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Research Article

Varietal Differences in Tillering and Yield Responses of Transplanted Rice on Different Soil Textured Sites of Southwestern Punjab

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Abstract

Background: Tillering is one of the yield-determining character in the rice. The growth and development of tillers depend on environment and varietal characteristics. In the same environment varieties of rice differs in producing tillers. In the rice physiology, major part of the population comes from tillers which are developed at the initial tillering period. Therefore, the present study was undertaken to study the tillering pattern of different rice varieties on varying soil textured sites.

Methods: The experimental soil sites were light, medium and heavy textured using four rice varieties viz. PR121, PAU201, PR128 and PR129. Plants of one meter row length (5 hills each from three locations) were selected and marked for tillering counting. Counting was performed at 35, 50 and 65 days after transplanting and at maturity. Tillering rate (TR) = the maximum tiller/tiller duration. Panicle bearing tiller rate (PBTR) = (number of panicle per hill/number of maximum tiller per hill) x 100.Tiller morality = (TL_1-TL_2/ TL_1 x 100 where TL_1 is the total tiller number at time T_1 and TL_2 is the total tiller number at time T_2. Correlation and regression analysis were performed.

Results: Among the four varieties, PR121 produced maximum effective tillers (11.7 hill^{-1}) whereas PR128 and PR129 were identical (10.3 hill^{-1}) and least (9.3 hill^{-1}) effective tillers have been recorded in PAU 201. The linear regression model (Y = 2.4514 X + 41.03, R^2 = 0.31) has been developed for forecasting grain yield of rice using number of effective tillers. Among rice varieties tiller mortality rate was in the order: PR 121 (52.1%) > PR 129 (51.3%) > PR 128 (49.1%) > PAU 201(47.7%). Variety PR 121 performed higher tillering rate (0.49 per hill per day). The yield superiority of variety PR 121 over PR 128, PAU 201 and PR 129 was 3.9, 7.1 and 15.0 respectively. Correlation coefficient between panicle number and maximum tillers was positive.

Keywords: Rice Varieties; Tillering Rate; Tiller Mortality; Yield Response; Soil Texture

Introduction

Rice is a staple food for more than two billion people in Asia and for many millions in Africa and Latin America. Growth and yield of rice plants are not only affected by weather conditions of a particular cultivation season, but also vary with the cultivar. In the rice physiology, major part of the population comes from tillers which are developed at the initial tillering period. Tillering is an important agronomic trait for rice grain production. Rice tiller is a specialize grain bearing branch that is formed on the unelongated basal enter node and grows independently of the mother stem (Culm) by means of its adventitious routes. Rice tiller occur

in a two stage process: The formation of auxiliary buds at each leaf axel and its subsequent out growth. The panicle bearing tiller rate influences the grain yield of rice [1] and excessive tillering leads to high tiller abortion, poor grain setting small panicle size and further production in grain yield [2-4]. Tillering characteristics can be altered by changes in environment and agronomic traits. The soil conditions may change the rooting characteristic of plants, leading to affect the tillering. An experiment was therefore, undertaken to study the tillering pattern of different rice varieties on varying soil textured sites.

Material and Methods

Adoptive research trial was conducted in south-western conditions of Punjab during 2019 (May-October). Agro eco-situations were made on the basis of soil type. The experimental soil sites were light, medium and heavy textured. Four rice varieties viz. PR121, PAU201, PR128 and PR129 were used in which PR128 and PR129 were new varieties. The unit plot size was 500 square meter 25 to 30 days old seedling were manually transplanted at the spacing of 20 x 15 cm with two seedling per hill from 25th June to 28th June. Plants of one meter row length (5 hills each from three locations) were selected and marked for tillering counting. Counting was performed at 35, 50 and 65 days after transplanting and at maturity. Plant height at maturity was measured from the soil surface to the tip of last leaf. The crop reached physiological maturity when 95% of spikelets had turned from green to yellow. At maturity the entire plot was harvested for grain yield. Tillering rate (TR) = the maximum tiller/tiller duration. Panicle bearing tiller rate (PBTR) = (number of panicle per hill/number of maximum tiller per hill) x 100.Tiller morality = (TL_1-TL_2/TL_1 x 100 where TL_1 is the total tiller number at time T_1 and TL_2 is the total tiller number at time T_2. Correlation and regression analysis were performed.

The weather data during the study period at the experimental site are shown in figure 1. Ranging from 14 to 32 °C and 26 to 45 °C mean of minimum and maximum temperature for the crop season was 25 and 34 °C, respectively. Similarly, diurnal mean of the relative humidity held between 24 and 88% having 65% as seasonal average. Total rainfall 284 mm has been recorded during the crop season.

