MARDI Res. Bull., (1985) 13, 2: (186–189)

RELATIONSHIPS BETWEEN MAIN TILLER AND SINGLE PLANT YIELD PERFORMANCE OF RICE

I. ALIAS*

Keywords: Single plants selection, Grain yield, Yield components, Rice.

RINGKASAN

Salah satu faktor yang mempengaruhi kesempurnaan pemilihan hasil serumpun pokok padi secara pemerhatian ialah kesusahan dalam membuat anggaran. Ini adalah disebabkan oleh wujudnya perbezaan di antara anak-anak bilah di dalam sesuatu rumpun. Kajian ini bertujuan untuk menentukan perhubungan (korelasi) antara anak bilah utama dengan prestasi keseluruhan pokok terhadap ciri hasil dan komponennya. Antara kedua peringkat ini, korelasi yang positif dikesan tetapi hanya bagi ciri-ciri yang sama sahaja. Korelasi yang semuanya bererti dan nilai kewarisan (heritability) yang baik telah diperolehi bagi ciri bilangan biji setangkai dan berat 1 000 biji. Oleh itu, prestasi anak bilah utama bagi kedua-dua ciri ini adalah sesuai digunakan sebagai panduan untuk tujuan pemilihan pokok padi.

INTRODUCTION

Single plants selection for grain yield and the component characters in basic or modified pedigree and mass selection methods in the initial stages of rice breeding are normally done visually. Visual selection is defined as the choice between plants, lines, clones, varieties or any other biological unit entering the next generation on the basis of visual and mental assessment. As pointed out by ALLARD (1960), visual selection is essential in early stages of selection where large number of plants or lines are involved, since it is quick, cheap and less cumbersome.

The process of visual assessment of a single plant of rice normally involves firstly, estimation of the performance of a single tiller (not necessarily the main tiller) and secondly rounding it up for the whole plant. During this process, the precision of the assessment may be affected by personal biases and experience of the assessors, size of populations and the variability that exists between individual tillers. Use of established pictorial scales to assist in estimations of the performance of barley panicles and subsequent assessment of single plants performance was found by ISMAIL and VALENTINE (1983) to be only moderately effective and took slightly longer time. Selecting tiller at random within a plant for assessment might introduce bias, resulting in low precision for useful single plant estimation (LOW and TAY, 1975). If a specific tiller within a plant can be identified and the assessors have been trained to use this tiller for assessment, perhaps the precision of the estimate and assessment, and the efficiency of visual selection can be improved.

This paper attempts to establish the relationships of grain yield and its components of the main tillers and single plants. If this can be established, the main tiller assessment, which can be carried out more efficiently, can be used for improvement of single plants selection.

MATERIALS AND METHODS

Six different genotypes of rice (MR 49, MR 50, MR 51, MR 58, MR 62 and MR 63) from the adaptability trial set were used. They were selected to represent the range of variability of various characters which usually appear in early generation populations. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The size of the plots was 5 metres by 5 metres.

Twenty-five-day old seedlings were

*Rice Research Division, MARDI, Alor Setar, Kedah, West Malaysia.

Table 1. Variability of average grain yield and its components between the six rice genotypes

Genotype	Single plant				Main tiller		
	Tillers/ plant	Grains/ panicle	1 000-grain wt. (g)	Grain yield (g)	Grains/ panicle	1 000-grain wt. (g)	Grain yield (g)
MR 49	15.3	83.9	25.8	32.6	102.0	26.0	2.6
MR 50	11.8	96.8	26.5	30.1	112.1	27.1	3.0
MR 51	12.9	97.9	23.6	29.1	112.3	23.7	2.7
MR 58	10.4	104.7	24.9	27.1	127.9	24.9	3.2
MR 62	12.8	97.0	23.9	29.4	125.2	24.1	3.1
MR 63	11.5	121.1	20.8	28.6	133.0	21.2	2.8

transplanted, one seedling per point, at a planting distance of 25 cm apart. Fertilizers were applied at the rate of 70 N:20 P:20 K per acre. Phosphorus and potassium were applied at 15 days after transplanting while application of N was half at 15 days and the other half at 45 days after transplanting.

