Environment and Ecology 40 (3B) : 1548—1550, July—September 2022
ISSN 0970-0420

Stepwise Regression Analysis in Induced Mutants of Aromatic Non-Basmati Rice

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Received 12 March 2022, Accepted 17 May 2022, Published on 11 August 2022

ABSTRACT

A population of 28 true-breeding induced mutants of aromatic non-basmati rice with its mother Tulaipanja was grown during warm wet season for two consecutive years. Data on ten important morphological characters were recorded. Stepwise multiple regression analysis was performed for identifying key yield determining traits in the mutant population. Stepwise regression analysis in the first year revealed that harvest index was the most important determinant of yield, which secured 1st position in the final regression analysis in the advanced generations. Harvest index alone accounted for 60.460% in first year and 39.443% in second year for the total variance in grain yield. The next important determinant was number of panicles per plant which appeared in 2nd position in first year and 3rd position in second year in the final regression analysis. Panicle length was the next important determinant for grain yield.

Keywords Regression, Forward selection, Quantitative characters, Induced mutants, Aromatic rice.

INTRODUCTION

There is a great demand of aromatic rice in the whole world. It has special market in world rice trade and fetches premium price. India and its subcontinent are popular for the cultivation and production of scented rice. Tulaipanja is popular landrace of aromatic rice in northern part of West Bengal. But its yield potential is low due to inefficient partitioning of biomass and susceptibility to lodging. Gamma ray induced mutation with a view to developing new plant type resulted in a number of promising mutant families with improvement in different agro-botanical characters. It is important to know the key yield determining traits in such mutant population. Kole *et al*. (2008) reported that selection favoring higher panicle number per plant, test weight and straw weight and medium plant height with a reasonable balance for moderate grain number would help to achieve higher grain yield in induced mutant population of aromatic non-basmati rice. Statistical analysis like stepwise regression method provides useful information for breeding program. Stepwise multiple regression analysis is used for estimating the contribution of a given trait to productivity with other traits held constant and determining the choice

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of weights in multiple traits selection system. It is an important method to determine the contribution of different characters towards grain yield. The information regarding the key characters for yield in aromatic non-basmati rice, that too, involving induced mutants, is scanty. Therefore, a population comprising 30 advanced generation true-breeding mutants with the mother Tulaipanja was grown during warm wet season for two consecutive years for the purpose of deciphering the most important determinants of grain yield through step-up regression analysis.

MATERIALS AND METHODS

Dry unhusked seeds of aromatic non-basmati landrace Tulaipanja were irradiated with two doses of gamma rays viz., 200 Gy and 300 Gy to generate M^1 generation followed by individual plant selection in subsequent segregating generations. In this way, single plant selection following pedigree methods, was continued till apparent true-breeding mutant families were obtained. In advanced generation, twenty eight true-breeding mutant families with mother Tulaipanja were grown during warm wet season for two consecutive seasons in a complete Randomized Block Design with three replications. Each plot consisted of 5 rows of 4m length with 20×15cm spacing. Standard cultural practices were followed to raise a good crop. Data were recorded on ten important quantitative characters, viz., plant height, flag leaf area, flag leaf angle, number of panicles per plant, panicle length, number of filled grains per panicle, spikelet fertility per cent, 1000-grain weight, harvest index and grain yield per plant from 5 randomly sampled plants from middle rows. Stepwise regression analysis was carried out for yield and its contributing characters in advanced generations following the method of Draper and Smith (1981). Stepwise regression procedures are selection techniques that sequentially add or delete single predictor variables to the prediction equation.

RESULTS AND DISCUSSION

The agro-botanical characters studied in both the years showed wide range of variation among the mutants with variable grain yield. Therefore, it became pertinent to decipher the key characters having significant contributions to rice yield. Hence, forward selection multiple regression analyses were used to identify such traits. This model identifies the importance of traits in terms of their contribution to yield variation by progressing addition of new trait in an interactive manner.

