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GROWTH, YIELD AND RIPENING OF BASMATI-370 AS INFLUENCED BY DIFFERENT HILL SPACINGS AND PER HILL SEEDLING DENSITIES

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A field experiment, to evaluate the effects of 1, 2 and 3 seedlings transplanted at 20x20, 25x25 and 30x30 cm spacing on the growth, yield and ripening quality of Basmati-370, was conducted in randomized complete block design with 4 replications and net plot of 3x3 m. Narrower spacing increased the paddy yield, abortive kernels, opaque kernels and sterility per centage. While more seedlings per hill increased the opaque kernels, sterility percentage and panicle bearing tillers per hill. Hill spacing of 20x20 cm and three seedlings per hill produced the maximum paddy yield of 3.90 and 3.83 t ha^{-1}, respectively.

Key words: *Oryza sativa* L., Hill spacings; Seedlings per hill.

Introduction

Rice (*Oryza sativa* L.) is the principal food crop of nearly half of the population of the world. In Pakistan it is also a major source of foreign exchange earning. Hill spacing is considered to be one of the major economic factors which greatly influences the yield of rice. If the spacing decreases beyond optimum level, the yield gets decreased due to adverse effects of mutual shading of leaves and greater competition among the plants for nutrients and water on yield components and ripening of rice. With the wider spacing, on the other hand the plant population decreases resulting in lower yield. So an optimum plant spacing is prime essential for obtaining desirable yield [2-6,9,14).

Optimum number of seedlings per hill, alongwith proper spacing, also plays an important role in increasing the paddy yield through increasing number of fertile tillers per hill and number of panicles per unit area. There are controversial views about the number of seedlings to be transplanted per hill. Three seedlings per hill helped to increase sterility percentage and opaque kernels, whereas, one seedling per hill increased abortive kernels, normal kernels and 1000-grain weight [7]. Rice transplanted at 22.5x22.5 cm spacings with two seedlings per hill yielded 7.9 t ha^{-1} due to increased number of productive tillers per hills as compared to one seedling per hill which yielded 7.41t ha^{-1} due to less number of productive tillers [12]. Pillai *et al.* [11] recorded the highest paddy yield at a spacing of 15 x 10 cm with 2-3 seedlings per hill. Katanyukul *et al.* [8] obtained the highest grain yield of 5 t ha^{-1} by transplanting 3 seedlings per hill at 25 x 25 cm spacings.

The present study was, therefore, undertaken to find out the optimum number of seedlings per hill to be transplanted at the most appropriate plant spacing to obtain the maximum yield of good quality Basmati-370, a fine cultivar of rice.

Materials and Methods

An experiment, to investigate the effects of 1, 2 and 3 seedlings transplanted at 20x20, 25x25 and 30x30 cm hill spacings on the growth, yield and ripening quality of fine rice Basmati-370, was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad. The experiment was laid out in randomized complete block (factorial) design with 4 replications and net plot measured 3x3 m. The hill number was 2,50,000, 1,60,000, 1,11,111 per hectare for 20x20, 25x25 and 30x30 cm hill spacings, respectively. Phosphorus at the rate of 25 kg P_2O_5 ha^{-1} was applied at the time of puddling. Nitrogen at the rate of 50 kg ha^{-1} was applied in 2 splits half at the time of puddling and half 50 days after transplanting. All other agronomic operations were kept normal and uniform. Ten hills were selected randomly from every experimental unit to count the panicle bearing tillers per hill. For recording 1000-kernels weight, percentage of sterile (unfertilized flower), abortive (the flower that gets fertilized but does not attain full size as it stops growing during early stage of kernel development), opaque (kernel that attain full size but do not become translucent due to lack of carbohydrates), and normal (kernal that attain full size, turn transplucent and show normal starch compaction) kernels, 10 panicles were selected at random from every plot and standard methods given by Nagato and Chaudhry [10] were employed. Data collected were analysed statistically by using Fisher's analysis of variance technique and Duncan's multiple range test at 5% probability was used to test the significance of treatment means as outlined by Steel and Torrie [15].

Results and Discussions

Effect on panicle bearing tillers. The data presented in the table indicated that the panicle bearing tillers per hill were significantly affected by the hill spacings. Maximum panicle

bearing tilers per hill were produced by 30x30 cm hill spacing followed by 25x25 and 20x20 cm. Significantly more panicle bearing tillers recorded with the increased hill spacings can be attributed to more availability of nutrients, air and solar radiation under wider spacing. These results are quite in line with those obtained by Mian and Ghaffar [9], Chaudhry and Suleman [4] and Chaudhary [12]. On the other hand panicle bearing tillers per hill were not affected significantly by the number of seedlings per hill. Three seedlings per hill produced the maximum panicle bearing tillers. While one seedling per hill produced the minimum panicle bearing tillers. These results are in accordance with those of Shafi and Ahmad [13]. Non-significant differences in panicle bearing tillers per hill due to varied seedling number per hill might be due to comparatively more tillering at less seedling number per hill because of better growth environments.

Effect on number of kernels per panicle. The hill spacings affected the number of kernels per panicle significantly. Hill spacing of 30x30 cm, did not differ significantly from 25x25 cm, but produced significantly more kernels per panicle than 20x20 cm which in turn was statistically at par with 25x25 cm. The more kernels per panicle recorded in wider hill spacing might be due to better nutrition and better penetration of light and air in the crop canopy resulting in more photosynthetic efficienty. These results are supported by those of Mian and Ghaffar [9], Hwu and Theseng [6] and Chaudhary [12]. Number of seedlings per hill did not influence significantly the number of kernels per panicle.

