bcL1R	vs b4S1R crop	0.161	0.799 ± 0.206	0.419 ±0.027	-0.030 ±0.075
ad_bcL1R	vs c4S1R crop	0.252	0.723 ± 0.179	0.451 ±0.026	0.096 ±0.074
ad_bcL1R	vs d4S1R crop	0.270	0.808 ± 0.171	0.494 ±0.025	0.061 ±0.075
ad_bcL1R	vs ad4S1R crop	0.346	0.901 ± 0.151	0.579 ±0.022	0.113 ±0.074
ad_bcL1R	vs bc4S1R crop	0.242	0.766 ± 0.173	0.468 ±0.025	0.041 ±0.075
ad_bcL1R	vs abcd4S1R	0.332	0.852 ± 0.152	0.553 ±0.023	0.104 ±0.074
ad_bcL1R	vs a2L1R crop	0.286	0.945 ± 0.161	0.571 ±0.022	0.019 ±0.075
ad_bcL1R	vs b2L1R crop	0.321	0.836 ± 0.157	0.537 ±0.023	0.114 ±0.074
ad_bcL1R	vs ab2L1R crop	0.340	0.903 ± 0.149	0.581 ±0.022	0.090 ±0.075
ad_bcL1R	vs a1L1R crop	0.337	0.861 ± 0.154	0.559 ±0.022	0.136 ±0.074

Table 37b continued (2/2)

Character & crop		Plots	Means (df =)		
X	Y	rP	rG	rP	rE
ad_bcL2R	vs abcd4L1R	0.447	0.846 ± 0.099	0.645 ±0.019	0.210 ±0.072
ad_bcL2R	vs a4S1R crop	0.408	0.907 ± 0.108	0.649 ±0.019	0.181 ±0.073
ad_bcL2R	vs b4S1R crop	0.211	0.858 ± 0.152	0.512 ±0.024	-0.050 ±0.075
ad_bcL2R	vs c4S1R crop	0.297	0.693 ± 0.141	0.492 ±0.025	0.110 ±0.074
ad_bcL2R	vs d4S1R crop	0.281	0.869 ± 0.126	0.570 ±0.022	-0.043 ±0.075
ad_bcL2R	vs ad4S1R crop	0.392	0.886 ± 0.105	0.638 ±0.019	0.094 ±0.075
ad_bcL2R	vs bc4S1R crop	0.297	0.776 ± 0.129	0.537 ±0.023	0.036 ±0.075
ad_bcL2R	vs abcd4S1R	0.388	0.847 ± 0.107	0.620 ±0.020	0.087 ±0.075
ad_bcL2R	vs a2L1R crop	0.323	0.843 ± 0.119	0.585 ±0.021	0.030 ±0.075
ad_bcL2R	vs b2L1R crop	0.384	0.811 ± 0.114	0.596 ±0.021	0.141 ±0.074
ad_bcL2R	vs ab2L1R crop	0.397	0.841 ± 0.106	0.621 ±0.020	0.116 ±0.074
ad_bcL2R	vs a1L1R crop	0.387	0.866 ± 0.108	0.627 ±0.020	0.117 ±0.074

Table 37c. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial. Row weights (kg) for different plot shapes.

Character & crop X	Y	Plots rP	Means (df =) rG		rP	rE
ad_bcLP	vs abcd4L2R	0.220	1.016 ±	0.490	0.423 ±0.027	0.038 ±0.075
ad_bcLP	vs a4S2R crop	0.170	0.757 ±	0.426	0.315 ±0.029	0.067 ±0.075
ad_bcLP	vs b4S2R crop	0.103	1.317 ±	0.653	0.428 ±0.027	-0.123 ±0.074
ad_bcLP	vs c4S2R crop	0.157	0.960 ±	0.499	0.361 ±0.028	0.018 ±0.075
ad_bcLP	vs d4S2R crop	0.194	0.917 ±	0.469	0.373 ±0.028	0.063 ±0.075
ad_bcLP	vs ad4S2R crop	0.206	0.865 ±	0.444	0.368 ±0.028	0.083 ±0.075
ad_bcLP	vs bc4S2R crop	0.151	1.137 ±	0.557	0.418 ±0.027	-0.071 ±0.075
ad_bcLP	vs abcd4S2R	0.198	0.990 ±	0.487	0.403 ±0.027	0.018 ±0.075
ad_bcLP	vs a2L2R crop	0.236	1.041 ±	0.496	0.437 ±0.026	0.103 ±0.074
ad_bcLP	vs b2L2R crop	0.191	1.096 ±	0.529	0.429 ±0.027	0.007 ±0.075
ad_bcLP	vs ab2L2R crop	0.237	1.092 ±	0.513	0.456 ±0.026	0.068 ±0.075
ad_bcLP	vs a1L2R crop	0.204	0.873 ±	0.446	0.371 ±0.028	0.086 ±0.075
tad_bcLP	vs abcd4L2R	0.239	0.713 ±	0.218	0.407 ±0.027	0.076 ±0.075
tad_bcLP	vs a4S2R crop	0.136	0.633 ±	0.245	0.316 ±0.029	-0.024 ±0.075
tad_bcLP	vs b4S2R crop	0.056	0.753 ±	0.273	0.314 ±0.029	-0.140 ±0.074
tad_bcLP	vs c4S2R crop	0.145	0.682 ±	0.253	0.336 ±0.029	-0.002 ±0.075
tad_bcLP	vs d4S2R crop	0.185	0.636 ±	0.238	0.343 ±0.029	0.053 ±0.075
tad_bcLP	vs ad4S2R crop	0.182	0.656 ±	0.232	0.353 ±0.029	0.020 ±0.075
tad_bcLP	vs bc4S2R crop	0.117	0.717 ±	0.245	0.345 ±0.029	-0.096 ±0.074
tad_bcLP	vs abcd4S2R	0.167	0.687 ±	0.230	0.361 ±0.028	-0.040 ±0.075
tad_bcLP	vs a2L2R crop	0.250	0.813 ±	0.228	0.450 ±0.026	0.097 ±0.074
tad_bcLP	vs b2L2R crop	0.197	0.709 ±	0.231	0.383 ±0.028	0.037 ±0.075
tad_bcLP	vs ab2L2R crop	0.247	0.769 ±	0.220	0.435 ±0.026	0.085 ±0.075
tad_bcLP	vs a1L2R crop	0.189	0.632 ±	0.231	0.349 ±0.029	0.054 ±0.075
ad_bcL1R	vs abcd4L2R	0.410	0.903 ±	0.138	0.614 ±0.020	0.226 ±0.071
ad_bcL1R	vs a4S2R crop	0.353	0.938 ±	0.152	0.597 ±0.021	0.134 ±0.074
ad_bcL1R	vs b4S2R crop	0.245	1.000 ±	0.177	0.562 ±0.022	-0.011 ±0.075
ad_bcL1R	vs c4S2R crop	0.271	0.866 ±	0.173	0.519 ±0.024	0.072 ±0.075
ad_bcL1R	vs d4S2R crop	0.270	0.974 ±	0.169	0.567 ±0.022	-0.007 ±0.075
ad_bcL1R	vs ad4S2R crop	0.352	0.989 ±	0.150	0.622 ±0.020	0.080 ±0.075
ad_bcL1R	vs bc4S2R crop	0.299	0.932 ±	0.158	0.573 ±0.022	0.042 ±0.075
ad_bcL1R	vs abcd4S2R	0.357	0.971 ±	0.147	0.621 ±0.020	0.078 ±0.075
ad_bcL1R	vs a2L2R crop	0.291	0.993 ±	0.164	0.591 ±0.021	0.024 ±0.075
ad_bcL1R	vs b2L2R crop	0.357	1.013 ±	0.151	0.634 ±0.019	0.087 ±0.075
ad_bcL1R	vs ab2L2R crop	0.366	1.023 ±	0.148	0.648 ±0.019	0.074 ±0.075
ad_bcL1R	vs a1L2R crop	0.324	0.878 ±	0.155	0.559 ±0.022	0.102 ±0.074

Table 37c continued (2/2)

Character & crop		Plots	Means (df =)		
X	Y	rP	rG	rP	rE
ad_bcL2R	vs abcd4L2R	0.432	0.842 ± 0.101	0.637 ±0.019	0.179 ±0.073
ad_bcL2R	vs a4S2R crop	0.420	0.835 ± 0.110	0.622 ±0.020	0.209 ±0.072
ad_bcL2R	vs b4S2R crop	0.241	0.965 ± 0.131	0.592 ±0.021	-0.098 ±0.074
ad_bcL2R	vs c4S2R crop	0.255	0.726 ± 0.146	0.484 ±0.025	0.038 ±0.075
ad_bcL2R	vs d4S2R crop	0.328	0.890 ± 0.118	0.605 ±0.021	0.032 ±0.075
ad_bcL2R	vs ad4S2R crop	0.423	0.892 ± 0.101	0.656 ±0.019	0.151 ±0.073
ad_bcL2R	vs bc4S2R crop	0.288	0.844 ± 0.122	0.570 ±0.022	-0.040 ±0.075
ad_bcL2R	vs abcd4S2R	0.395	0.877 ± 0.103	0.639 ±0.019	0.082 ±0.075
ad_bcL2R	vs a2L2R crop	0.297	0.908 ± 0.120	0.601 ±0.021	-0.027 ±0.075
ad_bcL2R	vs b2L2R crop	0.437	0.937 ± 0.096	0.685 ±0.017	0.156 ±0.073
ad_bcL2R	vs ab2L2R crop	0.418	0.942 ± 0.096	0.682 ±0.017	0.090 ±0.075
ad_bcL2R	vs a1L2R crop	0.394	0.883 ± 0.106	0.638 ±0.019	0.116 ±0.074

Table 38a. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial, plant crop 1987. Row weights (kg) for different plot shapes.

