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Research Note

Evaluation of rice genotypes for utilization in rice improvement programme in northern region of Bihar

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Abstract
Selection of germplasm /genotypes based on visual observation for different polygenic traits is less rewarding. In this context, selection of superior rice genotypes by assigning ranks to each genotype for various quantitative traits followed by rank correlation was estimated and it was observed that two multiple regression equation involving eight and four quantitative traits exhibited similar efficiency, indicated that four characters *viz.* panicle length, number of primary branches, L/B ratio and 1000 grain weight were the best characters for formulating selection criteria. Top ten genotypes identified on the basis of selection score were TCA-88-1, TCA88-3, TCA88-2, TCA88-81-1, TCA88-57-3, TCA88-10-1, TCA88-13-2, TCA88-79-2, TCA88-22 and TCA88-44-1. These genotypes found to be suitable for grain yield and components traits may be selected for further evaluation and utilization in rice improvement programme of north Bihar condition.

Key words
Evaluation, rice, ranking, yield components

Rice (*Oryza sativa* L.) acts as life for more than half of the global population. It is the chief source of carbohydrate and protein and also provides minerals and dietary fibers (Verma *et al.,* 2006). Rice is the most important crop of India and it occupies 23.03 per cent of the gross cropped area in the country. Rice contributes to 43 per cent of the total food grain production and 46 per cent of the total cereal production. 50 per cent of the area under rice falls in the Irrigated zone, 35 per cent is under rainfed cultivation, 12 per cent is under upland cultivation and the remaining 3 per cent falls under deep water cultivation. As about 50 per cent the area under rice is cultivated in rainfed conditions in eastern India with low productivity. In India rice is grown under widely varying conditions of altitude and climate. Therefore, the rice growing seasons vary in different parts of the country, depending upon temperature, rainfall, soil types, water availability and other climatic conditions. Rice is also a main crop of Bihar. There are three crop seasons *i.e.* autumn, winter and *garma* (summer) and as such grown throughout the year. Average productivity of the state is 1272 kg/ha and it belongs to low productivity group. Productivity of three districts are above the national average whereas productivity of the remaining thirty five districts are below the national average productivity of 2011 kg/ha. About 89 per cent of rice area is concentrated in medium low productivity group to very low productivity group which contributes 80 per cent of the total production of the state Rainfed lowland including flood prone constitutes more than 50 per cent of the total rice acreage in Bihar. Therefore, being the staple food of the population in India, improving its productivity has become a crucial importance (Subbaiah *et al*, 2011). Traditional cultivars in this situation show better performance consequently are preferred by farmers, full yield potential has not been realized and the productivity remained stagnant in Bihar as compared to other parts of the country. The future research strategy should aim at identifying donors for high panicle number, tolerance to yellow stem borer, early vigour, drought and submergence tolerance and to utilize them in breeding programme. Selection of germplasm in rice for yield and its components based on visual observation is not always effective. This necessitates the use of certain statistical method to enhance the efficiency of selection .Selection for yield by using simultaneous selection models involving important yield attributes did not show any advantage over visual selection. Therefore, an attempt has been made in the present investigation to select genotypes after assigning rank to each genotypes for different yield components.

The present investigation comprised of 120 local land races of rice germplasm of north Bihar and procured from rice section, Department of Plant Breeding and Genetics, Rajendra Agricultural University, Pusa, Bihar. The genotypes were grown in an augmented randomized block design with check varieties *viz.* Prabhat, Satyam, Rajshree and Sudha. Entries were grown in four rows in plots of 3m length. Twenty one day old seedlings were transplanted with spacing of 20 x 15 cm. Normal agronomic practices were followed to raise the good crop. Observations were recorded on nine quantitative characters *viz.* panicle length (cm),

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number of primary branches, number of secondary branches, number of grains per panicle, head rice recovery (%), L/B ratio, 1000grain weight (g), grain yield per plant and grain elongation (%) following standard evaluation system of rice (IRRI,1993). Observations on nine quantitative traits were subjected to analysis of variance in augmented design (Federer, 1956). All the individual plants were than ranked for each character on the basis of single characters as well as their possible combinations for selection and selection indices were constructed. Prior to selection, rank correlation coefficient was estimated between grain yield and its component traits in order to measure the association between two criteria of ranking. The aim of experiment was to select only the superior local germplasm for north Bihar condition.