Effect on sterility. The data also indicated that sterility percentage was affected significantly by the hill spacings as well as the number of seedlings per hill. The hill spacing of 20x20 cm lead to the maximum sterile kernels. The difference between hill spacings of 25x25 cm and 30x30 cm was non-significant. The decrease in sterility percentage by increased hill spacing could be due to better conditions for reproductive growth because of less mutual over shading of leaves, better aeratin and good supply of assimilates. These findings are in conformity with those of Suleman [14], and Chaudhary and Suleman [4]. As regards per hill seedlings, three seedlings per hill produced significantly more sterile kernels than 2 and 1 seedling per hill. The more sterility percentage caused by the more seedling number per hill could be attributed to more reproductive primordia per hill due to more panicle bearing tillers per hill, which would have had a severe competition for assimilates. These results are in accordance with those of Jamal [7].

Effect on abortive and opaque kernels. Hill spacing of 20x20 cm was statistically similar to 25x25 cm and produced significantly more abortive and opaque kernels than 30x30 cm spacing. This can be attributed to more hills per unit area resulting in sever competition for light, air and nutrition amongst the hills. These results are lent strong support by those of Suleman [14]. Two and three seedlings per hill, did not differ significantly from each other, but produced significantly less abortive kernels than one seedling per hill. More abortive kernels in case of one seedling per hill had been due to the fact that 1 seedling per hill gave less sterility resulting in hard competition among the more kernels for carbohydrates. Whereas, 3 seedlings per hill produced significantly higher percentage of opaque kernels than 1 seedling per hill, but did not differ significantly from 2 seedlings per hill. More opaque kernels with the more seedling number per hill might be due to greater competition for photosynthates because of more kernels per panicle and more panicle bearing tillers per hill. Jamal [7] also reported similar results.

Effect on number of kernels. It is revealed from the data that normal kernels were affected significantly by the hill spacing. There had been a consistent increase in normal kernels with the increase in hill spacing. The increased number of kernels obtained under wider spacings was due to the development of less opaque, abortive and sterile kernels as a result of better nutrition and light use efficiency. Hwu and

TABLE 1. EFFECT OF DIFFERENT PLANT SPACINGS AND PER HILL SEEDLING DENSITIES ON YIELD AND RIPENING QUALITY OF BASMATI – 370.

Hill spacing (cm)	Panicle bearing tillers hill^{-1}	Number of kernels panicle^{-1}	Sterility (%)	Abortive kernels (%)	Opaque kernels (%)	Normal kernels (%)	1000-kernels weight (g)	Paddy yield (t.ha^{-1})
20 x 20	12.8c	122.3 b*	10.1 a*	2.4 a*	7.6 a*	79.9 c*	15.4 b*	3.9 a*
25 x 25	16.9 b	129.0 ab	9.4 b	2.2 a	7.5 a	80.9 b	15.9 ab	3.6 ab
30 x 30	17.5 a	139.4 a	8.9 b	1.6 b	6.9 b	82.6 a	16.3 a	3.1 b
Per hill seedlings:								
1	14.8^{NS}	125.9^{NS}	8.5 c*	2.5 a*	7.0 b*	82.0 a*	16.2^{NS}	3.2 b*
2	15.5	128.1	9.6 b	2.0 b	7.4 a	81.0 b	15.8	3.6 ab
3	15.9	136.6	10.2 a	1.8 b	7.5 a	80.4 b	15.6	3.8 a

* = Means not sharing a letter in common differ significantly at 5% level.; NS= Non-significant.

Theseng [6] also obtained similar results. One seedling per hill produced significantly higher percentage of normal kernels than 2 and 3 seedlings per hill. The decrease in normal kernels obtained by increasing number of seedlings per hill could be attributed to more number of panicle bearing tillers per hill as well as more kernels per panicle which might have caused severe competition for carbohydrates. These findings were supported by those of Jamal [7].

Effect on 1000-kernel weight. The hill spacings influenced the kernel weight significantly. Hill spacing of 30x30 cm, not differing significantly from 25x25 cm, produced significantly heavier kernels than 20x20 cm. Hill spacings of 25x25 and 20x20 cm did not differ significantly from each other. The reason for heavier kernels due to increase in hill spacings might be due to well developed and bold kernels as a result of less competition. Hayat [5], Chaudhary [12] and Bari *et al.* [2] had substantiated similar results. Per hill seedling number did not affect significantly the 1000-kernel weight. However, the kernel weight was decreased consistently with the subsequent increase in seedling number per hill. Similar results were obtained by Jamal [7].

Effect on paddy yield. The data in the Table 1 revealed that the paddy yield was affected significantly by hill spacing and per hill seedling number. Hill spacing of 20x20 cm, not differing significantly from 25x25 cm, yielded significantly higher paddy (3.9 t. ha^{-1}) than 30x30 cm (3.1 t. ha^{-1}). The paddy yield was decreased as the spacing was increased. The wider hill spacing had beneficial effects on yield components like panicle bearing tillers per hill, number of kernels per panicle and kernel weight. But more hills per hectare, in case of narrowed spacing, overcame all the beneficial effects of wider spacing on yield components. These results are supported by those of Bhosal *et al.* [3], Amir *et al.* [1] and Bari *et al.* [2]. In case of per hill seedling number, 3 seedlings per hill, not differing significantly from 2 seedlings per hill, produced significantly higher yield (3.8 $t.ha^{-1}$) than 1 seedling per hill (3.2 $t.ha^{-1}$). One and 2 seedlings also did not differ significantly from each other. The more paddy yield, obtained for increased number of seedlings per hill, had been due to more panicle bearing tillers per hill and more kernels per panicle. These results are in conformity with those of Pillai *et al.* [11] and ;Katanyukul *et al.* [8] who also obtained higher paddy yield by transplanting three seedlings per hill as compared to transplanting 1 or 2 seedlings per hill.

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