Character & crop X	Y	Plots rP	Means (df =) rG		rP	rE
a4LP crop	vs b4LP crop	0.407	0.939 ±	0.072	0.719 ±0.016	-0.045 ±0.075
a4LP crop	vs c4LP crop	0.585	0.944 ±	0.049	0.803 ±0.012	0.238 ±0.071
a4LP crop	vs d4LP crop	0.561	0.975 ±	0.045	0.818 ±0.011	0.098 ±0.074
b4LP crop	vs c4LP crop	0.477	0.930 ±	0.067	0.740 ±0.015	0.122 ±0.074
b4LP crop	vs d4LP crop	0.504	0.938 ±	0.062	0.757 ±0.014	0.105 ±0.074
bc4LP crop	vs ad4LP crop	0.657	0.992 ±	0.030	0.875 ±0.008	0.088 ±0.075
bc4LP crop	vs abcd4LP	0.897	0.998 ±	0.009	0.962 ±0.002	0.731 ±0.035
ad4LP crop	vs abcd4LP	0.922	0.998 ±	0.006	0.974 ±0.002	0.744 ±0.034
ad4LP crop	vs a4SP crop	0.518	0.985 ±	0.053	0.796 ±0.012	-0.008 ±0.075
ad4LP crop	vs b4SP crop	0.534	0.996 ±	0.045	0.821 ±0.011	-0.059 ±0.075
ad4LP crop	vs c4SP crop	0.508	0.975 ±	0.060	0.776 ±0.013	0.075 ±0.075
ad4LP crop	vs d4SP crop	0.581	0.947 ±	0.046	0.807 ±0.011	0.098 ±0.074
ad4LP crop	vs ad4SP crop	0.634	0.984 ±	0.033	0.860 ±0.008	0.057 ±0.075
ad4LP crop	vs bc4SP crop	0.614	1.008 ±	0.033	0.867 ±0.008	0.017 ±0.075
ad4LP crop	vs abcd4SP	0.690	0.997 ±	0.025	0.895 ±0.006	0.049 ±0.075
ad4LP crop	vs a2LP crop	0.683	1.015 ±	0.027	0.895 ±0.006	0.193 ±0.072
ad4LP crop	vs b2LP crop	0.700	0.966 ±	0.028	0.877 ±0.007	0.167 ±0.073
ad4LP crop	vs ab2LP crop	0.762	0.970 ±	0.021	0.903 ±0.006	0.253 ±0.070
ad4LP crop	vs a1LP crop	0.631	0.988 ±	0.033	0.861 ±0.008	0.080 ±0.075
bc4LP crop	vs a4SP crop	0.495	0.939 ±	0.062	0.753 ±0.014	0.052 ±0.075
bc4LP crop	vs b4SP crop	0.540	0.932 ±	0.054	0.777 ±0.013	0.102 ±0.074
bc4LP crop	vs c4SP crop	0.444	1.033 ±	0.067	0.776 ±0.013	-0.058 ±0.075
bc4LP crop	vs d4SP crop	0.541	0.891 ±	0.059	0.754 ±0.014	0.142 ±0.074
bc4LP crop	vs ad4SP crop	0.598	0.932 ±	0.045	0.808 ±0.011	0.125 ±0.074
bc4LP crop	vs bc4SP crop	0.579	1.002 ±	0.039	0.843 ±0.009	0.021 ±0.075
bc4LP crop	vs abcd4SP	0.651	0.966 ±	0.034	0.854 ±0.009	0.099 ±0.074
bc4LP crop	vs a2LP crop	0.589	1.025 ±	0.037	0.861 ±0.008	0.028 ±0.075
bc4LP crop	vs b2LP crop	0.667	0.968 ±	0.032	0.861 ±0.008	0.161 ±0.073
bc4LP crop	vs ab2LP crop	0.694	0.975 ±	0.028	0.878 ±0.007	0.130 ±0.074
bc4LP crop	vs a1LP crop	0.567	0.951 ±	0.046	0.808 ±0.011	0.062 ±0.075
abcd4LP	vs a4SP crop	0.557	0.966 ±	0.050	0.802 ±0.012	0.029 ±0.075
abcd4LP	vs b4SP crop	0.589	0.969 ±	0.042	0.827 ±0.010	0.028 ±0.075
abcd4LP	vs c4SP crop	0.525	1.003 ±	0.056	0.801 ±0.012	0.012 ±0.075
abcd4LP	vs d4SP crop	0.618	0.923 ±	0.045	0.808 ±0.011	0.162 ±0.073
abcd4LP	vs ad4SP crop	0.678	0.962 ±	0.031	0.863 ±0.008	0.123 ±0.074
abcd4LP	vs bc4SP crop	0.656	1.008 ±	0.029	0.884 ±0.007	0.026 ±0.075
abcd4LP	vs abcd4SP	0.738	0.985 ±	0.021	0.905 ±0.006	0.100 ±0.074
abcd4LP	vs a2LP crop	0.702	1.021 ±	0.024	0.909 ±0.006	0.151 ±0.073
abcd4LP	vs b2LP crop	0.752	0.969 ±	0.023	0.898 ±0.006	0.223 ±0.071
abcd4LP	vs ab2LP crop	0.802	0.974 ±	0.017	0.921 ±0.005	0.260 ±0.070
abcd4LP	vs a1LP crop	0.660	0.973 ±	0.032	0.864 ±0.008	0.097 ±0.074

Table 38b. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial, 1R crop 1988. Row weights (kg) for different plot shapes.

