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EFFECT OF SEED BED SEED RATE ON THE QUALITY OF THE SEEDLINGS AND THE GRAIN YIELD OF THREE RICE HYBRIDS

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ABSTRACT

Hybrid rice cultivation is new to Sri Lanka and information available on agronomic management of hybrid rice is scares. In this study, effect of four seed bed seed rate (20, 30 40 and 50 g m^2) on the quality of seedlings (tiller number) and their subsequent effect after transplanting in the field on the grain yield of three experimental hybrids, BgHR1, BgHR6 and BgHR12 developed at RRDI, Batalagoda were studied. Tiller number of the seedlings in the nursery highly influenced by the seeding density in all varieties tested and there was a negative trend between seeding density and tiller number per seedling at transplanting. Majority of the seedlings produced under the 40 and 50 g m^{-2} density had no tillers, while the highest percentage of the seedlings produced under 30 g m^{-2}had one tiller. Majority of the seedlings at 20 g m^{-2}density had two tillers. There was a significant effect of tiller number per seedling at transplanting on panicle number per unit area and the yield of all tested varieties. The highest panicle number per unit area and the highest grain yield was observed from 20 g m^{-2} (transplanting of two tiller seedlings) density. These results indicate that the transplanting of seedlings raised with 20 g m^{-2}nursery density is suitable for the tested hybrids for higher grain yield.

KEYWORDS: Rice hybrids, Seed bed seed rate, Seedling quality.

INTRODUCTION

Hybrid rice is the commercial rice crop grown from F1 seeds of a cross between two genetically dissimilar parents. They have an ability to produce more than 20 percent yield increase over the best inbred rice varieties grown in similar environment and use of hybrid is one of the options to increase the productivity. The excellent inherent characteristics of hybrid rice are at the base of its yield potential. However, its heterosis can be fully realized only by adopting appropriate cultural techniques in accordance with these characteristics and the response of hybrid rice to its growing environment (Long-Ping Yuan and Xi-Qin Fu 1995). Yan (1988) observed that agronomic management of hybrid rice differed considerably from that of inbred rice varieties. Therefore, to exploit this advantage, it is necessary to adopt appropriate crop management practices. Most studies on optimizing hybrid rice management were conducted with temperate rice hybrid in China and those strategies are not applicable and cannot be adopted directly for tropical

hybrids (Peng *et. al.*,1998). A very few studies have been carried out on agronomic aspects out side the China (Peng *et al.*, 1988, Rao *et al.*, 1999, Sanbagavali *et al.*, 1999, Javier and Dupitas 2001, Jayawardena and Abeysekera 2002) and therefore, knowledge is limited on management strategies to maximize the yield of tropical hybrids. Therefore, the objective of the study was to identify the suitable seed bed seed rate for rice hybrids developed locally.

Tiller number per seedling is one of the most important characters in high quality seedlings (Long-Ping Yuan and Xi-Qin Fu, 1995). Use of high quality seedlings with many tillers is important in hybrid rice than inbred rice to reduce the seed requirement and also to increase the grain yield. Hybrid rice has an ability to produce more tillers than that of inbred rice. Initial tillering in the nursery seedlings is highly influenced by nursery seed rate. Presently Rice Research Development Institute (RRDI), Sri Lanka has developed three experimental hybrids and these will be released for commercial cultivation in near future. However, information on seedbed seed rates on the quality of seedlings and grain yield is not available for those rice hybrids.

MATERIALS AND METHODS

Two experiments were conducted at Rice Research and Development Institute, Batalagoda (RRDI) in the IL1 region during 2002/03 Maha season. The soils classified as Plinthaqulls sandy clay loam texture with a pH of 6.4, 1.78% organic matter, 1.09% of total nitrogen, 11.12 mg kg^{-1} Olsen P and 0.068 cmol (+) kg^{-1} exchangeable K and 12.1 cmol(+) kg^{-1} CEC.

