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Rice Planting Geometry Facilitating Relay Cropping at Zero Tillage

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ABSTRACT

Investigations into the planting geometry of rice facilitating relay cropping at zero tillage and its effects on yield components were carried out at the Agronomic Research Area, University of Agriculture, Faisalabad. The planting geometries comprised of 20 x 20 cm hills, 30 cm apart single rows (30 x 15 cm), 45 cm apart double row strips (15/45 cm), 60 cm apart triple row strips (15/60 cm) and 75 cm apart 4–row strips (15/75 cm), while the varieties included in the experiment were Basmati–385 and Basmati–370. The experiment was laid out in split plot design randomizing the varieties in the main and planting pattern in the sub–plots. Basmati–385 appeared to be early maturing and gave significantly higher paddy yield (35.73 q ha^{-1}) than Basmati–370 (28.98 q ha^{-1}). The highest paddy yield of 34.42 q/ ha^{-1} was recorded in plots planted in the pattern of 20 x 20 cm hills against the lowest of 30.66 q ha^{-1} in plots planted in the pattern of 75 cm apart four row strips. The results further led to the conclusion that rice should preferably be planted in 60 cm apart triple row strips as it not only facilitates relay cropping at zero tillage but also gives total yield/ha comparable to the conventional planting system in 20 x 20 cm/hills which does not permit easy planting of relay crops at zero tillage.

Key Words: *Oryza sativa*; Planting geometry; Relay cropping; Zero tillage, Yields

INTRODUCTION

In many rice growing regions, wheat, lentil, gram, sunflower follows the rice crops. Sowing of succeeding crops usually gets delayed due to non–availability of labour at the time of harvest and time consuming operations of land preparation for these crops. Late sowing of rabi crops not only affects germination but also results in poor growth and ultimately lowers yield. Thus there is a need to develop such a system of planting rice which may facilitate timely sowing of rabi crops in rice fields where rice–wheat, rice–lentil or rice–sunflower rotation is followed. Late sowing of rabi crops is one of the main constraints in harvesting good yields of the crops planted after rice.

One possibility to avoid late planting is to reduce time between rice harvest and planting of rabi crops. Reduction in time can be achieved by eliminating some time consuming and costly tillage practices. Relay cropping technology at zero tillage is one of such option. However, relay cropping is not possible under the present method of planting rice in 20 x 20 cm hills because of narrow row spacing on one hand and intensive binding up of the soil by root mass of closely growing rice plants on the other.

Dutta *et al*. (1994) found higher rice yield with *Eupatorium odoratum* than *Sesbania aculeata* manures (4.72 vs. 4.47 t/ha.) and higher with relay cropping with linseed than niger (5.11 vs. 3.59 t/ha.). Cheong *et al*. (1996) found highest grain yield of 552 kg/10 a by sowing 10 kg sprouted seed/10a just before barley harvesting compared with 515 jg/10a from the machine transplanted crop. Cho *et al.* (2003) reported that rice in the wheat–rice system generally had more panicles, fewer spikelets per panicle and heavier grains. They also reported higher yield ranging from 4.7 to 6.9 t/ha. In a no–tillage, direct sown, unfertilized, wheat–rice relay cropping system.

Keeping in view the need of the time, some new planting patterns for rice have been designed which not only facilitate planting succeeding crops at zero tillage without any hindrance but also leave the inter–strip space free of root mass and in easily workable condition. Another possibility lies in sowing a rice variety that completes its maturity cycle earlier and vacates the land for the sowing of succeeding crop. However, both these component i.e., planting pattern and variety of proposed technology need to be tested against conventional practices.