Character & crop X		Y	Plots rP	Means (df =) rG	rP	rE
a4L1R crop	vs	b4L1R crop	0.541	1.003 ± 0.049	0.817 ±0.011	0.113 ±0.074
a4L1R crop	vs	c4L1R crop	0.592	0.944 ± 0.045	0.812 ±0.011	0.189 ±0.072
a4L1R crop	vs	d4L1R crop	0.551	0.855 ± 0.060	0.743 ±0.015	0.167 ±0.073
b4L1R crop	vs	c4L1R crop	0.534	1.025 ± 0.048	0.828 ±0.010	0.051 ±0.075
b4L1R crop	vs	d4L1R crop	0.549	0.950 ± 0.051	0.792 ±0.012	0.115 ±0.074
bc4L1R crop	vs	ad4L1R crop	0.742	0.978 ± 0.023	0.900 ±0.006	0.275 ±0.069
bc4L1R crop	vs	abcd4L1R	0.911	0.993 ± 0.008	0.966 ±0.002	0.731 ±0.035
ad4L1R crop	vs	abcd4L1R	0.952	0.996 ± 0.004	0.982 ±0.001	0.857 ±0.020
ad4L1R crop	vs	a4S1R crop	0.625	1.043 ± 0.036	0.880 ±0.007	0.136 ±0.074
ad4L1R crop	vs	b4S1R crop	0.477	1.002 ± 0.062	0.780 ±0.013	-0.024 ±0.075
ad4L1R crop	vs	c4S1R crop	0.600	0.913 ± 0.049	0.795 ±0.012	0.213 ±0.072
ad4L1R crop	vs	d4S1R crop	0.614	0.993 ± 0.036	0.856 ±0.009	0.094 ±0.075
ad4L1R crop	vs	ad4S1R crop	0.709	1.015 ± 0.022	0.911 ±0.006	0.154 ±0.073
ad4L1R crop	vs	bc4S1R crop	0.629	0.963 ± 0.036	0.845 ±0.009	0.120 ±0.074
ad4L1R crop	vs	abcd4S1R	0.746	1.003 ± 0.019	0.920 ±0.005	0.180 ±0.073
ad4L1R crop	vs	a2L1R crop	0.682	1.013 ± 0.026	0.897 ±0.006	0.151 ±0.073
ad4L1R crop	vs	b2L1R crop	0.703	0.983 ± 0.027	0.886 ±0.007	0.219 ±0.072
ad4L1R crop	vs	ab2L1R crop	0.774	1.015 ± 0.016	0.936 ±0.004	0.246 ±0.071
ad4L1R crop	vs	a1L1R crop	0.711	0.970 ± 0.028	0.880 ±0.007	0.274 ±0.070
bc4L1R crop	vs	a4S1R crop	0.538	0.979 ± 0.049	0.807 ±0.011	0.027 ±0.075
bc4L1R crop	vs	b4S1R crop	0.496	1.016 ± 0.059	0.794 ±0.012	0.011 ±0.075
bc4L1R crop	vs	c4S1R crop	0.580	0.927 ± 0.049	0.794 ±0.012	0.145 ±0.074
bc4L1R crop	vs	d4S1R crop	0.582	0.999 ± 0.037	0.850 ±0.009	0.037 ±0.075
bc4L1R crop	vs	ad4S1R crop	0.642	0.988 ± 0.030	0.872 ±0.008	0.043 ±0.075
bc4L1R crop	vs	bc4S1R crop	0.628	0.977 ± 0.035	0.852 ±0.009	0.101 ±0.074
bc4L1R	vs	bc4S2R	0.537	0.730 ± 0.078	0.662 ±0.018	0.217 ±0.072
bc4L1R crop	vs	abcd4S1R	0.705	0.994 ± 0.023	0.900 ±0.006	0.091 ±0.075
bc4L1R crop	vs	a2L1R crop	0.660	0.967 ± 0.033	0.857 ±0.009	0.173 ±0.073
bc4L1R crop	vs	b2L1R crop	0.656	0.973 ± 0.032	0.864 ±0.008	0.129 ±0.074
bc4L1R crop	vs	ab2L1R crop	0.735	0.987 ± 0.022	0.904 ±0.006	0.198 ±0.072
bc4L1R crop	vs	a1L1R crop	0.653	0.945 ± 0.036	0.842 ±0.009	0.169 ±0.073
abcd4L1R	vs	a4S1R crop	0.629	1.022 ± 0.036	0.870 ±0.008	0.111 ±0.074
abcd4L1R	vs	b4S1R crop	0.519	1.014 ± 0.055	0.806 ±0.011	-0.011 ±0.075
abcd4L1R	vs	c4S1R crop	0.632	0.924 ± 0.044	0.814 ±0.011	0.229 ±0.071
abcd4L1R	vs	d4S1R crop	0.642	1.001 ± 0.031	0.875 ±0.008	0.086 ±0.075
abcd4L1R	vs	ad4S1R crop	0.728	1.009 ± 0.020	0.917 ±0.005	0.132 ±0.074
abcd4L1R	vs	bc4S1R crop	0.672	0.974 ± 0.030	0.869 ±0.008	0.139 ±0.074
abcd4L1R	vs	abcd4S1R	0.779	1.005 ± 0.015	0.934 ±0.004	0.177 ±0.073
abcd4L1R	vs	a2L1R crop	0.719	0.999 ± 0.023	0.902 ±0.006	0.200 ±0.072
abcd4L1R	vs	b2L1R crop	0.730	0.984 ± 0.023	0.899 ±0.006	0.225 ±0.071
abcd4L1R	vs	ab2L1R crop	0.810	1.009 ± 0.013	0.946 ±0.003	0.281 ±0.069
abcd4L1R	vs	a1L1R crop	0.734	0.965 ± 0.026	0.886 ±0.007	0.285 ±0.069

Table 38c. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial, 2R crop 1989. Row weights (kg) for different plot shapes.

Character & crop X	Y	Plots rP	Means (df =) rG	rP	rE
a4L2R crop	vs b4L2R crop	0.535	1.025 ± 0.051	0.820 ±0.011	0.076 ±0.075
a4L2R crop	vs c4L2R crop	0.614	0.947 ± 0.046	0.815 ±0.011	0.261 ±0.070
a4L2R crop	vs d4L2R crop	0.562	0.912 ± 0.050	0.784 ±0.013	0.094 ±0.075
b4L2R crop	vs c4L2R crop	0.481	1.044 ± 0.063	0.795 ±0.012	0.080 ±0.075
b4L2R crop	vs d4L2R crop	0.418	0.898 ± 0.077	0.695 ±0.017	0.009 ±0.075
bc4L2R crop	vs ad4L2R crop	0.672	0.955 ± 0.033	0.857 ±0.009	0.184 ±0.073
bc4L2R crop	vs abcd4L2R	0.881	0.983 ± 0.012	0.947 ±0.003	0.720 ±0.036
ad4L2R crop	vs abcd4L2R	0.942	0.993 ± 0.005	0.977 ±0.001	0.814 ±0.025
ad4L2R crop	vs a4S2R crop	0.676	0.976 ± 0.031	0.867 ±0.008	0.226 ±0.071
ad4L2R crop	vs b4S2R crop	0.565	1.004 ± 0.043	0.835 ±0.010	0.046 ±0.075
ad4L2R crop	vs c4S2R crop	0.591	0.912 ± 0.051	0.786 ±0.012	0.213 ±0.072
ad4L2R crop	vs d4S2R crop	0.628	1.006 ± 0.033	0.868 ±0.008	0.083 ±0.075
ad4L2R crop	vs ad4S2R crop	0.738	1.025 ± 0.020	0.928 ±0.005	0.195 ±0.072
ad4L2R crop	vs bc4S2R crop	0.671	0.957 ± 0.032	0.859 ±0.009	0.175 ±0.073
ad4L2R crop	vs abcd4S2R	0.770	1.003 ± 0.017	0.928 ±0.005	0.232 ±0.071
ad4L2R crop	vs a2L2R crop	0.660	0.984 ± 0.032	0.866 ±0.008	0.190 ±0.072
ad4L2R crop	vs b2L2R crop	0.712	1.008 ± 0.023	0.906 ±0.006	0.197 ±0.072
ad4L2R crop	vs ab2L2R crop	0.771	1.016 ± 0.016	0.936 ±0.004	0.250 ±0.070
ad4L2R crop	vs a1L2R crop	0.715	0.975 ± 0.026	0.886 ±0.007	0.251 ±0.070
bc4L2R crop	vs a4S2R crop	0.517	0.962 ± 0.050	0.794 ±0.012	-0.024 ±0.075
bc4L2R crop	vs b4S2R crop	0.547	0.918 ± 0.057	0.770 ±0.013	0.193 ±0.072
bc4L2R crop	vs c4S2R crop	0.569	0.935 ± 0.053	0.786 ±0.012	0.200 ±0.072
bc4L2R crop	vs d4S2R crop	0.545	0.971 ± 0.047	0.809 ±0.011	0.054 ±0.075
bc4L2R crop	vs ad4S2R crop	0.600	1.000 ± 0.035	0.857 ±0.009	0.020 ±0.075
bc4L2R crop	vs bc4S2R crop	0.648	0.926 ± 0.041	0.825 ±0.010	0.265 ±0.070
bc4L2R	vs bc4S1R	0.513	0.797 ± 0.072	0.692 ±0.017	0.151 ±0.073
bc4L2R crop	vs abcd4S2R	0.675	0.975 ± 0.030	0.871 ±0.008	0.162 ±0.073
bc4L2R crop	vs a2L2R crop	0.623	0.924 ± 0.046	0.809 ±0.011	0.265 ±0.070
bc4L2R crop	vs b2L2R crop	0.549	0.942 ± 0.047	0.800 ±0.012	0.015 ±0.075
bc4L2R crop	vs ab2L2R crop	0.652	0.952 ± 0.035	0.847 ±0.009	0.172 ±0.073
bc4L2R crop	vs a1L2R crop	0.599	0.927 ± 0.045	0.808 ±0.011	0.137 ±0.074
abcd4L2R	vs a4S2R crop	0.666	0.981 ± 0.031	0.868 ±0.008	0.146 ±0.074
abcd4L2R	vs b4S2R crop	0.608	0.981 ± 0.041	0.839 ±0.010	0.146 ±0.074
abcd4L2R	vs c4S2R crop	0.635	0.931 ± 0.045	0.815 ±0.011	0.268 ±0.070
abcd4L2R	vs d4S2R crop	0.647	1.003 ± 0.031	0.875 ±0.008	0.091 ±0.075
abcd4L2R	vs ad4S2R crop	0.742	1.026 ± 0.019	0.932 ±0.004	0.149 ±0.073
abcd4L2R	vs bc4S2R crop	0.721	0.955 ± 0.028	0.876 ±0.008	0.280 ±0.069
abcd4L2R	vs abcd4S2R	0.797	1.002 ± 0.014	0.938 ±0.004	0.259 ±0.070
abcd4L2R	vs a2L2R crop	0.703	0.971 ± 0.030	0.874 ±0.008	0.290 ±0.069
abcd4L2R	vs b2L2R crop	0.703	0.993 ± 0.025	0.895 ±0.006	0.148 ±0.074
abcd4L2R	vs ab2L2R crop	0.787	1.002 ± 0.016	0.933 ±0.004	0.278 ±0.069
abcd4L2R	vs a1L2R crop	0.727	0.967 ± 0.026	0.885 ±0.007	0.258 ±0.070

Table 38d. Genotypic, phenotypic and environmental correlations (± standard error) for X = weight of cane in end 1m of the middle rows in the 4LP crop, or middle rows minus these ends, correlated with row weights in all crops.