Experiment 1: Effect of seedbed seed rate on the quality of seedling

This experiment was conducted to investigate the effect of four seedbed seed rates (20, 30, 40 and 50 g m^{-2}) on the quality of seedlings of three rice hybrids (BgHR1, BgHr6 and BgHR12) developed at Batalagoda. Seeding density 10 g m^{-2} was not tested, as it is the seed rate for direct sowing. The seed rate below 20 g m^{-2} was not tested because 10 g m^{-2} was the recommended seed rate for inbred rice. The nursery area was ploughed twice and leveled adequately. At the sowing 1.5 x 2.0 x 0.10m plots were prepared by separating 30cm ditch to provide irrigation and drainage facilities. Pre-germinated seeds of above three varieties were sown evenly on the seedbeds. After the sowing the plots covered with the woven cajan leaves to prevent from the mixing of seeds of different varieties and seeding treatments from the heavy rains as the cropping season was Maha season. A split plot design was used with three replications. Variety was assigned to main plot treatment and seed rate was in sub plots. Water level was maintained between 0.5 and 1 cm throughout the nursery period to enhance the tillering. Insects were controlled

using recommended insecticides. The nursery received fertilizer at the rate of 75 kg P_2O_5, 40 kg K_2O and 15 kg N ha^{-1} as a basal and another 25 kg N ha^{-1} as a top dressing at 10 days after seeding. Twenty days after seeding seedlings were carefully uprooted. Seedlings were grouped according to the tiller number (0, 1, 2 and 3 tillers per seedling).

Experiment 2: Effect of the quality of seedlings on the grain yield

The effect of the seedlings raised under different seed rates of same three rice hybrids used in the previous experiment on the grain yield was investigated in this experiment. The field was ploughed twice, harrowed and puddled and leveled to obtain lowland rice growing conditions. 21-day-old seedlings uprooted and grouped according to the tiller number (0,1,2 and 3 tillers/seedling) and used as treatments in this experiment. The majority of the seedling group produced under each seeding density was used as a treatment. Selected seedlings based on the tiller number were transplanted at 20x20cm spacing with single seedling per hill. Treatments were arranged in a split plot design with four replications. The plot size was 6mx3m. Varieties were assigned to main plot treatment and seed rates were in sub plots. The sub plots were separated by 30cm border. The plot size was 6x3m. The plots were weeded at 2 and 6 weeks after transplanting (WAT) using a single-row-Japanese rotary weeder. All plots received fertilizer at the rate of 75 kg P_2O_5, 40 kg K_2O and 150 kg N ha^{-1} Nitrogen fertilizer was split-applied at 0, 2, 5, 7 WAT and at heading at the rate of 5%, 25%, 30%, 30% and 10 % respectively. The plots were irrigated frequently to maintain 2-3 cm of water depth throughout the growing period. Grain yield was determined from a sample area of 12.5 m^2 per plot. Yield components were determined from 10-hills selected at random per plot. Grain yield was recorded at 14% moisture level

RESULTS AND DISCUSSION

Effect of seedbed seed rate on seedling quality

Tillers are branches that develop from the leaf axils at each un-elongated node of the main shoot or from other tillers during vegetative growth. However, all the tiller buds do not develop in to tillers. Some may remain dormant. Spacing, light, nutrient supply and other cultural conditions affect tillering ability in rice (Yoshida, 1981). The effects of nursery bed seeding density on the tillering performances are given in figure 1, 2.and 3. Tiller number per seedling in the nursery bed affected only by the seeding density and not by the variety. Regardless to treatments, tiller number per seedling was range from 0-3. However, the percentage of seedlings with 3 tillers was very small and hence it was not taken as a treatment. There was a negative trend between seeding density and tiller number per seedling. In all