At maturity, ten plants were randomly selected among the standing crop. For each plant, the tallest tiller was marked and identified as the primary or main tiller. At full ripening, the plants were individually harvested and the main tillers were separated. Data for grain yield and its components were derived for the single plants and the main tillers. For grain yield and 1 000-grain weight, the data were obtained after drying harvested grains to 14 % moisture content.

RESULTS AND DISCUSSION

Ranges of Variability

Average performance of single plants and main tillers for each character is shown in *Table 1*. For single plants, the values ranged from 10.4 to 15.3 for number of tillers per plant, 83.9 to 121.1 for number of grains per panicle and 20.8 to 26.5 for 1 000-grain weight. Among the genotypes, MR 49 had high number of tillers per plant and 1 000-grain weight but it was lowest in number of grains per panicle. On the other extreme, MR 63 had low number of tillers per plant and 1 000-grain weight but highest number of grains per panicle. The performance of main tillers was in all cases superior to that of single plants except for 1 000-grain weight of MR 58, where both values were equal. These ranges of variability which existed both between different genotypes and characters, are almost similar to those exist in early generations of selecting populations.

Heritability Estimates

The structure of the analysis of variance of the experiment, the components of variance and the model used to calculate estimates of broad sense heritability are shown in *Table 2*.

Table 2. Structure of the analysis of variance of the experiment

Source	d.f.	Expected mean square
Genotype	5	$\sigma_E^2 + r\,\sigma_G^2$
Reps.	2	$\sigma_E^2 + a\,\sigma_r^2$
Error	162	σ_E^2

r = number of replications (3).

$$h^2 \text{ (heritability)} = \frac{\sigma_G^2}{\sigma_G^2 + \sigma_E^2} \times 100$$

Broadsense heritability estimates for the characters are presented in *Table 3*. The heritability values for the number of grains per panicle and 1 000-grain weight were slightly higher for single plant than for main tiller, indicating almost similar environmental influence. The heritability estimates

Table 3. Analyses of variance (mean square values between genotypes) and the derived broad sense heritability estimates (h^2) for grain yield and its components

Character	Single plant		Main tiller	
	Mean square value	Heritability % (h^2)	Mean square value	Heritability % (h^2)
Tillers/plant	82.29**	79.9	–	–
Grains/panicle	4 495.07**	84.3	4 170.17**	60.5
1 000-grain wt.	121.76**	99.0	126.44**	96.5
Grain yield	102.08N.S.	25.7	1.57**	50.0

* = P<0.05
** = P<0.01
N.S. = P>0.05

of 1 000-grain weight were higher for both main tiller and single plant than the number of grains per panicle, but the values for both characters were sufficiently high to be of significance for selection. On this basis, selection using these two characters could be equally effective.

The number of tillers per plant also had a relatively high heritability value. This is so, probably because of the limited number of genotypes used and these genotypes were of advanced generations. However, this could also suggest that such character should not be totally ignored in single plants selection.

The heritability estimate for grain yield was low though the estimate for main tiller almost doubled that for single plant. Its effectiveness for selection would be low for main tiller and even less for single plant. Apart from low heritability value, single plants selection for yield had also been reported to be affected by genotype-environment interaction and intergenotypic competition (VALENTINE, 1979).

Correlation Analyses

The usefulness of grain yield and the component characters of the main tillers for the purpose of single plants selection further depend on the relationships between characters of main tiller (target) and single plant. The relationships as determined by the correlation coefficients (r) are shown in *Table 4*. The relationships for the same characters were in all cases positive. For number of grains per panicle and 1 000-grain weight, the relationships were highly significant (P<0.01) for all the genotypes studied. In the case of grain yield, significant relationships were observed in three out of the six genotypes used. This clearly shows that the performance of the main tiller is closely related to the performance of single plant, especially for 1 000-grain weight and the number of grains per panicle.