Character & crop X	Y	Plots rP	Means (df =) rG		rP	rE
endBCkgLP	vs abcd4LP	0.455	0.874 ±	0.128	0.624 ±0.020	0.328 ±0.067
endBCkgLP	vs a4SP crop	0.184	0.895 ±	0.187	0.481 ±0.025	-0.074 ±0.075
endBCkgLP	vs b4SP crop	0.188	0.733 ±	0.185	0.421 ±0.027	-0.024 ±0.075
endBCkgLP	vs c4SP crop	0.218	0.671 ±	0.196	0.404 ±0.027	0.084 ±0.075
endBCkgLP	vs d4SP crop	0.195	0.649 ±	0.188	0.386 ±0.028	0.013 ±0.075
endBCkgLP	vs ad4SP crop	0.219	0.783 ±	0.171	0.464 ±0.026	-0.042 ±0.075
endBCkgLP	vs bc4SP crop	0.240	0.720 ±	0.172	0.448 ±0.026	0.045 ±0.075
endBCkgLP	vs abcd4SP	0.252	0.755 ±	0.163	0.473 ±0.025	-0.001 ±0.075
endBCkgLP	vs a2LP crop	0.277	0.896 ±	0.160	0.545 ±0.023	0.020 ±0.075
endBCkgLP	vs b2LP crop	0.282	0.868 ±	0.155	0.539 ±0.023	-0.011 ±0.075
endBCkgLP	vs ab2LP crop	0.308	0.865 ±	0.149	0.553 ±0.023	0.007 ±0.075
endBCkgLP	vs a1LP crop	0.168	0.792 ±	0.180	0.443 ±0.026	-0.115 ±0.074
endBCkgLP	vs abcd4L1R	0.256	0.669 ±	0.163	0.437 ±0.026	0.050 ±0.075
endBCkgLP	vs a4S1R crop	0.085	0.650 ±	0.206	0.328 ±0.029	-0.128 ±0.074
endBCkgLP	vs b4S1R crop	0.011	0.447 ±	0.234	0.192 ±0.031	-0.128 ±0.074
endBCkgLP	vs c4S1R crop	0.078	0.392 ±	0.212	0.216 ±0.031	-0.039 ±0.075
endBCkgLP	vs d4S1R crop	0.206	0.562 ±	0.188	0.356 ±0.028	0.065 ±0.075
endBCkgLP	vs ad4S1R crop	0.168	0.603 ±	0.183	0.360 ±0.028	-0.043 ±0.075
endBCkgLP	vs bc4S1R crop	0.052	0.421 ±	0.206	0.219 ±0.031	-0.113 ±0.074
endBCkgLP	vs abcd4S1R	0.129	0.530 ±	0.185	0.312 ±0.029	-0.099 ±0.074
endBCkgLP	vs a2L1R crop	0.171	0.585 ±	0.186	0.353 ±0.028	-0.007 ±0.075
endBCkgLP	vs b2L1R crop	0.120	0.662 ±	0.187	0.363 ±0.028	-0.152 ±0.073
endBCkgLP	vs ab2L1R crop	0.161	0.638 ±	0.178	0.377 ±0.028	-0.109 ±0.074
endBCkgLP	vs a1L1R crop	0.108	0.537 ±	0.194	0.301 ±0.030	-0.097 ±0.074
endBCkgLP	vs abcd4L2R	0.274	0.588 ±	0.167	0.406 ±0.027	0.151 ±0.073
endBCkgLP	vs a4S2R crop	0.108	0.716 ±	0.193	0.376 ±0.028	-0.161 ±0.073
endBCkgLP	vs b4S2R crop	0.041	0.323 ±	0.222	0.165 ±0.032	-0.058 ±0.075
endBCkgLP	vs c4S2R crop	0.125	0.493 ±	0.207	0.282 ±0.030	-0.006 ±0.075
endBCkgLP	vs d4S2R crop	0.194	0.648 ±	0.185	0.389 ±0.028	0.013 ±0.075
endBCkgLP	vs ad4S2R crop	0.171	0.705 ±	0.178	0.409 ±0.027	-0.092 ±0.075
endBCkgLP	vs bc4S2R crop	0.097	0.408 ±	0.200	0.237 ±0.031	-0.043 ±0.075
endBCkgLP	vs abcd4S2R	0.151	0.581 ±	0.181	0.345 ±0.029	-0.087 ±0.075
endBCkgLP	vs a2L2R crop	0.184	0.650 ±	0.185	0.386 ±0.028	-0.004 ±0.075
endBCkgLP	vs b2L2R crop	0.220	0.555 ±	0.182	0.362 ±0.028	0.078 ±0.075
endBCkgLP	vs ab2L2R crop	0.228	0.608 ±	0.174	0.393 ±0.028	0.050 ±0.075
endBCkgLP	vs a1L2R crop	0.144	0.574 ±	0.188	0.335 ±0.029	-0.057 ±0.075

Table 38d continued 2/2

Character & crop X	Y	Plots rP	Means (df =) rG	rP	rE
trueBCLP	vs abcd4LP	0.806	0.962 ± 0.022	0.904 ±0.006	0.572 ±0.051
trueBCLP	vs a4SP crop	0.479	0.885 ± 0.072	0.711 ±0.016	0.108 ±0.074
trueBCLP	vs b4SP crop	0.529	0.923 ± 0.058	0.763 ±0.014	0.128 ±0.074
trueBCLP	vs c4SP crop	0.403	1.063 ± 0.073	0.768 ±0.013	-0.122 ±0.074
trueBCLP	vs d4SP crop	0.527	0.897 ± 0.061	0.749 ±0.014	0.146 ±0.074
trueBCLP	vs ad4SP crop	0.580	0.908 ± 0.051	0.783 ±0.013	0.167 ±0.073
trueBCLP	vs bc4SP crop	0.548	1.012 ± 0.044	0.832 ±0.010	-0.008 ±0.075
trueBCLP	vs abcd4SP	0.624	0.957 ± 0.039	0.835 ±0.010	0.109 ±0.074
trueBCLP	vs a2LP crop	0.540	0.989 ± 0.046	0.815 ±0.011	0.016 ±0.075
trueBCLP	vs b2LP crop	0.628	0.927 ± 0.043	0.817 ±0.011	0.185 ±0.073
trueBCLP	vs ab2LP crop	0.646	0.937 ± 0.038	0.832 ±0.010	0.137 ±0.074
trueBCLP	vs a1LP crop	0.571	0.928 ± 0.050	0.791 ±0.012	0.149 ±0.074
trueBCLP	vs abcd4L1R	0.480	0.650 ± 0.091	0.593 ±0.021	0.224 ±0.071
trueBCLP	vs a4S1R crop	0.347	0.583 ± 0.118	0.493 ±0.025	0.160 ±0.073
trueBCLP	vs b4S1R crop	0.277	0.744 ± 0.113	0.540 ±0.023	-0.076 ±0.075
trueBCLP	vs c4S1R crop	0.322	0.616 ± 0.114	0.500 ±0.024	0.034 ±0.075
trueBCLP	vs d4S1R crop	0.295	0.646 ± 0.110	0.507 ±0.024	-0.099 ±0.074
trueBCLP	vs ad4S1R crop	0.367	0.616 ± 0.105	0.526 ±0.024	0.043 ±0.075
trueBCLP	vs bc4S1R crop	0.350	0.681 ± 0.100	0.556 ±0.022	-0.030 ±0.075
trueBCLP	vs abcd4S1R	0.398	0.650 ± 0.096	0.562 ±0.022	0.011 ±0.075
trueBCLP	vs a2L1R crop	0.348	0.598 ± 0.110	0.506 ±0.024	0.055 ±0.075
trueBCLP	vs b2L1R crop	0.384	0.660 ± 0.099	0.558 ±0.022	0.031 ±0.075
trueBCLP	vs ab2L1R crop	0.410	0.642 ± 0.097	0.561 ±0.022	0.056 ±0.075
trueBCLP	vs a1L1R crop	0.364	0.583 ± 0.110	0.505 ±0.024	0.109 ±0.074
trueBCLP	vs abcd4L2R	0.316	0.445 ± 0.121	0.403 ±0.027	0.132 ±0.074
trueBCLP	vs a4S2R crop	0.263	0.426 ± 0.134	0.366 ±0.028	0.097 ±0.074
trueBCLP	vs b4S2R crop	0.226	0.447 ± 0.140	0.355 ±0.028	0.019 ±0.075
trueBCLP	vs c4S2R crop	0.202	0.340 ± 0.148	0.287 ±0.030	0.093 ±0.075
trueBCLP	vs d4S2R crop	0.300	0.537 ± 0.122	0.447 ±0.026	0.058 ±0.075
trueBCLP	vs ad4S2R crop	0.319	0.498 ± 0.120	0.435 ±0.026	0.098 ±0.074
trueBCLP	vs bc4S2R crop	0.248	0.393 ± 0.134	0.340 ±0.029	0.076 ±0.075
trueBCLP	vs abcd4S2R	0.313	0.456 ± 0.122	0.407 ±0.027	0.110 ±0.074
trueBCLP	vs a2L2R crop	0.162	0.349 ± 0.144	0.278 ±0.030	-0.029 ±0.075
trueBCLP	vs b2L2R crop	0.288	0.512 ± 0.122	0.429 ±0.027	0.011 ±0.075
trueBCLP	vs ab2L2R crop	0.258	0.449 ± 0.126	0.381 ±0.028	-0.010 ±0.075
trueBCLP	vs a1L2R crop	0.230	0.418 ± 0.132	0.349 ±0.029	-0.000 ±0.075

trueBCLP = (bc4LP - endBCkgLP) * 9.2/7.2, where endBCkgLP is the weight of cane in the 1
end portions of each row. The formula adjusts the weight back to the normal row length

