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Construction of selection indices using equal weight and broad sense heritability method in rice (*Oryza sativa* L.)

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Abstract
Using the equal weight approach and broad sense heritability, twenty seven selection indices were created, accounting for all possible combinations of the grain yield per plant with five yield contributing characteristics. When selection was based on two or more characters then the expected genetic advance and relative efficiency assessed for different indices increased considerably. Among all the selection indices, the index based on five component characters *viz*., grain yield per plant, effective tillers per plant, panicle length, grains per panicle and 1000 seed weight ($X_1.X_3.X_4.X_5.X_6$) possessed the highest genetic gain and relative efficiency as compared to straight selection for grain yield per plant alone. Further, there was a consistent increase in the relative efficiency of the succeeding index with simultaneous inclusion of each character. However, six components based index showed lower efficiency than five components based index in both methods due to negative correlation of plant height with grain yield per plant. It was observed that grains per panicle and panicle length were included in all character combinations exhibiting the best relative efficiency and advancement. Effective tillers per plant was the other important character.

Keywords: Selection index, rice, yield contributing characters, percent relative efficiency

Introduction
In *Poaceae* family and *Oryzoidae* subfamily, rice (*Oryza sativa* L.) is the most important staple food crop. It is diploid with 12 chromosomes (2n=24). (Garris *et al.*, 2005) [5]. It is hydrophilic, annual, self-pollinating, short day and C_3 plant. Asia is considered as a 'rice bowl' of the world. For around 3.5 billion people, rice is the most significant food staple, making up at least 35-75% of total calories. (Rudresh *et al*. 2021) [11]. The famous theme of international year of rice, 2004 was *"Rice is life"*. India possesses a vast and varied genetic diversity in rice. Smith (1936) [9] originally suggested use of selection index, based on Fisher (1936)'s idea of a discriminant function. Hazel (1943) [7] used path coefficients to develop a selection index. By creating a suitable "selection index" or "score," it is possible to maximize rice yield potential by enabling the selection of superior genotypes. Characters with high and positive direct effects on grain yield per plant and desirable correlation were taken into consideration for the formulation of the selection indices. To do this, a detailed understanding of the variability present in the plant material utilized for the study, the relationships between the characteristics included in the study, and the causes for those relationships, is required.

Materials and Methods
The experiment was conducted at Main Rice Research Centre, Navsari Agricultural University, Navsari during *kharif*, 2021. A set of 40 diverse genotypes of rice was laid out in randomized block design with three replications. The observations on grain yield and its component character were recorded from five randomly selected competitive plants for each treatment in each replications and average values per plant were computed. Six characters were studied for this experiment i.e. grain yield per plant (g/plant), plant height (cm), effective tillers per plant, panicle length (cm), grains per panicle and 1000 grain weight (g). Broad sense heritability and equal weight approaches were used for this study. A total 27 selection indices were constructed by discriminant function techniques.

Results and Discussion

For construction of the selection indices, the characters, which had desirable correlation as well as high direct effects on grain yield per plant were considered. In this context, the grain yield per plant (X_1) along with its five components *viz*., plant height (X_2), effective tillers per plant (X_3), panicle length (X_4), grains per panicle (X_5) and 1000 grain weight (X_6) were identified and considered for the construction of selection indices. Twenty seven selection indices were constructed with help of two methods, equal weight (W_1) and broad sense heritability (W_2) in all possible combinations of the five yield contributing characters and grain yield per plant. Their respective genetic advance was calculated and relative efficiency of different discriminant functions in relation to the straight selection for grain yield was compared. The data on selection indices of top five character combinations and their genetic advance and relative efficiency are given in Table 1 and 2 assuming the efficiency of straight selection for grain yield as 100%. Among all the twenty seven selection indices, the index based on five component characters *viz*., grain yield per plant, effective tillers per plant, panicle length, grains per panicle and 1000 seed weight ($X_1.X_3.X_4.X_5.X_6$) possessed the highest genetic advance and relative efficiency as compared to straight selection for grain yield per plant.

Further, there was a consistent increase in the relative efficiency of the succeeding index with simultaneous inclusion of each character. However in practice, the plant breeder might be interested in maximum gain with minimum number of characters. In such a case, selection index involving grain yield per plant, effective tillers per plant, panicle length, grains per panicle and 1000 grain weight ($X_1.X_2.X_3.X_4.X_5$), grain yield per plant, effective tillers per plant, panicle length and grains per panicle ($X_1.X_3.X_4.X_5$) followed by grain yield per plant, panicle length and grains per panicle ($X_1.X_4.X_5$) and grain yield per plant and grains per panicle and grains per panicle ($X_1.X_5$) in each group *i.e.* indices involving two, three or four character combinations, could be advantageously exploited in the rice breeding programmes. Most appropriate selection index depends on objective of the selection and target area. The results are at par with the findings of Habib *et al*. (2007) [6] and Sowjanya *et al.* (2017) [10].