MATERIALS AND METHODS

Investigations into the planting geometry facilitating relay cropping at zero tillage were carried out at the Agronomic Research Area, University of Agriculture, Faisalabad. The rice varieties Basmati–370 and Basmati–385 were sown on July 13, 1999 and July 18, 2000 and harvested on October 28 and November 1, in both the years, respectively. A basal dose of 30 kg N + 60 kg P_20_5 ha^{-1} was applied at the time of pudding while the second dose of 30 kg N ha^{-1} was top dressed one month after transplanting. Irrigation water was applied as and when needed which amounted to about 13 irrigation each of 10–hectare centimeter. Both rice varieties Basmati–370 and Basmati–385 were sown according to five planting patterns viz., P1= 20 x 20 cm hills with one seedling/hill, P2 = 30 cm apart single rows, P3 = 45 cm apart double rows strips (15/45cm), P4 = 60 cm apart triple row strips (15/60 cm) and P5 = 75 cm apart four row strips (15/75 cm). The experiment was laid out in split plot design randomizing the varieties and planting patterns in the main and sub–plots, respectively. The net plot size measured 3.60 x 8 m. Observations on relevant parameters were recorded following standard procedures. The observations such as number of hills m^{-2}, total number of tillers $hill^{-1}$, panicle bearing tillers $hill^{-1}$, non–panicle bearing tillers $hill^{-1}$, leaf area $plant^{-1}$, number of grains $hill^{-1}$, grain weight $hill^{-1}$, dry matter % $hill^{-1}$, paddy yield ha^{-1} and straw yield ha^{-1} were recorded. The individual observations on panicle bearing tillers $hill^{-1}$, number of grains and weight of grains $hill^{-1}$ based on 12 hills were taken at random from each plot, while leaf area/ $hill^{-1}$ based on four hills only. The paddy yield was recorded on net plot basis and then calculated per hectare. The data collected were subjected to Fisher's analysis of variance technique and Duncan's New Multiple Range Test at 0.05 level of probability was used to compare the treatment means (Steel & Torrie, 1980).

RESULTS AND DISCUSSION

The data (Table I) pertaining to average number of hills m^{-2} revealed non–significant difference between both rice cultivars. Differences among different planting patterns were found to be significant in both the years. On the basis of two years average, the highest number of 23.87 hills m^{-2} was recorded in plots planted in 20 x 20–cm hills while rest of the planting patterns showed non–significant differences. Significantly higher number of hills m^{-2} in case of 20 x 20–cm hills was attributed to initial higher stand density of seedlings m^{-2} due to narrow spacing. Tsuchiya and Kinoshita (1984) reported almost similar results. The interaction between the varieties and planting patterns was found to be non–significant.

The data regarding number of tillers (Table I) revealed that Basmati–370 produced significantly more number of tillers (17 $hill^{-1}$) than basmati–385 (14.48 $hill^{-1}$). Plants planted in 30 cm apart single rows produced significantly higher number of tillers (16.92 $hill^{-1}$) than those planted in 20 x 20 cm hills (14.64 $hill^{-1}$) which reported by Agasimani *et al*. (1983) and Takahashi *et al.* (1986).

The final paddy yield is purely a function of the number of panicle bearing tillers $hill^{-1}$. The data (Table I) indicated that average number of panicle bearing tillers $hill^{-1}$ was significantly affected both by the planting patterns and the varieties under study. The two years average data revealed that Basmati–370 produced significantly higher number of panicle bearing tillers $hill^{-1}$ than Basmati–385, which amounted to 15.72 and 13.52 $hill^{-1}$, respectively. As regards planting patterns, the highest number of 15.97 panicle bearing tillers $hill^{-1}$ was recorded in case of 30 cm apart single rows which was at par with that of planted in the patterns of 60 cm apart triple row strips. The next best treatment appeared to be 45–cm apart double row strips, which recorded on an average of 14.45 panicle bearing tillers $hill^{-1}$ and was at par with 75 cm apart four row strips (13.77 tillers $hill^{-1}$). However, the lowest number of 13.61 tillers $hill^{-1}$ was recorded in case of 20 x 20 cm hills which was attributed to narrow inter row spacing as compared to rest of the planting patterns. These findings are strongly supported with those of Sing *et al*. (1986).

Table I. Effect of planting geometry of rice on number of hills $^{-1}m^2$, total number of tillers/hill and panicle bearing tillers/hill (Average of 1999 and 2000)

Treatments	Number of hills m^{-2}	Total number of tillers $hill^{-1}$	Panicle bearing tillers $hill^{-1}$
20 X20 cm hills	23.87 a	14.64 d	13.61 c
30 cm apart single rows	21.60 b	16.92 a	15.97 a
45 cm apart double rows strips	21.53 b	15.68 bc	14.45 b
60 cm apart triple row strips	21.62 b	16.33 ab	15.33 a
75 cm apart 4 rows strips	21.58 b	15.14 cd	13.77 bc
Varieties			
Basmati 370	22.00	17.00 a	15.72 a
Basmati 385	22.08	14.48 b	13.52 b