Table 39. Correlations between variety means for harvest characters and competition effects.

		ccs 4LP	ccs 4L1R	ccs 4L2R	fib 4L2R	app 4LP	app 4L1R	app 4L2R
ccs4LP	1	1.0000				DF =	58	
ccs4L1R	2	0.7966	1.0000					
ccs4L2R	3	0.6844	0.8074	1.0000				
fib4L2R	4	-0.1457	-0.0632	-0.2396	1.0000			
app4LP	5	0.2458	0.0126	0.0511	0.1237	1.0000		
app4L1R	6	0.2323	0.1245	0.2315	0.2009	0.6884	1.0000	
app4L2R	7	0.1141	0.0302	0.1825	-0.0007	0.6064	0.7550	1.0000
tch4LP	8	-0.1361	-0.1252	-0.2398	-0.0665	-0.0908	-0.0713	-0.0306
tch4L1R	9	0.1961	0.1638	0.0095	0.1316	0.1456	0.2360	0.1505
tch4L2R	10	0.1996	0.1649	0.1429	0.0314	0.3186	0.4750	0.4103
tsh4LP	11	0.4134	0.3193	0.1593	-0.1429	0.0390	0.0544	0.0280
tsh4L1R	12	0.4029	0.4353	0.2481	0.0997	0.1298	0.2507	0.1445
tsh4L2R	13	0.3302	0.3259	0.3479	-0.0129	0.3093	0.5003	0.4243
nmg4LP	14	0.6188	0.4310	0.3108	-0.1958	0.3767	0.2899	0.2101
nmg4L1R	15	0.5100	0.5317	0.3927	0.0543	0.2984	0.4921	0.3211
nmg4L2R	16	0.3525	0.3390	0.4451	-0.1323	0.4144	0.6323	0.6462
ccs4SP	17	0.7017	0.7044	0.6974	-0.0790	0.1271	0.1878	0.1026
ccs4S1R	18	0.8135	0.9056	0.7693	0.0057	0.1597	0.2312	0.1611
ccs4S2R	19	0.4703	0.6380	0.7884	-0.1687	0.0235	0.2532	0.1357
tch4SP	20	0.0428	0.0256	-0.1140	-0.0288	0.0012	0.0109	-0.0036
tch4S1R	21	0.2262	0.2241	0.0967	0.1025	0.1745	0.2383	0.0923
tch4S2R	22	0.1734	0.1780	0.1210	0.0861	0.2655	0.4097	0.2925
tsh4SP	23	0.4159	0.4083	0.2879	-0.0686	0.0572	0.1016	0.0437
tsh4S1R	24	0.4229	0.4621	0.3166	0.0907	0.1779	0.2663	0.1090
tsh4S2R	25	0.2562	0.2832	0.2536	0.0563	0.2631	0.4420	0.3104
nmg4SP	26	0.5262	0.4929	0.4274	-0.1147	0.2156	0.2249	0.1529
nmg4S1R	27	0.5006	0.5418	0.4250	0.0242	0.2743	0.3833	0.2153
nmg4S2R	28	0.2744	0.2840	0.3289	-0.0191	0.3912	0.5913	0.4921
ccs2LP	29	0.8593	0.8358	0.7653	-0.1569	0.1103	0.2037	0.0584
ccs2L1R	30	0.7131	0.8685	0.7536	0.0207	0.0360	0.1765	0.0622
ccs2L2R	31	0.6640	0.7459	0.8532	-0.2961	0.1372	0.2647	0.1729
tch2LP	32	-0.0478	-0.0286	-0.1753	0.0116	-0.0686	-0.0220	-0.0115
tch2L1R	33	0.1414	0.1621	0.0157	0.1998	0.1178	0.2040	0.0687
tch2L2R	34	0.1073	0.1279	0.0700	0.1093	0.2297	0.3823	0.2695
tsh2LP	35	0.3360	0.3457	0.1942	-0.0622	-0.0218	0.0626	0.0059
tsh2L1R	36	0.2892	0.3469	0.1959	0.1857	0.1032	0.2145	0.0645
tsh2L2R	37	0.2083	0.2454	0.2093	0.0623	0.2440	0.4160	0.2919
nmg2LP	38	0.4840	0.4693	0.3706	-0.1149	0.1799	0.2385	0.1507
nmg2L1R	39	0.3902	0.4360	0.3185	0.1444	0.2186	0.3790	0.2039
nmg2L2R	40	0.2354	0.2553	0.3051	-0.0305	0.3540	0.5545	0.4727
ccs1LP	41	0.6843	0.7105	0.6020	-0.1238	-0.0305	0.0943	0.0099
ccs1L1R	42	0.6657	0.7682	0.7194	-0.1939	0.0954	0.2734	0.2225
ccs1L2R	43	0.5648	0.6320	0.6209	-0.1409	0.2423	0.4384	0.4333
tch1LP	44	-0.0819	0.0116	-0.1291	0.0587	-0.1512	-0.1526	-0.1105
tch1L1R	45	0.2065	0.2139	0.0708	0.1614	0.1013	0.1724	0.0666
tch1L2R	46	0.2067	0.2108	0.1430	0.1155	0.1225	0.3276	0.2326
tsh1LP	47	0.1969	0.2934	0.1245	-0.0039	-0.1607	-0.1017	-0.1049
tsh1L1R	48	0.2935	0.3259	0.1879	0.1201	0.0898	0.1999	0.0898
tsh1L2R	49	0.2671	0.2828	0.2235	0.0841	0.1401	0.3578	0.2645
nmg1LP	50	0.2918	0.3823	0.2305	-0.0824	-0.0650	-0.0132	-0.0258
nmg1L1R	51	0.3496	0.3749	0.2681	0.0624	0.1695	0.3010	0.2007
nmg1L2R	52	0.2735	0.2857	0.2630	0.0189	0.2127	0.4412	0.3784
ad_bcL1R	53	-0.0847	-0.0574	-0.0576	0.2346	0.0550	0.1234	0.2179
ad_bcL2R	54	0.0560	0.1162	0.1416	0.1294	-0.0052	0.1289	0.1650
ad_bcS1R	55	0.1394	0.1299	0.1908	-0.0134	-0.1311	0.1454	-0.0065
ad_bcS2R	56	0.1961	0.1947	0.1742	-0.1507	-0.1975	-0.0190	0.0125
		1	2	3	4	5	6	7

Table 39 continued (2/6)