varieties, the highest percentage of seedlings produced under the 40 and 50 gm^{-2} had no tillers (non-tillered seedlings). The percentage of non-tillered seedlings was ranged from 91-91% and 83-93% for 50 and 40 g^{-2} density, respectively. At 30 g m^{-2} density the majority of seedlings had 1 or 2 tillers. The percentage of seedlings with 1 and 2 tillers was range from 48-52% and 18-20% respectively. Seedlings produced with 20 g m^{-2} density had 1 or 2 tillers where the majority of the seedlings were with 2 tillers. The percentage of seedlings with 1 and 2 tillers was ranged from 48-59% and 22-33%, respectively. Based on the above results the number of tillers per seedlings at 50, 40, 30 and 20 g m^{-2} seeding density was considered as 0, 0, 1 and 2, respectively and used as treatments in the experiment 2. These results clearly indicates that the seeding density 50 g m^{-2} which is recommended seed rate for inbred rice varieties and 40g m^{-2} is not suitable to obtain multi tillered seedlings in hybrid rice. Low inter-plant competition among the seedlings at 20 and 30 g m^{-2} densities could be the reason for producing multi-tillered seedling at low seeding densities. Therefore, It is required to adopt low seeding density in the nursery in order to obtain multi-tillered seedlings. Among the tested seeding densities 20 g m^{-2} found to be the best to obtain multi-tillered seedlings in regardless of varieties. Shenet *et al.*, (2001) reported that 15 g m^{-2} of seeding density in the seedbed had significant effects on seeding quality of cytoplasmic male sterile lines in hybrid rice seed production as reflected by increases in tiller number, dry weight of seedlings. In India adopt 10 –15 g m^{-2} seed bed seed rates for their hybrids (DDR Bulletin 2001). China, the recommended amount of hybrid seeds is 15-25 kg ha^{-1} compared with 100-180 kg ha^{-1} for inbreds. However, in the seedbed hybrid rice seedlings receive three to four time spacing than that of conventional rice. Low seeding density favors tillering in the nursery to make it possible to transplant a single hybrid rice seedling per hill with three to four tillers compared with three to four inbred seedlings per hill with no tillers.

Experiment 2

The interaction effects of variety and nursery seed rate (tiller number/seedling) for panicle grain yield, panicle number, filled grains and harvest index were not significant. This indicates that the response of all varieties to varying nursery seeding density is similar. Among the varieties BgHR12 recorded the significantly higher yield (5.20 t ha^{-1}) over other varieties. There was no yield difference between BgHR1 and BgHR6.Among the seed rates the lowest grain yield (4.78 t ha^{-1}) recorded with the 50 g m^{-2} seed rate and the highest yield of 5.18 t ha^{-1} observed from the 20 g m^{-2} seeding density (table 1). The seeding density of 50 g m^{-2} is the recommended nursery seed rate for the inbred varieties. The panicle number per unit area was significantly affected by both factors. Among the three varieties, BgHR 12 had the significantly higher panicle number (368) per unit area. There was no significant difference in panicle number between BgHR1 and BgHR12.

Seed rate in the nursery significantly influenced the panicle number per unit area. A negative trend was observed between seed rate and tiller number per seedling, where, increasing seed rate reduce the tiller number in all varieties. Among the different seed rates tested 20 gm^2 showed the significantly highest panicle number (375) per unit area (table 1).

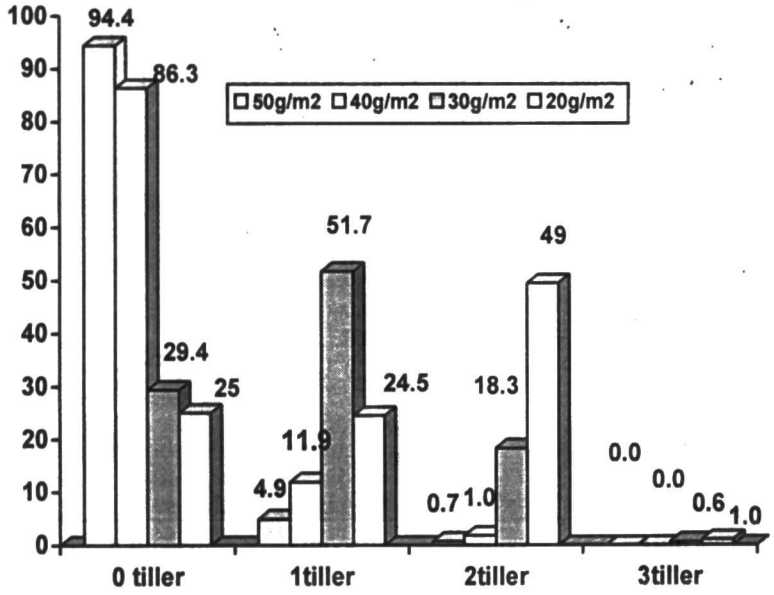

Figure 1. Tiller performances of BgHR1 under different nursery seed rate.