The results of stepwise multiple regression analyses following the step up procedures for important yield contributing characters for both the years were presented in Tables 1, 2. The results revealed that the most important determinant among the yield contributing characters is harvest index which was selected first in the regression equation in both the years contributing 60.46 % and 39.44% of the total variance in grain yield. Number of panicles per plant was the 2nd most important character in the first year contributing 12.65% and with harvest index explaining 73.11% of the total variation in grain yield. The 3rd important determinant in the first year was panicle length which contributed 4.66% and with harvest index and panicles per plant explained 72.72% of the total variation in rice yield. The same two characters were also selected in the step up regression equations in the second year but with interchangeable sequence i.e. panicle length 2nd and panicles per plant 3rd position. Panicle length and panicles per plant contributing 4.32% and 3.1%, respectively jointly with harvest index accounted for 46.86% variation in seed yield in rice in second year. The variables which entered the regression equations in the 4th step was filled grain in the first year sharing 2.27% and flag leaf angle in the second year sharing 3.58%, explained 79.99% and 50.44% variation in rice yield, respectively. No fur-

Table 1. Stepwise multiple regression analysis in aromatic rice (First Year). Y = Yield, X_4 = Number of panicles per plant, X_5 = Panicle length, X_6 = Number of field grains per panicle, X_9 = Harvest index; **: Significant at 1% level.

Equation	% of variation explained by regression (R^2)
$Y = 0.347 + 0.464\ X_9$	60.460**
$Y = -6.520 + 0.461\ X_9 + 0.304\ X_4$	73.111**
$Y = -8.562 + 0.306\ X_9 + 0.370\ X_4 + 0.078\ X_5$	77.715**
$Y = -15.958 + 0.327\ X_9 + 0.457\ X_4 + 0.063\ X_5 + 0.221\ X_6$	79.989**

Table 2. Multiple regression analysis in aromatic rice (Second Year). Y = Yield, X_1 = Plant height, X_4 = Number of panicles per plant, X_5 = Panicle length, X_9 = Harvest index, X_3 = Area of flag leaf; ** : Significant at 1% level.

Equation	% of variation explained by regression (R^2)
$Y = 0.525 + 0.048 X_9$	39.44**
$Y = 0.145 + 0.046 X_9 + 0.020 X^5$	43.47**
$Y = -0.545 + 0.040 X_9 + 0.036 X_5 + 0.041 X_4$	46.86**
$Y = -0.425 + 0.036 X_9 + 0.054 X_5 + 0.044 X_4 - 0.029 X_3$	50.44**
$Y = -1.525 + 0.051 X_9 + 0.053 X_5 + 0.045 X_4 - 0.031 X_3 + 0.005 X_1$	52.72**

ther variables were stepped up which could contribute to significant variation in grain yield in the first year. However, in the second year plant height entered as 5th and last important variable in the regression equation with a contribution of 2.28% and finally accounting to 52.72% of rice yield. Stepwise regression analysis by Kiani and Nimathzadeh (2012) showed that 72.1 % of yield variation could be explained by three characters: The panicles per plant, filled grains per panicle and panicle length. Augustina *et al*. (2013) through stepwise regression identified number of grains per plant as the most reliable selection index for yield improvement in rice.

The overall results from both the two years indicate that harvest index, panicle number and panicle length are the most important traits for determining grain yield in this mutant population. In addition to these traits, flag leaf angle, plant height and filled grain per panicle contributed substantially to grain yield in either year. Hasib and Kole (2008) through regression method identified panicle length and plant height for yield variation in induced mutants of aromatic rice. Kole (2006) from step up multiple regression analysis reported the importance of tiller number, grain number and 100-grain weight for variation in grain yield in the population of third somaclonal generation of barley cv Dissa. The induction of mutation was targeted to generating variation by altering the physiological rhythm (Banerjee and Kole 2009) for improved partitioning efficiency of photosynthates. This was achieved through a network of integrative mutant traits of reduced plant height, increased panicle number with altered panicle length, change in flag leaf geometry with better solar light inception and so on in a syntenic manner. Therefore, harvest index had the highest contribution followed by two panicle traits. Variation in contribution by each of the traits and inclusion of few variable traits in later steps of regression in the experimental years is due to environmental variation having impact on the expression of traits. From these results, selection index could be constructed for identifying promising plant type in aromatic rice.

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