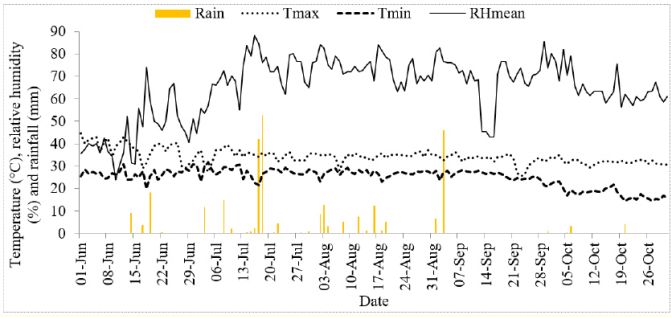

Figure 1: Weather parameters during the rice growing season 2019.

Results and Discussions

Plant height

Plant height varied among the rice variety at different soil textured sites. The plant height at maturity in varieties ranged from 106.4cm in PR121 to 121.8cm in PR129. The varietal variation may be due to better GXE interactions. Heavy textured soil recorded remarkably taller plants (120.7cm) as compared to light textured soil (110.4cm). This may be attributed to better soil health status of heavy textured soil. The correlation analysis (Table 1) indicated that the higher plant height was associated (r = -0.45) with reduction of the rice yield. The yield prediction model (Y = -0.2524 X + 95.599, R^2 = 0.20) developed using plant height may be used for forecasting of grain yield of rice.

Number of effective tillers

Number of effective tillers under different soil textures (Table 1) revealed that medium textured soil was relatively superior for producing more effective tillers (10.9) closely followed by the heavy textured (10.7) and light textured (9.6) soils. Among different varieties, PR 121 produced maximum effective tillers (11.7 hill^{-1}) whereas, PR 128 and PR 129 were identical (10.3 hill^{-1}) and least (9.3 hill^{-1}) effective tillers have been recorded in PAU 201. The number of effective tillers were responsible for yield enhancement (r = 0.56) of the rice crop grown under different sites having vary-

ing soil texture. The linear regression model (Y = 2.4514 X + 41.03, R^2 = 0.31) has been developed for forecasting of grain yield of rice using number of effective tillers.

Soil texture	Varieties	Plant height (cm)	Effective tillers no. hill^{-1}	Yield (q ha^{-1})
Light	PR 128	110.4	9.0	68.0
	PAU 201	106.0	8.6	69.2
	PR 129	120.8	11.0	57.6
	PR 121	104.6	10.8	67.2
Medium	PR 128	125.6	9.4	72.0
	PAU 201	114.4	11.2	63.0
	PR 129	116.0	12.0	62.0
	PR 121	103.6	10.2	73.0
Heavy	PR 128	127.2	9.6	65.4
	PAU 201	115.8	11.0	65.0
	PR 129	128.8	12.0	62.0
	PR 121	111.0	9.0	73.4
Corr. Coeff. (r) with yield		-0.45	0.56	
Coeff. of det.(R^2) with yield		0.20	0.31	
Yield prediction model		Y = -0.2524 X + 95.599	Y = 2.4514 X + 41.03	

Table 1: Plant height, effective tillers and yield of different rice varieties at varying textured soils.

Tillering pattern

Tiller number/hill varied among all the treatment at all the crop growth stages (Figure 2). Tiller number/hill increased up to 50 DAT (days after transplanting), thereafter decreased gradually up to maturity (Lalitha et al., 2000). Heavy soil recorded higher number of tiller/hills at all the growth stages but was identical with medium textured soil. Variety PR 121 exhibited maximum tillers at all the stages whereas PR 129 and PR 128 was notably identical. Variety PAU 201 and light textured soil showed the lowest tiller number.

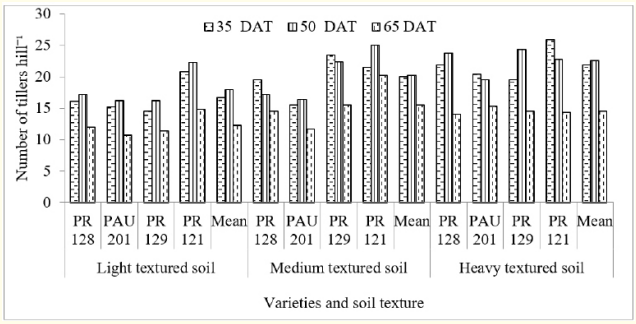

Figure 2: Tillering pattern of rice varieties under different soil textures.