It was noted that grains per panicle and panicle length were part of the all the character combinations showing highest relative efficiency and genetic advance in each group *i.e*. indices involving two, three or four character combinations in both methods. The other important character was effective tillers per plant. The results of the present study also revealed that, the discriminant function method of making selection in plants appeared to be the most useful than the straight selection for grain yield alone and hence, due weightage should be given to the important selection indices while making selection for yield advancement in rice. Habib *et al.* (2007) [6], Bastia *et al*. (2008) [1], Sabouri *et al*. (2008) [8], Chaudhary *et al.* (2017) [3], Sowjanya *et al*. (2017) [10] and Bhutta *et al.* (2019) [2] were also found the similar results earlier, which are in parity with the results of present investigation.

Table 1: Selection indices with genetic advance in yield and relative efficiency with the use of equal weight (W_1) method in rice

Sr. No.	Indices	Character Combinations	Expected Genetic Advance	Relative efficiency (%)
1	I_1	$I=0.755X_1$	9.63	100.00
2	I_2	$I=0.187X_2$	4.86	50.49
3	I_3	$I=0.723X_3$	2.57	26.69
4	I_4	$I=0.758X_4$	5.63	58.41
5	I_5	$I=0.94X_5$	58.70	609.50
6	I_6	$I=0.954X_6$	7.08	73.53
7	I_{15}	$I=0.755X_1+0.954X_5$	63.46	658.88
8	I_{25}	$I=0.155X_2+0.942X_5$	58.99	612.56
9	I_{35}	$I=0.843X_3+0.942X_5$	59.60	618.86
10	I_{45}	$I=1.015X_4+0.941X_5$	61.71	640.78
11	I_{56}	I=0.94X5+0.902X6	59.18	614.45
12	I_{125}	$I=0.448X_1+0.103X_2+0.977X_5$	63.23	656.49
13	I_{135}	$I=0.721X_1+1.184X_3+0.954X_5$	64.61	670.84
14	I_{145}	$I=0.751X_1+1.196X_4+0.948X_5$	66.81	693.75
15	I_{156}	$I=0.762X_1+0.953X_5+1.069X_6$	64.41	668.76
16	I_{345}	$I=0.658X_3+0.994X_4+0.946X_5$	62.60	649.95
17	I_{1235}	$I=0.741X_1+0.029X_2+-1.379X_3+0.99X_5$	64.29	667.51
18	I_{1245}	$I=0.414X_1+0.064X_2+1.354X_4+0.966X_5$	66.63	691.82
19	I_{1345}	$I=0.761X_1+0.892X_3+1.156X_4+0.95X_5$	67.92	705.19
20	I_{1356}	$I=0.735X_1+1.136X_3+0.952X_5+1.066X_6$	65.67	681.89
21	I_{1456}	$I=0.765X_1+1.171X_4+0.947X_5+1.048X_6$	67.68	702.77
22	I_{12345}	$I=0.753X_1+-0.021X_2+-1.77X_3+1.389X_4+0.98X_5$	67.78	703.76
23	I_{12356}	$I=0.839X_1+-0.009X_2+-1.184X_3+0.981X_5+0.411X_6$	64.68	671.54
24	I_{12456}	$I=0.583X_1+0.012X_2+1.283X_4+0.959X_5+0.214X_6$	66.93	694.93
25	I_{13456}	$I=0.778X_1+0.845X_3+1.133X_4+0.949X_5+1.068X_6$	68.90	715.38
26	I_{23456}	$I=-0.025X_2+-1.514X_3+1.169X_4+0.972X_5+0.299X_6$	63.02	654.33
27	I_{123456}	$I=0.861X_1+-0.057X_2+-1.562X_3+1.323X_4+0.973X_5+0.399X_6$	68.12	707.29

Table 2: Selection indices with genetic advance in yield and relative efficiency with the use of broad sense heritability (W_2) in rice

