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Effects of Seeding Rate on the Yield Components of an Enhanced Rice Cultivar (DTPMFe+) *Oryza sativa* Linn.

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Abstract: This study was conducted to investigate the comparative effects of seeding rates of two plants per hill and one plant, per hill on the yield components of DTPMFE+, an enhanced rice cultivar. The design of the field experiment was Randomized Complete Block with replications on a fenced plot of 18.00×4.00 m. A potted experiment was carried out in ten four litre buckets. At maturity panicle characteristics and number of tillers of plants randomly selected were measured. In the field population, there was no significant difference in total number of spikelets, number and length of primary branches, number and length of secondary branches, panicle length, panicle density and number of tillers. Significant differences were observed in grain length and grain width one plant per hill had higher values than two plants per hill. In the potted population, there was significant difference in total number of spikelets, length of primary branches, number and length of secondary branches, number and length of primary branches and panicle length; one plant per hill still showed higher values. Two plants per hill could not influence the yield components for better yield.

Key words: Enhanced rice, seeding rate, yield components

INTRODUCTION

Oryza sativa (Asian Rice) is a common cereal species and is a staple food for about half of the human race. A number of workers have reported that the maintenance of a critical level of rice plant population in the field was necessary to maximize grain yield. There have been extensive studies on the relationships between yield and plant density under non-stressed conditions. The relationships varied with different planting systems. In transplanted cultural systems, maximum yield can be reached at a plant density of about 200 plants m^{-2} (Akita, 1982). Rice seeding rates from 57 to 500 m^{-2} seeds resulting in a rice density range of 73 to 373 plants m^{-2} does not effect rice above ground biomass production, panicle density, harvest index or yield (Ottis and Talbert, 2005a).

A compensatory relationship between yield component and plant density has been observed. It was shown that panicle density significantly increased with increase in seeding densities, while filled spikelets per panicle were reduced significantly (Counce, 1987; Jones and Synder, 1987a and b; Gravois and Helms, 1992). Tillers per plant and spikelets per panicle increased with decrease of plant densities in direct seeded rice (Wu *et al*., 1998). Zeng and Shannon (2000) and Ottis and Talbert (2005b) reported no significant increase on panicle density, kernel weight and shoot weight per plant at seeding densities tested; plant stand and plant density were significantly increased, while seed weight per plant, fertility and harvest index were significantly decreased with increase of seeding densities.

Esechie *et al*. (2002) identified enhanced tillering on wheat by increasing plant density resulting in taller plants which make them prone to lodging. In transplanted rice within spacing hills of 25×25 cm one plant per hill have been found to have highest yield compared to 3, 6 and 9 plants per hill (Prasan, 1993). DTPMFE+ is an early maturing, dense panicle and heavy tillering dwarf developed from local germplasm. It can bear as many as twenty tillers. This study was undertaken to determine the effects seeding rate of two plants per hill on the yield components of the cultivar compared to one plant per hill.

MATERIALS AND METHODS

This experiment was conducted at the Department of Botany Obafemi Awolowo University, Ile-Ife in 2002. The design of the experiment was Randomized Complete Block with replications. Three week old rice seedlings of DTPMFE+ were transplanted into a fenced plot of land 18×4 m divided into four equal blocks near the Reforestation Project Nursery site. The seedlings had an equal spacing of 30×30 cm within and between rows. The seedlings were grown at density rates of one plant per hill and two plants per hill. Plants in the two plants per

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hill category were marked by strong pieces of wood for easy identification. A control experiment was carried out in the screen house by planting the rice seedlings into 4 L plastic buckets. Five of the buckets were seeded one plant per hill the other five at two plants per hill. Standard cultural practices were carried out till the crop was matured.

At maturity, five primary panicles were selected randomly from plants in each seeding rate category in each block and in the potted plants. The panicles selected were bagged and numbered according to blocks and seeding rate. The following panicle parameters were assessed for the plant selected: total number of spikelets, total number of primary branches, total number of secondary branches, total length of primary branches and secondary branches, panicle length, grain length/breadth, panicle density. This is defined as total number of spikelets/panicle length according to Futsuhara *et al.* (1979). Total number of tillers per plant was also taken into consideration for plants selected. The data was analyzed using ANOVA and Duncan's Multiple Range Test.

RESULTS

Field population: One plant per hill had a mean spikelet number of (210.50±18.18) on about 13 primary branches totaling 138 cm and about 42 secondary branches totaling 122.00 cm on a panicle with, mean length 26.69±0.78 cm and a panicle density of 7.91±0.05 (Table 1). Two plants per hill had a mean spikelets number of 229.70±21.96 on about 13 primary branches totaling 133.00 cm and about 44 secondary branches totaling 123 cm on a panicle with mean length of 26.71±1.02 cm and a panicle density of 8.16±0.64. One plant per hill produced mean tiller number of 4.25±0.74; two plants per hill produced mean tiller number of 5.00±0.96.

Potted population: One plant per hill had a mean spikelet number of 217.20±8.91 on about 12 primary branches totaling 119 cm on a panicle with mean length of 28.00±0.79 (Table 2). It has a panicle density of 7.74±0.33. Two plants per hill had lower values for these panicle parameters. It had a panicle length of about 11 primary branches, totaling 115 cm and about 29 secondary branches, totaling 82 cm. It had a panicle density of 5.40±0.25. Two plants per hill produced mean tiller number of 6.00.