The analysis of variance (Table 1) revealed highly significant variations among the check and germplasm for all the characters except panicle length. The check *vs* germplasm also exhibited highly significant variation for all the characters barring number of secondary branches which showed significant variation. Among the germplasm lines/entries highly significant differences were observed and presence of adequate variability is a prerequisite for efficient selection. This indicated that selection among the local genotypes could be effective for various characters. Range, mean (test genotypes), mean (checks), variance and coefficient of variation (CV) computed for nine quantitative traits are presented in table 2. Almost all the traits except head rice recovery (%) showed high frequency of genotypes in intermediate classes.

Yield is a complex quantitative character, which is highly influenced by environmental fluctuations. Hence direct selection for grain yield may not be effective. Therefore, selection criteria based on grain yield as well as its components were taken into consideration in selecting desirable germplasm. The knowledge of relationship among grain yield components and relative weight age that should be given to different components to obtain maximum grain yield are therefore, the most important. In the present investigation, through multiple regressions the effects of more than one independent variable upon the dependent variable were estimated. Therefore, the relationship of the dependent variable with other variables, which are independent may be used to estimate the dependent variable for given value of the dependent variable.

The partial regression coefficient of grain yield on eight quantitative traits *viz.*, panicle length, number of primary branches, number of secondary branches, number of grains per panicle, head rice recovery, L/B ratio, 1000 grain weight, grain yield per plant and grain elongation were computed (Table 2). In the present investigation , two multiple regression equation were computed, first by taking all eight component characters and second by including four significant characters *viz.* panicle length, number of primary branches, L/B ratio and 1000 grain weight which were found significant to partial regression coefficient. Selection indices can be constructed on the basis of panicle length, number of primary branches, L/B ratio and 1000 grain weight. Due to non-significant partial regression coefficient number of secondary branches number of grains per panicle, head rice recovery and grain elongation were excluded. The equation are given as follows

$$Y = 0.205.0.234X_1 + 0.313X_2 + 0.053X_3 + 0.163X_4 + 0.139X_5 + 0.702X_6 + 0.208X_8 \text{.....eq (i)}$$

$$Y = 0.125+0.0155X_1 + 0.021X_2 + 0.0930X_3 \text{ ..... eq (ii)}$$

where, X_1,X_2, X_3, X_4, X_5, X_6, X_7 and X_8 are the mean values of characters *viz.* panicle length, number of primary branches, number of secondary branches, number of grains per panicle, head rice recovery, L/B ratio,1000 grain weight and grain elongation resection for equation.

Whereas, for equation (ii), X_1, X_2 and X_3 are number of primary branches, panicle length and 1000 grain weight respectively. It was further revealed that the four component characters, panicle length, number of primary branches, L/B ratio and 1000 grain weight recorded high and significant value of regression coefficient (Table 3).

In the present investigation it was observed that two multiple regression equation involving eight and four quantitative characters exhibited similar efficiency r2(1) = 0.205 and r2(2) = 0.125 indicated that four characters, panicle length, number of primary branches, L/B ratio and 1000 grain weight were the best characters for formulating selection criteria. Similar results were reported by Mishra *et al.* (1973), Sukanya (1988), Mishra *et al.(*1993) and Chakraborty and Hazarika (1996). This finding further revealed that selection should be done not only grain yield singly but also simultaneously on four characters since the heritability of grain yield is low.

The assigned relative ranking and selection score of different germplasm for grain yield on the basis of selection score have been shown in Table 4. Genotypes identified on the basis of selection score *viz*. TCA 88-3,TCA 88—2, TCA 88-81-1,TCA 88-57-3,TCA 88-10-1,TCA 88-13-2,TCA 88-79-2,TCA 88-22,TCA 88-44-1, TCA 88-51-2,TCA 88-28 , TCA 88-75-1,TCA 88-36,TCA 88-48,TCA 88-29,TCA 88-89-9,TCA 88-17-2,TCA 88-75-2 and TCA 88-57-2 were found to be suitable for grain yield and its components. These germplasm

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may be selected for further evaluation and utilization in rice improvement programme of north Bihar condition.