Means sharing similar letters are non–significantly different by DMR Test at P = 0.05

Two years data (Table II) showed that Basmati–385 produced significantly more number of grains per hill (1542.14) than Basmati–370, which was due to comparatively higher sink capacity of Basmati–385 because of being semi–dwarf in nature. Regarding planting geometry, hills of 30–cm apart single rows planting system recorded significantly the highest number of 1591.60 grains $hill^{-1}$ following by the hills of 60 cm apart triple row strips planting system (1497.71) as against the minimum of 1392.28 grains $hill^{-1}$ in case of 75 cm apart four row strips which again was attributed to poor growth and development of the plants growing in the central two rows of the strips due to mutual shading effect.

The data regarding weight of grains $hill^{-1}$ (Table II) revealed that Basmati–385 produced significantly higher grain weight $hill^{-1}$ (16.15 g) than Basmati–370 which recorded 13.07 g $hill^{-1}$. This was also attributed to comparatively less Sink capacity of Basmati–370 than that of Basmati–385. The data further indicated that among the planting pattern, significantly the highest grain weight $hill^{-1}$ (14.96 g) was recorded in case of hill of 30–cm apart single rows followed by hills of 60–cm apart triple row strips (14.80 g) as against the minimum of 14.24 gm $hill^{-1}$ for 75 cm apart four row strips and 14.37 g $hill^{-1}$ for 20 x 20 cm hill planting system. It was interesting to point out that 45 and 60 cm apart double and triple row strips recorded significantly more grain weight per hill than that of the conventional one of 20 x 20–cm hills probably because of relatively more nutritional area/hill and better growth

Table II. Effect of planting geometry of rice on number of grains/hill, grain weight/hill and paddy yield ha^{-1} (Average of 1999–2000)

Treatments	**Grains hill^{-1}**	**Grain Weight ha^{-1}**	**Paddy yield q ha^{-1}**
20 X20 cm hills	1429.75 cd	14.37 d	34.42 a
30 cm apart single rows	1591.60 a	14.96 a	32.72 b
45 cm apart double rows strips	1456.15 c	14.62 c	31.36 c
60 cm apart triple row strips	1497.71 b	14.80 b	32.32 bc
75 cm apart 4 rows strips	1392.28 d	14.24 e	30.66 d
Varieties			
Basmati 370	1404.86 b	13.03 b	29.98 b
Basmati 385	1542.14 a	16.15 a	35.73 a

Means sharing similar letters are non–significantly different by DMR Test at P = 0.05

factors. Similar results were reported by Sobral and Oliveira (1984) and Sing *et al.* (1986).

The data regarding paddy yield ha^{-1} (Table II) revealed that Basmati–385 produced significantly higher paddy yield ha^{-1} than Basmati–370 which amounted to 35.73 and 28.98 q ha^{-1}, respectively, clearly showing the superiority of Basmati–385 to Basmati–370. The higher paddy yield of Basmati–385 was attributed to considerably more number of grains and grain weight/hill than that of Basmati–370, which possesses low sink capacity. Considering the planting patterns, two years average data, it was observed that the lowest paddy yield/ha (30.66 q ha^{-1}), was recorded in case of 4–row strip planting system as against the maximum (34.42 q ha^{-1}) for 20 x 20 cm hill planting system, while the differences between the double and triple and that of 30 cm apart single row and 60 cm apart triple row planting system was non–significant. Higher paddy yield/ha in case of 20 x 20–cm hill planting system was attributed to initially more number of hills/m^2 compared to rest of the planting patters. The results reported by Mian and Towheed (1987), Patel *et al*. (1983), Anonymous (1984), Amir *et al*. (1984) and Deka *et al*. (1984). Nagamine *et al*. (1984), Trikha (1984), Furdzher and Tashkov (1985), Jain *et al*. (1985), Sharma *et al.* (1986), Sing *et al*. (1986), Dutta *et al.* (1994), Cheong *et al*. (1996) and Cho *et al*. (2003) are in agreement with the above findings.

The results led to the conclusion that planting rice in 20 x 20–cm hills although gave higher paddy yield ha^{-1} than spaced planting patterns yet it did not allow convenient relay cropping at zero tillage. It is further suggested that research on these lines should be continued keeping the plant population constant in all the treatments, which of course will help eliminating the yield difference to a great extent.

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