		tch 4LP	tch 4L1R	tch 4L2R	tsh 4LP	tsh 4L1R	tsh 4L2R	nmg 4LP
tch4LP	8	1.0000						
tch4L1R	9	0.7136	1.0000					
tch4L2R	10	0.5580	0.8483	1.0000				
tsh4LP	11	0.8431	0.7576	0.6096	1.0000			
tsh4L1R	12	0.6189	0.9576	0.8208	0.7868	1.0000		
tsh4L2R	13	0.4783	0.8058	0.9769	0.6105	0.8310	1.0000	
nmg4LP	14	0.6307	0.6796	0.6247	0.9123	0.7439	0.6549	1.0000
nmg4L1R	15	0.4806	0.8746	0.8385	0.7159	0.9515	0.8779	0.7700
nmg4L2R	16	0.3522	0.6613	0.9015	0.5076	0.7030	0.9484	0.6177
ccs4SP	17	-0.2455	0.0527	0.1120	0.1556	0.2515	0.2510	0.3095
ccs4S1R	18	-0.0968	0.2767	0.2721	0.3521	0.5093	0.4163	0.4934
ccs4S2R	19	-0.1690	-0.0079	0.1310	0.0972	0.1783	0.2889	0.2132
tch4SP	20	0.9049	0.7666	0.6061	0.8569	0.7125	0.5515	0.7039
tch4S1R	21	0.6490	0.9344	0.8308	0.7143	0.9164	0.8080	0.6657
tch4S2R	22	0.5365	0.8182	0.9379	0.5716	0.7952	0.9147	0.5672
tsh4SP	23	0.6583	0.7049	0.5837	0.8375	0.7690	0.6150	0.7826
tsh4S1R	24	0.5404	0.8845	0.7909	0.7241	0.9409	0.8165	0.7162
tsh4S2R	25	0.4848	0.7872	0.9285	0.5699	0.7983	0.9344	0.5875
nmg4SP	26	0.4874	0.6157	0.5677	0.7372	0.7088	0.6278	0.7800
nmg4S1R	27	0.4448	0.8234	0.7799	0.6776	0.9071	0.8277	0.7330
nmg4S2R	28	0.3719	0.6768	0.8980	0.4744	0.6971	0.9199	0.5597
ccs2LP	29	-0.1381	0.1578	0.1746	0.3387	0.3799	0.3230	0.4997
ccs2L1R	30	-0.0240	0.2882	0.2294	0.3618	0.5090	0.3747	0.4452
ccs2L2R	31	-0.2831	0.0234	0.1515	0.1068	0.2409	0.3272	0.3018
tch2LP	32	0.9211	0.7463	0.5793	0.8220	0.6776	0.5116	0.6287
tch2L1R	33	0.6672	0.9462	0.7994	0.6911	0.9152	0.7635	0.6037
tch2L2R	34	0.5456	0.8227	0.9330	0.5468	0.7878	0.8997	0.5260
tsh2LP	35	0.7578	0.7368	0.5865	0.8844	0.7770	0.5957	0.7805
tsh2L1R	36	0.5997	0.9146	0.7659	0.7110	0.9409	0.7701	0.6471
tsh2L2R	37	0.4806	0.7983	0.9267	0.5444	0.8011	0.9245	0.5555
nmg2LP	38	0.5801	0.6677	0.5898	0.7977	0.7443	0.6347	0.8155
nmg2L1R	39	0.5119	0.8870	0.8048	0.6827	0.9395	0.8322	0.6858
nmg2L2R	40	0.3429	0.6831	0.8951	0.4319	0.6986	0.9147	0.5145
ccs1LP	41	-0.1523	0.1978	0.1678	0.2339	0.3835	0.2857	0.3197
ccs1L1R	42	0.0053	0.2993	0.3140	0.3664	0.4936	0.4507	0.4740
ccs1L2R	43	-0.0807	0.1520	0.3620	0.2336	0.3248	0.4698	0.3726
tch1LP	44	0.8636	0.6828	0.5023	0.7577	0.6361	0.4514	0.5325
tch1L1R	45	0.6083	0.8861	0.7724	0.6760	0.8775	0.7493	0.5939
tch1L2R	46	0.4794	0.8030	0.8854	0.5484	0.7978	0.8678	0.5057
tsh1LP	47	0.7402	0.7081	0.5292	0.7982	0.7409	0.5308	0.6230
tsh1L1R	48	0.5759	0.8705	0.7662	0.6948	0.8967	0.7689	0.6276
tsh1L2R	49	0.4500	0.7781	0.8814	0.5557	0.7975	0.8818	0.5322
nmg1LP	50	0.6505	0.6799	0.5512	0.7679	0.7388	0.5726	0.6593
nmg1L1R	51	0.5281	0.8440	0.7926	0.6788	0.8852	0.8097	0.6583
nmg1L2R	52	0.3905	0.7083	0.8784	0.5042	0.7344	0.8862	0.5200
ad_bcL1R	53	0.3258	0.5811	0.6136	0.2463	0.5106	0.5747	0.1581
ad_bcL2R	54	0.3281	0.6453	0.6373	0.3315	0.6235	0.6386	0.2582
ad_bcS1R	55	0.2808	0.4455	0.4449	0.3325	0.4529	0.4660	0.2502
ad_bcS2R	56	0.4351	0.5432	0.5129	0.5114	0.5575	0.5252	0.3860
		8	9	10	11	12	13	14

Table 39 continued (3/6)

		nmg 4L1R	nmg 4L2R	ccs 4SP	ccs 4S1R	ccs 4S2R	tch 4SP	tch 4S1R
nmg4L1R	15	1.0000						
nmg4L2R	16	0.8162	1.0000					
ccs4SP	17	0.3498	0.2913	1.0000				
ccs4S1R	18	0.6056	0.4280	0.6758	1.0000			
ccs4S2R	19	0.3213	0.3708	0.5586	0.6595	1.0000		
tch4SP	20	0.6010	0.4241	-0.0736	0.0852	-0.0880	1.0000	
tch4S1R	21	0.8532	0.6571	0.1428	0.3384	0.0730	0.7673	1.0000
tch4S2R	22	0.7969	0.8113	0.1280	0.2758	0.1290	0.6289	0.8686
tsh4SP	23	0.7203	0.5242	0.4770	0.4407	0.2219	0.8373	0.7523
tsh4S1R	24	0.9133	0.6874	0.3196	0.5771	0.2660	0.6937	0.9612
tsh4S2R	25	0.8251	0.8496	0.2188	0.3796	0.2846	0.5888	0.8486
nmg4SP	26	0.7193	0.5853	0.6556	0.5410	0.3381	0.6731	0.6745
nmg4S1R	27	0.9358	0.7474	0.3999	0.6593	0.3593	0.6187	0.9069
nmg4S2R	28	0.7879	0.9113	0.2780	0.3905	0.3783	0.4676	0.7375
ccs2LP	29	0.4895	0.3540	0.7324	0.8079	0.5848	0.0241	0.2411
ccs2L1R	30	0.5824	0.3733	0.6260	0.8775	0.7093	0.1085	0.3406
ccs2L2R	31	0.3973	0.4267	0.6859	0.7296	0.7585	-0.1136	0.1271
tch2LP	32	0.5465	0.3787	-0.1189	0.0114	-0.1577	0.9240	0.7176
tch2L1R	33	0.8259	0.6019	0.0602	0.2566	-0.0029	0.7470	0.9387
tch2L2R	34	0.7782	0.7901	0.0956	0.2175	0.0972	0.5903	0.8274
tsh2LP	35	0.7052	0.4900	0.2259	0.3675	0.1194	0.8343	0.7492
tsh2L1R	36	0.8743	0.6220	0.2073	0.4322	0.1585	0.7040	0.9225
tsh2L2R	37	0.8179	0.8362	0.2031	0.3264	0.2173	0.5496	0.8187
nmg2LP	38	0.7503	0.5899	0.3706	0.5100	0.2616	0.6868	0.7023
nmg2L1R	39	0.9369	0.7307	0.2930	0.5320	0.2759	0.6414	0.9045
nmg2L2R	40	0.7782	0.9047	0.2509	0.3425	0.3136	0.4277	0.7107
ccs1LP	41	0.4464	0.2888	0.7495	0.6626	0.4481	-0.0055	0.2796
ccs1L1R	42	0.6050	0.5000	0.5812	0.7686	0.6260	0.1462	0.3604
ccs1L2R	43	0.4797	0.5530	0.5210	0.6578	0.5621	0.0604	0.1962
tch1LP	44	0.4741	0.2937	-0.0780	0.0330	-0.1186	0.8528	0.6720
tch1L1R	45	0.7874	0.5870	0.1355	0.2939	0.0192	0.7077	0.9022
tch1L2R	46	0.7732	0.7434	0.1689	0.2834	0.0977	0.5582	0.8018
tsh1LP	47	0.6175	0.3867	0.2314	0.2860	0.0645	0.7918	0.7305
tsh1L1R	48	0.8298	0.6251	0.2202	0.3951	0.1269	0.6903	0.8951
tsh1L2R	49	0.7933	0.7748	0.2197	0.3468	0.1675	0.5388	0.7822
nmg1LP	50	0.6612	0.4626	0.3497	0.3689	0.1326	0.7243	0.7122
nmg1L1R	51	0.8614	0.7047	0.2788	0.4471	0.1998	0.6570	0.8730
nmg1L2R	52	0.7689	0.8248	0.2509	0.3488	0.2071	0.4859	0.7242
ad_bcL1R	53	0.4296	0.4869	-0.0647	0.0388	-0.0707	0.3069	0.5534
ad_bcL2R	54	0.5610	0.5537	0.0634	0.2055	0.1703	0.3280	0.6199
ad_bcS1R	55	0.4336	0.3857	0.1195	0.1263	0.1801	0.2386	0.4302
ad_bcS2R	56	0.4852	0.4388	0.0374	0.1599	0.0472	0.3728	0.4880
		15	16	17	18	19	20	21