Table 4. Correlation coefficients (r_1 n = 30) between main tillers and single plants of different genotypes of rice

Genotype	Characters		
	Grains/panicle	1 000-grain wt.	Yield
MR 49	+0.588**	+0.422**	+0.254N.S.
MR 50	+0.714**	+0.471**	+0.065N.S.
MR 51	+0.652**	+0.417**	+0.383**
MR 58	+0.467**	+0.576**	+0.512**
MR 62	+0.638**	+0.598**	+0.211N.S.
MR 63	+0.659N.S.	+0.643N.S.	+0.439N.S.
r pooled	+0.623N.S.	+0.530N.S.	+0.319N.S.

* = P<0.05
** = P<0.01
N.S. = P>0.05

When pooled correlation coefficients (r pooled) were computed for each character *(Table 4)*, they were not significant (P>0.05), indicating homogeneity

among the correlation coefficients of the different genotypes. Grains per panicle and 1 000-grain weight had relatively high pooled correlation coefficients, indicating further, their practical use in single plants selection.

Nevertheless, the strength of the relationships, as indicated by the individual values of the correlation coefficients, were in general only moderately high. This would to a certain extent limit the sole use of the main tiller estimation for single plants assessment and selection. The main tillers can, however, be utilized as a standard or a reference point in assessing single plants performance. For further increase in precision of single plant estimation, as suggested by LOW and TAY (1975), perhaps a few tillers should be used.

CONCLUSION

Number of grains per panicle and 1 000-grain weight of main tillers were found to be positively related to those of single plants. The correlation coefficients were highly significant but were not strong enough for the main tillers performance to be solely used for single plants selection. Thus, performance of these two characters on the main tillers were recommended to be used only as standard references when assessing and selecting single plants of rice.

Selection based on single plant yield would not be effective due to its low heritability, genotype-environment interaction and intergenotypic competition. In addition to that, the relationships between the main tiller and single plant yield were also inconsistent. As such, grain yield whether at main tillers or single plants, should not be used as a criterion for the selection of single plants.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. Othman Omar and Dr. J. Valentine for their constructive comments and Mr. Yap Beng Ho for statistical analysis. Thanks are also due to all the staff of Rice Breeding Unit in MARDI, Alor Setar for their technical assistance, and Ms. Tatariah Ahmad and Ms. Roshadah Said for typing this paper.

ABSTRACT

One of the factors that affect the efficiency of single plants selection for yield is the difficulty in making visual estimates due to variability within a hill. This study determined the relationships between the performance of main tillers and single plants for yield and its components. Main tiller performance was found to be positively correlated to single plants performance but only for the yield component characters. Consistent significant ($P<0.01$) correlation coefficients (r) between lines were detected for number of grains per panicle and 1 000-grain weight. They also had relatively high heritability values. Performance of these characters on the main tillers was recommended to be used only as standard in single plants selection.

REFERENCES

ALLARD, R.W. (1960). *Principles of Plant Breeding.* New York: John Wiley and Sons, Inc.

ISMAIL, A.B. and VALENTINE, J. (1983). The efficiency of visual assessment of grain yield and its components in spring barley rows. *Ann. appl. Biol.* ***102***, 539–49.

LOW, W.L. and TAY, C.Y. (1975). Spikelet number distribution in panicles within a hill for four varieties of padi. *MARDI Res. Bull.* ***3***, 15–9.

VALENTINE, J. (1979). The effect of competition and method of sowing on the efficiency of single plant selection for grain yield, yield components and other characters in spring barley. *Z. Pflanzenzuchtg* ***83***, 193–204.

Accepted for publication on 30th January, 1985

Diterbitkan oleh:
Institiut Penyelidikan dan Kemajuan Pertanian Malaysia (MARDI),
Peti Surat 202, U.P.M., Serdang, Selangor, Malaysia.

Dicetak oleh Percetakan Nadzam, Kuala Lumpur.