Tiller mortality rate (%)

At the maximum to panicle initiation stage heavy soil showed higher tiller mortality (54.6%) followed my medium soils (48.7%) and light soils (46.9%) respectively (Figure 3). Among rice variety the tiller mortality rate was in the order: PR 121 (52.1%) > PR 129 (51.3%) > PR 128 (49.1%) > PAU 201 (47.7%). These results are supported by the findings of Wang *et al.*, 2007 who reported excessive tillering leads to high tiller abortion.

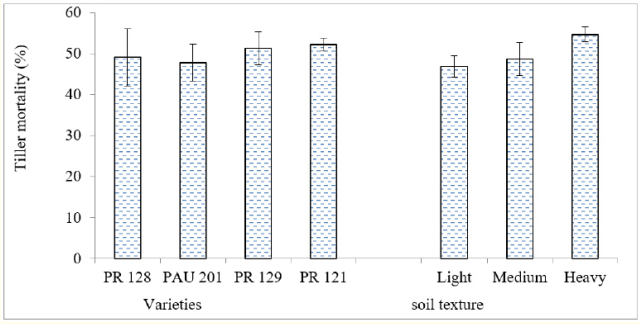

Figure 3: Tillering mortality of rice varieties under different soil textures.

Tillering rate

Tillering rate varied outstandingly among the treatments (Figure 4). Heavy soils showed higher tillering rate (0.47 per hill per day) whereas less tillering rate (0.36 per hill per day) was observed

in light soil. Variety PR 121 performed higher tillering rate (0.49 per hill per day) whereas PAU 201 has recorded minimum tillering rate (0.36 per hill per day). The tillering rate of variety PR 129 and PR 128 was identical.

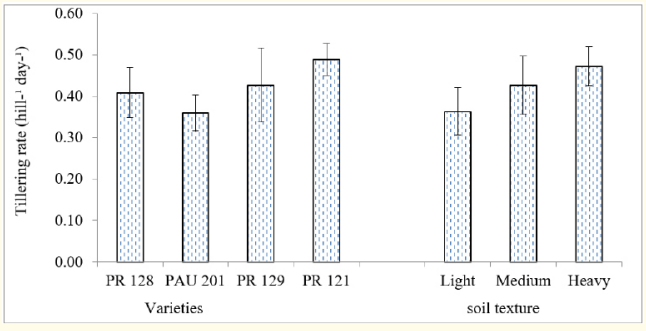

Figure 4: Tillering rate of rice varieties under different soil textures.

Relationship of maximum tiller number with apical number and bearing tiller rate

There was a significant co-relation between panicle number per hill and maximum tiller per hill but not between maximum tiller number and panicle bearing tiller rate (Figure 5). Huang *et al.* (2011) also reported the positive relationship between panicle numbers and maximum tillers but not with the rate of the panicle bearing tillers.

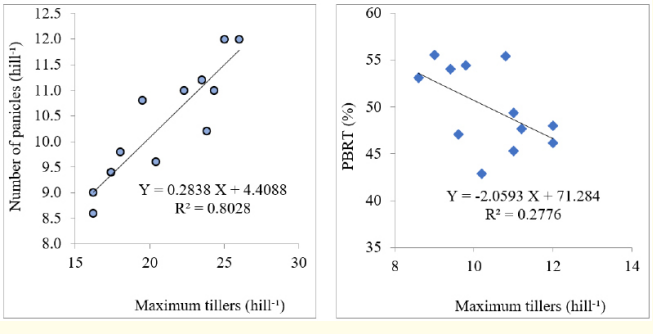

Figure 5: Relationship between maximum tiller numbers with panicles and panicle bearing tiller rate.

Grain yield

Grain yield of rice varieties varied sufficiently on varying soil textured sites (Table 1). Highest grain yield was recorded in medium soil (67.5q/ha) over heavy soil (66.4q/ha) and light soil (65.5q/ha). The yield superiority of variety PR121 over PR128, PAU201 and PR129 was 3.9, 7.7 and 15.0 per cent, respectively. Regarding varieties better translocation and partitioning of assimilates to grain may be the cause of higher yield.

Conclusion

Correlation coefficient between panicle number and maximum tillers was positive. Variety PR 121 exhibited highest effective tillers hence, the maximum grain yield. Increasing maximum tillers number may enhance the yield of new varieties i.e., PR 128 and PR 129 by exposing them to varying plant density. The grain yield may be effectively estimated using final plant height and effective tillers.

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