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Table 1. Analysis of variance for nine quantitative characters in rice

Characters	Block	Check	Entries	Germplasm/Variety	Check *vs* variety
Panicle length(cm)	23.89 **	10.76	7.26*	6.93	36.08**
No. of Primary branches	8.21**	26.37**	3.72**	2.97**	24.75**
No. of secondary Branches	28.12**	53.88**	22.88**	22.04**	30.57**
No. of grains per panicle	238.70	11765.61**	793.65**	495.22**	3390.93**
Head rice recovery (%)	52.80**	262.15**	36.05**	28.25**	285.04**
L/B ratio	0.43**	0.59**	0.20**	0.15**	5.63**
1000-grain weight (g)	25.08**	21.44**	14.57**	14.04**	57.09**
Grain elongation (g)	43.00	978.50**	83.01**	58.96**	258.50**
Grain yield per plant (g)	46.02**	193.33**	19.70**	337.24**	

* and ** significant at 0.05 and 0.01 levels of probability, respectively.

Table 2. Variability parameters for nine quantitative traits in rice germplasm of north Bihar

Traits	Range	Mean (test Genotype)	Mean (check)	Variance	C.V.
Panicle length (cm)	17.25-30.25	23.48	21.43	3.443	11.63
No. of primary branches	5-15	9.60	8.16	0.741	21.15
No. of secondary branches	2-32	19.49	16.44	4.822	24.01
No. of grains/panicle	90-200	136.36	128.56	85.183	19.36
Head rice recovery (%)	40-68	52.89	49.16	7.354	10.78
L/B ratio	1.71-3.77	2.69	2.53	0.014	16.35
1000-grain weight (g)	19.04-34.32	25.94	22.78	1.750	14.21
Grain elongation (%)	6.66-137.03	114.85	109.34	20.525	7.49
Grain yield/plant (g)	12.00-43.85	22.88	20.42	3.832	21.74

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Table 3. Multiple regression coefficient of grain yield on eight different quantitative characters in rice (*Oryza sativa* L.)

Sl. No.	Multiple regression of yield/plant on	When all eight characters were included	When all four characters were included
X1	Panicle length (cm)	0.234*±0.159	0.021±0.0103
X2	No. of primary branches	0.313*±0.217	0.015±0.0114
X3	Number of secondary branches	0.053±0.096	
X4	Number of grains per panicle	0.016±0.015	
X5	Head rice recovery (%)	0.139±0.071	
X6	L/B ratio	0.70**±0.953	0.067*±0.0011
X7	1000 grain weight(g)	0.208*±0.108	0.093±0.0136
X8	Grain elongation(%)	0.073±0.047	

R^2 value of all eight characters=20.5%
R^2 value of all four characters=12.5%
*and**Significant at 0.05 and 0.01 levels of probability, respectively.

Table 4. Relative ranking and selection score of different germplasm for grain yield in rice on the basis of eight components traits

Entry No.	Entry name	Selection score	Rank
1	TCA88-1	43.850	1
3	TCA88-3	35.300	2
2	TCA88-2	31.100	3
73	TCA88-81-1	29.850	4
58	TCA88-57-3	29.470	5
11	TCA88-10-1	29.410	6
15	TCA88-13-2	29.140	7
70	TCA88-79-2	29.000	8
5	TCA88-5-2	28.900	9
25	TCA88-22	28.840	10
44	TCA88-44-1	28.620	11
53	TCA88-51-2	28.310	12
30	TCA88-28	28.190	13
75	TCA88-75-1	28.050	14
38	TCA88-36	28.030	15
49	TCA88-48	27.990	16
31	TCA88-29	27.950	17
83	TCA88-89-9	27.680	18
20	TCA88-17-2	27.650	19
76	TCA88-75-2	27.180	20
57	TCA88-57-2	27.160	21