Statistical analysis of number of tillers and panicle parameters: Statistical analysis showed that there was no significant difference in number of tillers between one plant per hill and two plants per hill in both field and potted populations. In the field population, there was no significant difference between one plant per hill and two plants per hill in most of the parameters that contributes to panicle yield. These parameters are number of spikelets, number of primary branches, number and length of secondary branches, panicle length and panicle density. However there was significant difference in grain length and grain width in the field population. One plant per hill had a higher mean (8.75 mm) for grain length and 2.37 mm for grain width. Two plants per hill showed a lower mean

Table 1: Effect of seeding rate on the yield components compared in the field population

Parameters	1 plant per hill	2 plants per hill	ANOVA
Mean No. of spikelets	215.50±13.18a	229.70±13.18a	ns
Mean No. of primary branches	13.25±0.43a	12.80±0.63a	ns
Mean No. of secondary branches	41.65±3.36a	43.35±4.91a	ns
Mean length of primary branches (cm)	138.06±5.25a	133.17±8.76a	ns
Mean length of secondary branches (cm)	121.75±14.00a	123.39±15.29a	ns
Mean panicle length (cm)	26.69±2.20a	26.71±1.02a	ns
Mean panicle density	7.91±0.50a	8.16±0.64a	ns
Mean grain length (mm)	8.75±0.13a	8.55±0.24b	s
Mean grain width (mm)	2.37±0.05a	2.31±0.06b	s
Mean No. of tillers	4.25±0.74a	5.00±0.960a	ns

Means with the same letter(s) are not significantly different from each other at 5%, ns = Not significant at 5%, s = Significant at 5%

Table 2: Effect of seeding rate on the yield components compared in the potted population

Parameters	1 plant per hill	2 plants per hill	ANOVA
Mean No. of spikelets	217.20±8.91a	162.80±14.99b	s
Mean No. of primary branches	11.70±0.69a	11.00±0.32a	s
Mean No. of secondary branches	41.60±2.98a	28.60±1.61b	s
Mean length of primary branches (cm)	143.30±12.61a	114.60±2.94b	s
Mean length of secondary branches (cm)	119.24±12.61a	81.05±5.73b	s
Mean panicle length (cm)	28.00±0.79a	24.74±0.57b	s
Mean panicle density	7.74±0.33a	6.59±0.63a	ns
Mean grain length (mm)	8.75±0.11a	8.89±0.05a	ns
Mean grain width (mm)	2.29±0.02b	2.49±0.05a	s
Mean No. of tillers	5.40±0.25a	6.00±0.00a	ns

Means with the same letter(s) are not significantly different from each other at 5%, ns = Not significant at 5%, s = Significant at 5%

of 8.65 mm for grain length and 2.31 mm for grain width. In the potted population, one plant per hill had higher values for most of the parameters contributing to panicle yield. These was significant difference in number of spikelets, length of primary branches, number and length of secondary branches, panicle length and grain width.

DISCUSSION

The results of this study suggested that the seeding rate of two plants per hill reduced the yield components, while one plant per hill did not reduce the yield component of DTPMFe+. This result is consistent with the study of Prasan (1993), Esechie *et al.* (2002) and Zeng and Shannon (2000), in which they reported reduction in rice yield components due to increasing plant density. Moraday and Fathi (2000) reported that increase in plant density does not affect yield components in rice. The seeding rate affected tiller population in DTPMFE+. Two plants per hill had higher means than one plant per hill in both field and potted populations, but the inability of two plants per hill to produce significantly higher number of tillers showed that there is no difference in the yield of one plant per hill and two plants per hill in terms of tiller production.

Each panicle parameter contributes to the yield of the rice plant. Spikelet number remains the ultimate measure of individual plant yield (Faluyi *et al.*, 1998; Zeng and Shannon, 2000). In the field population, the insignificant difference in most panicle parameters that contribute to panicle yield (number of spikelets, number and length of primary branches, number and length of secondary branches, panicle length and panicle density) showed that seeding rate did not affect these yield components but affected grain length and breadth one plant per hill having higher values. This made it had a better grain shape than two plants per hill. This is consistent with the result of Zeng and Shannon (2000) and Steppuhn (1997) in which they reported lack of increase in grain yield with increase of seeding density.

In the potted population, the significant difference in total number of spikelets, length of primary branches, number and length of secondary branches and panicle length showed that seeding rate of two plants per hill led to the reduction of these yield components. This might have been as a result of the localized environment in the pot, which engendered interaction effects and competition for nutrients in the two plants per hill which could be responsible for superiority of one plant per hill. Evans and De Datta (1979), Counce and Wells (1991) and Baloch *et al.* (2002) reported that with increased plant density, competition among plants and environmental factors such as light and nutrient leads to reduction of yield components.

The very low number and length of secondary branches in two plants per hill in the potted population was responsible for its low number of spikelets (162.60) when compared with higher number of spikelets (217.20) observed in one plant per hill. The seeding rate of one plant per hill has been found to be more effective because of it better grain shape in field population, its superiority in many panicle characteristics in potted population and the inability of two plants per hill to produce significantly higher number of tillers.

CONCLUSION

It is therefore concluded that the seeding rate of two plants per hill relative to the yield components studied can not increase the yield of DTPMFe+, because of the significant reduction in number of spikelets, grain length and breadth. So in order to increase the yield of this cultivar it is necessary to develop other management options. The application of fertilizer at the period of tiller initiation could be helpful to achieve better tiller production in two plants per hill and this could go a long way to achieving better yield.

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