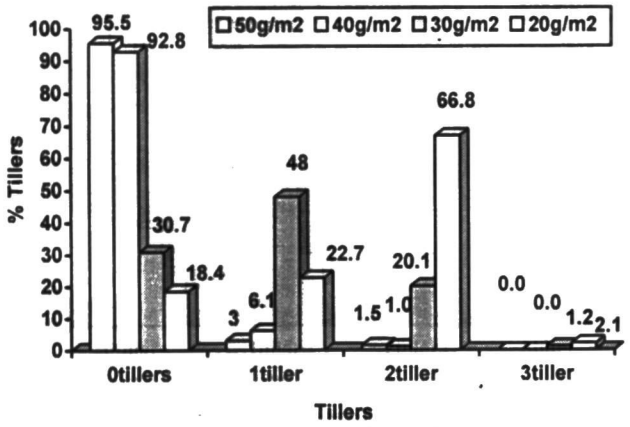

Figure 2. Tiller performances of BgHR6 under different nursery seed rate.

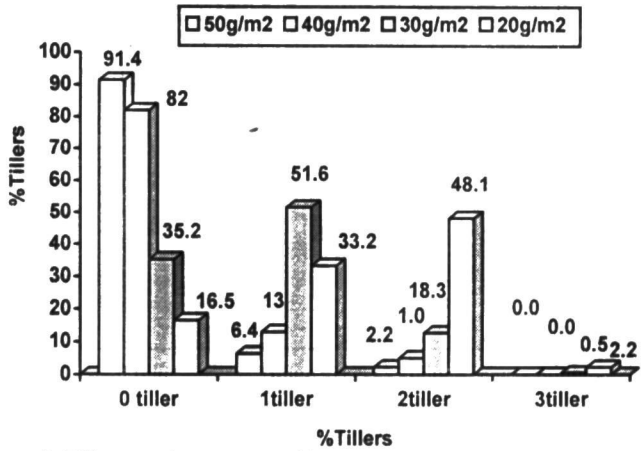

Figure 3. Tiller performances of BgHR12 under different nursery seed rate.

Table 1. Effect of seedbed seed rate on panicle/m2, filled grains, 1000 - grain weight, grain yield and harvest index of three rice hybrids at RRDI, Batalagoda during *maha* 2002/03 season.

Treatment Variety	*Panicles/m2*	*Filed grains/ panicle*	*1000 grain weight(g)*	*Yield (t/ha)*	*Harvest Index*
BgHR1	357 b	162 a	25.97 a	4.78 b	0.47 a
BgHR6	353 b	133 b	26.9 a	4.90 b	0.44 b
BgHR12	368 a	122 b	27.4 a	5.20 a	0.45 ab
Seed rate(g/ m^2					
50	340 c	134 a	26.6 a	4.38 c	0.44 b
40	350 c	139 a	26.7 a	4.66 bc	0.46 ab
30	373 b	146 a	26.5 a	5.08 ab	0.48 a
20	375 a	137 a	27.0 a	5.18 a	0.47 ab

Means in a column followed by the same letters are not different by DMRT at p=0.05.

Filled grain number per panicle was significantly affected by varieties. Among the varieties BgHR1 had the significantly higher filled grains (162) per panicle. 1000-grain weight was not affected significantly either by varieties or by seed rate (table 1). Harvest index (HI) is a ratio between economic yield and biological yield of a crop (Yoshida, 1981). HI was significantly affected by variety as well as by seedbed seed rate. The highest (0.47) and the lowest (0.44) HI were observed from BgHR1 and BgHR6, respectively. Among the different seed rates the highest (0.48) and the lowest HI values were observed from 30 g m^{-2} and 50 g m^{-2} densities, respectively.

CONCLUSION

Seed rate in the nursery seedbed influence the tillering ability of the seedlings in the nursery. Among the tested four seed rates (20, 30, 40 and 50 g m^{-2}), treatment found to be as best as far as tiller number is concern. Seed rate of 20 g m^{-2} produced the largest percentage of seedlings with two tillers compared to that of other densities. Transplanting of seedlings with two tillers produced under 20 g m^{-2} seed rate gave the highest grain yield over the single tillers and no tiller seedlings. Major contributing factor for higher yield with seedlings planted with two seedlings was increased panicle per unit area. Therefore, according to this results it can be suggested that seedbed seed rate of 20 g m^{-2} is the best-seeding rate for the nursery seedbeds to obtain high quality seedlings and higher grain yield from local hybrids

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