Table 39 continued (4/6)

		tch 4S2R	tsh 4SP	tsh 4S1R	tsh 4S2R	nmg 4SP	nmg 4S1R	nmg 4S2R
tch4S2R	22	1.0000						
tsh4SP	23	0.6065	1.0000					
tsh4S1R	24	0.8262	0.7858	1.0000				
tsh4S2R	25	0.9864	0.6216	0.8419	1.0000			
nmg4SP	26	0.5737	0.9492	0.7423	0.6100	1.0000		
nmg4S1R	27	0.8092	0.7622	0.9758	0.8416	0.7608	1.0000	
nmg4S2R	28	0.9283	0.5428	0.7470	0.9591	0.5865	0.7911	1.0000
ccs2LP	29	0.1837	0.4196	0.4430	0.2810	0.5352	0.5305	0.2999
ccs2L1R	30	0.2663	0.4393	0.5520	0.3755	0.5074	0.6142	0.3612
ccs2L2R	31	0.1625	0.2798	0.3251	0.2887	0.4332	0.4445	0.3718
tch2LP	32	0.5939	0.7490	0.6298	0.5417	0.5873	0.5389	0.4206
tch2L1R	33	0.8197	0.6996	0.8917	0.7894	0.6046	0.8234	0.6678
tch2L2R	34	0.9356	0.5610	0.7756	0.9172	0.5256	0.7478	0.8585
tsh2LP	35	0.5990	0.8633	0.7623	0.5971	0.7692	0.7183	0.4959
tsh2L1R	36	0.7924	0.7447	0.9314	0.7911	0.6729	0.8831	0.6762
tsh2L2R	37	0.9289	0.5864	0.8013	0.9324	0.5771	0.7940	0.8898
nmg2LP	38	0.5839	0.8102	0.7558	0.6078	0.8056	0.7679	0.5647
nmg2L1R	39	0.8179	0.7323	0.9429	0.8365	0.7040	0.9359	0.7664
nmg2L2R	40	0.8803	0.5035	0.7116	0.9033	0.5448	0.7483	0.9273
ccs1LP	41	0.2272	0.4061	0.4317	0.3004	0.4952	0.4858	0.3065
ccs1L1R	42	0.3530	0.4465	0.5358	0.4516	0.5237	0.6145	0.4670
ccs1L2R	43	0.3395	0.3239	0.3574	0.4219	0.4106	0.4520	0.5066
tch1LP	44	0.5105	0.7149	0.6014	0.4682	0.5523	0.4916	0.3266
tch1L1R	45	0.8015	0.7064	0.8692	0.7760	0.6204	0.8049	0.6520
tch1L2R	46	0.8774	0.5826	0.7734	0.8624	0.5367	0.7442	0.7795
tsh1LP	47	0.5565	0.8331	0.7258	0.5464	0.7168	0.6466	0.4174
tsh1L1R	48	0.7988	0.7382	0.8952	0.7929	0.6653	0.8459	0.6780
tsh1L2R	49	0.8674	0.5931	0.7766	0.8654	0.5593	0.7599	0.7973
nmg1LP	50	0.5654	0.8386	0.7307	0.5673	0.7751	0.6874	0.4727
nmg1L1R	51	0.8180	0.7374	0.8892	0.8236	0.6970	0.8697	0.7406
nmg1L2R	52	0.8563	0.5602	0.7259	0.8614	0.5529	0.7352	0.8341
ad_bcL1R	53	0.6207	0.2404	0.4821	0.5930	0.1987	0.4177	0.5194
ad_bcL2R	54	0.6389	0.3370	0.5955	0.6461	0.2927	0.5631	0.5816
ad_bcS1R	55	0.4491	0.2848	0.4235	0.4666	0.2281	0.3733	0.3793
ad_bcS2R	56	0.4732	0.3525	0.4753	0.4684	0.2549	0.4076	0.3785
		22	23	24	25	26	27	28

Table 39 continued (5/6)

		ccs 2LP	ccs 2L1R	ccs 2L2R	tch 2LP	tch 2L1R	tch 2L2R	tsh 2LP
ccs2LP	29	1.0000						
ccs2L1R	30	0.7942	1.0000					
ccs2L2R	31	0.7378	0.7017	1.0000				
tch2LP	32	-0.0017	0.0763	-0.2175	1.0000			
tch2L1R	33	0.1599	0.2954	0.0336	0.7636	1.0000		
tch2L2R	34	0.1223	0.2076	0.1190	0.5990	0.8401	1.0000	
tsh2LP	35	0.4396	0.4205	0.1407	0.8940	0.7630	0.5825	1.0000
tsh2L1R	36	0.3274	0.4931	0.1922	0.7146	0.9747	0.8024	0.7959
tsh2L2R	37	0.2358	0.3129	0.2803	0.5411	0.8182	0.9859	0.5838
nmg2LP	38	0.6210	0.5270	0.3551	0.7370	0.6842	0.5627	0.9372
nmg2L1R	39	0.4270	0.5750	0.3206	0.6292	0.9292	0.8110	0.7598
nmg2L2R	40	0.2641	0.3098	0.4015	0.4011	0.6869	0.9202	0.4695
ccs1LP	41	0.7381	0.6619	0.6810	-0.0234	0.2194	0.1722	0.3147
ccs1L1R	42	0.6974	0.8261	0.7766	0.0620	0.2807	0.2858	0.3640
ccs1L2R	43	0.5778	0.5762	0.6036	0.0192	0.1290	0.2412	0.2661
tch1LP	44	-0.0181	0.0750	-0.1864	0.8688	0.6836	0.5055	0.7708
tch1L1R	45	0.2000	0.3137	0.1018	0.7023	0.9161	0.7847	0.7255
tch1L2R	46	0.2324	0.2947	0.1448	0.5890	0.8204	0.8825	0.6291
tsh1LP	47	0.2783	0.3266	0.1051	0.7995	0.7244	0.5351	0.8465
tsh1L1R	48	0.2978	0.4254	0.2176	0.6715	0.8997	0.7753	0.7421
tsh1L2R	49	0.2963	0.3503	0.2200	0.5618	0.7945	0.8613	0.6338
nmg1LP	50	0.3888	0.3801	0.2364	0.7300	0.6904	0.5396	0.8348
nmg1L1R	51	0.3532	0.4720	0.3074	0.6227	0.8612	0.7825	0.7197
nmg1L2R	52	0.3119	0.3392	0.2774	0.5073	0.7251	0.8464	0.5903
ad_bcL1R	53	-0.0930	0.0179	-0.0863	0.3605	0.5815	0.6481	0.2834
ad_bcL2R	54	0.0543	0.2373	0.1136	0.3265	0.6207	0.6825	0.3263
ad_bcS1R	55	0.2157	0.3117	0.1685	0.2944	0.4710	0.4886	0.3654
ad_bcS2R	56	0.1849	0.2529	0.1280	0.3888	0.5254	0.5329	0.4353
		29	30	31	32	33	34	35

		tsh 2L1R	tsh 2L2R	nmg 2LP	nmg 2L1R	nmg 2L2R	ccs 1LP	ccs 1L1R
tsh2L1R	36	1.0000						
tsh2L2R	37	0.8078	1.0000					
nmg2LP	38	0.7442	0.6000	1.0000				
nmg2L1R	39	0.9738	0.8372	0.7657	1.0000			
nmg2L2R	40	0.6865	0.9570	0.5452	0.7638	1.0000		
ccs1LP	41	0.3509	0.2793	0.4306	0.4139	0.2662	1.0000	
ccs1L1R	42	0.4373	0.4013	0.4900	0.5408	0.4426	0.6888	1.0000
ccs1L2R	43	0.2432	0.3286	0.3839	0.3654	0.4031	0.5665	0.6269
tch1LP	44	0.6429	0.4591	0.5996	0.5458	0.3051	-0.0185	0.0745
tch1L1R	45	0.9032	0.7752	0.6459	0.8611	0.6489	0.2951	0.3457
tch1L2R	46	0.8071	0.8753	0.5972	0.8102	0.7909	0.3021	0.3394
tsh1LP	47	0.7396	0.5363	0.7310	0.6729	0.3895	0.3789	0.3399
tsh1L1R	48	0.9147	0.7853	0.6809	0.8906	0.6730	0.3800	0.4834
tsh1L2R	49	0.7971	0.8678	0.6190	0.8147	0.7974	0.3568	0.3998
nmg1LP	50	0.7203	0.5626	0.7869	0.6845	0.4407	0.5263	0.4259
nmg1L1R	51	0.8881	0.8061	0.6991	0.8965	0.7288	0.4208	0.5721
nmg1L2R	52	0.7303	0.8626	0.6074	0.7756	0.8331	0.3644	0.4256
ad_bcL1R	53	0.5288	0.6151	0.2329	0.4868	0.5484	-0.0039	0.1044
ad_bcL2R	54	0.6141	0.6828	0.2899	0.6077	0.6240	0.1760	0.3074
ad_bcS1R	55	0.4982	0.5029	0.3188	0.4886	0.4441	0.2880	0.3303
ad_bcS2R	56	0.5305	0.5381	0.3315	0.4968	0.4416	0.2761	0.2937
		36	37	38	39	40	41	42