Sr. No.	Indices	Character Combinations	Expected Genetic Advance	Relative efficiency (%)
1	I_1	$I=0.57X_1$	7.27	100.00
2	I_2	$I=0.035X_2$	0.91	12.49
3	I_3	$I=0.523X_3$	1.86	25.57
4	I_4	$I=0.575X_4$	4.27	58.66
5	I_5	$I=0.884X_5$	55.20	759.06
6	I_6	$I=0.91X_6$	6.76	92.91
7	I_{15}	$I=0.575X_1+0.894X_5$	58.71	609.58
8	I_{25}	$I=0.005X_2+0.885X_5$	55.23	573.47
9	I_{35}	$I=0.639X_3+0.885X_5$	55.85	579.86
10	I_{45}	$I=0.823X_4+0.883X_5$	57.46	596.66
11	I_{56}	$I=0.884X_5+0.861X_6$	55.66	577.95
12	I_{125}	$I=0.508X_1+-0.027X_2+0.9X_5$	58.66	609.07
13	I_{156}	$I=0.589X_1+0.892X_5+0.981X_6$	59.54	618.19
14	I_{145}	$I=0.565X_1+0.96X_4+0.888X_5$	61.20	635.42
15	I_{135}	$I=0.545X_1+0.895X_3+0.894X_5$	59.50	617.84
16	I_{345}	$I=0.485X_3+0.807X_4+0.886X_5$	58.10	603.23
17	I_{1245}	$I=0.483X_1+-0.056X_2+1.025X_4+0.892X_5$	61.17	635.18
18	I_{1256}	$I=0.555X_1+-0.045X_2+0.896X_5+0.786X_6$	59.34	616.20
19	I_{1345}	$I=0.569X_1+0.671X_3+0.931X_4+0.889X_5$	61.96	643.37
20	I_{1356}	$I=0.564X_1+0.87X_3+0.892X_5+0.974X_6$	60.42	627.34
21	I_{1456}	$I=0.585X_1+0.934X_4+0.887X_5+0.969X_6$	61.96	643.39
22	I_{12345}	$I=0.563X_1+-0.084X_2+0.031X_3+1.018X_4+0.896X_5$	61.91	642.87
23	I_{12356}	$I=0.59X_1+-0.064X_2+0.347X_3+0.899X_5+0.811X_6$	60.18	624.83
24	I_{12456}	$I=0.541X_1+-0.075X_2+0.99X_4+0.889X_5+0.755X_6$	61.81	641.78
25	I_{13456}	$I=0.59X_1+0.645X_3+0.906X_4+0.888X_5+0.98X_6$	62.81	652.23
26	I_{23456}	$I=-0.076X_2+0.045X_3+0.855X_4+0.891X_5+0.712X_6$	58.50	607.45
27	I_{123456}	$I=0.609X_1+-0.1X_2+0.064X_3+0.984X_4+0.893X_5+0.8X_6$	62.63	650.35

Conclusion
The discriminant function analysis for selection indices suggested that the selection efficiency was higher over straight selection, when the selection was based on yield contributing characters and not directly for grain yield per plant. The relative selection efficiency further increased with the inclusion of two or more characters. The highest relative efficiency was obtained with five character combinations *viz*., grain yield per plant, effective tillers per plant, panicle length, grains per panicle and 1000 grain weight, followed by selection index of four component characters *viz*., grain yield per plant, panicle length, grains per panicle and 1000 grain weight. It was noted that grains per panicle and panicle length were part of the all the character combinations showing highest efficiency and advance in each group *i.e*. indices involving two, three and four character combinations.

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Reference
1. Bastia D, Mishra TK, Das SR. Genetic variability and selection indices for grain yield in upland rice. Oryza, Int. J Rice. 2008;45(1):72-75.
2. Bhutta MA, Munir BS, Qureshi MK, Shahzad AN, Aslam K, Manzoor H, *et al.* Correlation and path analysis of morphological parameters contributing to yield in rice (*Oryza sativa* L.) under drought stress. Pak. J Bot. 2019;51(1):73-80.
3. Chaudhary AP, Parmar DJ, Muniya SD, Darji VB. Construction of selection index using simple correlation coefficients and path coefficients (direct effects) as a weight in rice (*Oryza sativa* L.). Int. J Curr. Res. 2017;9(7):53864-53869.
4. Fisher RA. The use of multiple measurements in taxonomic problems. Annals of Eugenics. 1936;7:179-188.
5. Garris AJ, Tai TH, Coburn J, Kresovich S, Couch MS. Genetic Structure and diversity in *Oryza sativa*. Genetics. 2005;169:1631-1638.
6. Habib SH, Iftekharuddaula KM, Bashar MK, Akter K, Hossain MK. Genetic variation, correlation and selection indices in advanced breeding lines of rice (*Oryza sativa* L.). Bangladesh J Pl. Breed. Genet. 2007;20(1):25-32.
7. Hazel LN. The Genetic basis for constructing selection indices. Genetics. 1943;28:479-490.
8. Sabouri H, Babak R. Use of selection indices based on multivariate analysis for improving grain yield in rice. Rice Sci. 2008;15(4):303-310.
9. Smith HG. A discriminant function for plant selection. Annals of Eugenics. 1936;7:240-250.
10. Sowjanya PR, Raghavendra P, Hittalmani S. Trait association studies to determine selection indices in two F_3 segregating populations of rice *(Oryza sativa* L.) under aerobic condition. *Oryza*- Int. J Rice. 2017;54(3):276-281.
11. Rudresh NS, Jayamani P, Viyayakumar E, Manonmani S, Gangashetti M, Jeyakumar P, *et al.* Genetic analysis of rice germplasm suitable for direct and transplanted establishments. Electro. J Pl. Breed. 2021;12(4):1148-1156.