Table 39 continued (6/6)

		ccs 1L2R	tch 1LP	tch 1L1R	tch 1L2R	tsh 1LP	tsh 1L1R	tsh 1L2R
ccs1L2R	43	1.0000						
tch1LP	44	0.0205	1.0000					
tch1L1R	45	0.2700	0.7254	1.0000				
tch1L2R	46	0.4184	0.5393	0.8676	1.0000			
tsh1LP	47	0.2417	0.9157	0.7902	0.6209	1.0000		
tsh1L1R	48	0.3539	0.6988	0.9871	0.8608	0.8001	1.0000	
tsh1L2R	49	0.5158	0.5173	0.8532	0.9924	0.6229	0.8586	1.0000
nmg1LP	50	0.3499	0.8106	0.7581	0.6325	0.9620	0.7795	0.6479
nmg1L1R	51	0.4416	0.6337	0.9560	0.8677	0.7563	0.9838	0.8753
nmg1L2R	52	0.5894	0.4443	0.7905	0.9652	0.5586	0.8035	0.9832
ad_bcL1R	53	-0.0558	0.3591	0.5586	0.5589	0.3260	0.5333	0.5205
ad_bcL2R	54	0.0625	0.3705	0.6267	0.6384	0.4105	0.6298	0.6094
ad_bcS1R	55	0.1811	0.2818	0.4295	0.4973	0.3784	0.4648	0.4963
ad_bcS2R	56	0.1616	0.4016	0.5186	0.5252	0.4839	0.5348	0.5228
		43	44	45	46	47	48	49

		nmg 1LP	nmg 1L1R	nmg 1L2R	ad_bc L1R	ad_bc L2R	ad_bc S1R	ad_bc S2R
nmg1LP	50	1.0000						
nmg1L1R	51	0.7663	1.0000					
nmg1L2R	52	0.6063	0.8435	1.0000				
ad_bcL1R	53	0.2812	0.5062	0.4710	1.0000			
ad_bcL2R	54	0.3910	0.6254	0.5655	0.7755	1.0000		
ad_bcS1R	55	0.3606	0.4516	0.4531	0.3952	0.4052	1.0000	
ad_bcS2R	56	0.4572	0.5064	0.4853	0.3607	0.4323	0.6649	1.0000
		50	51	52	53	54	55	56

Correlation is significantly different from zero if > 0.260 (5%), > 0.335 (1%)
ad_bcL1R = A+D-B-C, 4-row long plots, 1R crop.
ad_bcS2R = A+D-B-C, 4-row short plots, 2R crop.
nmg1LP = NMG, 1-row long plot, plant crop.
a1L1R = row A, 1-row long plots, first ratoon crop.
General term = Character, No. of rows in plot, row length (L/S), crop (P,1R,2R).

Table 40a. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial, plant crop, 1987. Harvest characters.

Character & crop X	Y	Plots rP	Means (df =) rG		rP	rE
nmg4LP	vs nmg4SP	0.601	0.879 ±	0.051	0.780 ±0.013	0.195 ±0.072
nmg4LP	vs nmg2LP	0.579	0.936 ±	0.043	0.816 ±0.011	0.086 ±0.075
nmg4LP	vs nmg1LP	0.440	0.807 ±	0.082	0.659 ±0.018	0.083 ±0.075
tsh4LP	vs tsh4SP	0.647	0.933 ±	0.036	0.838 ±0.010	0.059 ±0.075
tsh4LP	vs tsh2LP	0.718	0.961 ±	0.025	0.884 ±0.007	0.083 ±0.075
tsh4LP	vs tsh1LP	0.588	0.918 ±	0.047	0.798 ±0.012	0.093 ±0.075
tch4LP	vs tch4SP	0.737	0.985 ±	0.021	0.905 ±0.006	0.099 ±0.074
tch4LP	vs tch2LP	0.802	0.974 ±	0.017	0.921 ±0.005	0.260 ±0.070
tch4LP	vs tch1LP	0.660	0.973 ±	0.032	0.864 ±0.008	0.097 ±0.074
App4LP	vs App4SP	0.566	0.938 ±	0.073	0.745 ±0.014	0.303 ±0.068
App4LP	vs App2LP	0.505	0.980 ±	0.076	0.736 ±0.015	0.136 ±0.074
App4LP	vs App1LP	0.347	0.930 ±	0.152	0.573 ±0.022	0.067 ±0.075
ccs4LP	vs ccs4SP	0.515	0.813 ±	0.066	0.702 ±0.017	-0.128 ±0.074
ccs4LP	vs ccs2LP	0.654	0.974 ±	0.032	0.859 ±0.009	-0.077 ±0.075
ccs4LP	vs ccs1LP	0.474	0.838 ±	0.077	0.684 ±0.017	0.077 ±0.075

Table 40b. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial, first ratoon crop, 1988. Harvest characters.

Character & crop X	Y	Plots rP	Means (df =) rG		rP	rE
nmg4L1R	vs nmg4S1R	0.758	1.017 ±	0.016	0.936 ±0.004	0.199 ±0.072
nmg4L1R	vs nmg2L1R	0.762	1.021 ±	0.017	0.937 ±0.004	0.208 ±0.072
nmg4L1R	vs nmg1L1R	0.674	0.961 ±	0.032	0.861 ±0.008	0.231 ±0.071
tsh4L1R	vs tsh4S1R	0.776	1.016 ±	0.015	0.941 ±0.004	0.171 ±0.073
tsh4L1R	vs tsh2L1R	0.805	1.003 ±	0.014	0.941 ±0.004	0.273 ±0.070
tsh4L1R	vs tsh1L1R	0.733	0.981 ±	0.024	0.897 ±0.006	0.239 ±0.071
tch4L1R	vs tch4S1R	0.779	1.005 ±	0.015	0.934 ±0.004	0.177 ±0.073
tch4L1R	vs tch2L1R	0.810	1.009 ±	0.013	0.946 ±0.003	0.280 ±0.069
tch4L1R	vs tch1L1R	0.734	0.965 ±	0.026	0.886 ±0.007	0.285 ±0.069
App4L1R	vs App4S1R	0.532	0.976 ±	0.057	0.789 ±0.012	0.151 ±0.073
App4L1R	vs App2L1R	0.569	1.097 ±	0.043	0.888 ±0.007	0.001 ±0.075
App4L1R	vs App1L1R	0.461	0.959 ±	0.066	0.750 ±0.014	0.029 ±0.075
ccs4L1R	vs ccs4S1R	0.593	1.078 ±	0.034	0.906 ±0.006	-0.079 ±0.075
ccs4L1R	vs ccs2L1R	0.677	0.971 ±	0.030	0.869 ±0.008	0.164 ±0.073
ccs4L1R	vs ccs1L1R	0.558	0.913 ±	0.057	0.768 ±0.013	0.177 ±0.073

Table 40c. Genotypic, phenotypic and environmental correlations (± standard error) for Johnson trial, second ratoon crop, 1989. Harvest characters.

Character & crop X	Y	Plots rP	Means (df =) rG	rP	rE
nmg4L2R	vs nmg4S2R	0.743	0.987 ± 0.020	0.911 ±0.006	0.224 ±0.071
nmg4L2R	vs nmg2L2R	0.712	0.997 ± 0.023	0.905 ±0.006	0.273 ±0.070
nmg4L2R	vs nmg1L2R	0.644	0.920 ± 0.040	0.825 ±0.010	0.194 ±0.072
tsh4L2R	vs tsh4S2R	0.797	0.997 ± 0.015	0.934 ±0.004	0.260 ±0.070
tsh4L2R	vs tsh2L2R	0.780	0.994 ± 0.017	0.925 ±0.005	0.298 ±0.068
tsh4L2R	vs tsh1L2R	0.719	0.964 ± 0.027	0.882 ±0.007	0.228 ±0.071
tch4L2R	vs tch4S2R	0.797	1.002 ± 0.014	0.938 ±0.004	0.259 ±0.070
tch4L2R	vs tch2L2R	0.787	1.002 ± 0.016	0.933 ±0.004	0.278 ±0.069
tch4L2R	vs tch1L2R	0.727	0.967 ± 0.026	0.885 ±0.007	0.258 ±0.070
App4L2R	vs App4S2R	0.567	1.069 ± 0.052	0.841 ±0.010	0.113 ±0.074
App4L2R	vs App2L2R	0.544	1.006 ± 0.059	0.792 ±0.012	0.153 ±0.073
App4L2R	vs App1L2R	0.382	1.164 ± 0.109	0.746 ±0.014	-0.053 ±0.075
ccs4L2R	vs ccs4S2R	0.491	0.999 ± 0.057	0.788 ±0.012	0.018 ±0.075
ccs4L2R	vs ccs2L2R	0.554	1.058 ± 0.045	0.853 ±0.009	0.066 ±0.075
ccs4L2R	vs ccs1L2R	0.336	0.857 ± 0.099	0.621 ±0.020	-0.051 ±0.075

Table 41. Variance ratios (F) and CV% from RCB analysis of weight (KG) of 1-row and 2-row plots. These results can be compared with plot shapes from 4-row plots in Table 10.

Crop	Variance ratio (F) 2-row A	B	AB	1-row	CV% 2-row A	B	AB	1-row
P	5.62	8.79	13.39	5.84	13	12	9	15
1R	6.24	6.91	10.38	6.72	19	20	15	24
2R	5.18	6.56	8.84	6.78	22	23	18	28

There were 60 families x 4 replicates

	Treatments	Error	F > 0 if greater than P.05	P.01
df	59	177	1.40	1.61