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Impact of Different Depths of Transplanting by Machine Transplanter on Growth and Yield Performance of Rice Variety (Bw 361)

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Abstract: Depth of transplanting is an important factor which influences the grain yield in rice production systems by determining the number of tillers. Field trial was conducted to evaluate the growth and yield response of different planting depths of seedlings of mechanical transplanted rice. Four rows of behind-walk type paddy KUBOTA (SPW 48c) transplanter was used with 30 cm row spacing and five different planting depth (0.7, 1.4, 2.1, 2.8 and 3.7 cm), and replicated four times. The growth parameters of plant height, number of tillers, root length and yield parameters of panicle per hill, panicle length, and grain yield were recorded. Plant height (cm) during vegetative period, was significantly ($p<0.05$) higher at shallow planting depth of 0.7 cm. Root length and panicle length were not significantly influenced by depth of planting. The number of tillers per hill was significantly ($p<0.05$) differed among depth of planting. A positive correlation was observed between depth and tillers per hill up to 2.1 cm depth. The maximum number of tillers per hill and panicle numbers per hill were recorded at the depth of 2.1 cm. Results revealed that the planting depth of 2.1 cm produces significantly higher tillers, panicles per hill and grain yield. Therefore, 2.1 cm planting depth is more appropriate for cultivation of Bw361 variety in machine transplanting system in low country dry zone of Sri Lanka.

***Keywords*:** Mechanical transplanting, Planting Depth, Rice, Yield

Introduction

Rice (*Oryza sativa* L.) is the most important cereal food crop of the developing world and the staple food of more than 3.5 billion people or more than half of the world's population (Tripathi *et al.,* 2004). There is a need to increase the productivity of rice using reduced inputs and resources to feed the burgeoning population (Das *et al.,* 2010). Rice production in Sri Lanka is an important part of the National economy. Yield of transplanted rice is generally believed to be higher than that of dry-seeded rice (Balasubramanian *et al*., 2007). In manual transplanting, 20-30 people are required to transplant one ha/day. It consumes time and labour for planting and makes drudgery to farmers. To overcome this problem, Machine Transplanting (MT) was introduced in 'Yaya 11 program' to farmers by the Department of Agriculture in 2016.

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MT of rice is the process of transplanting young seedlings, which have been grown in a mat nursery, using a rice transplanter (Joseph *et al.,* 2015). Major advantages of this method are labour saving and timely crop establishment (Tripathi *et al.,* 2004). Three people can transplant approximately 2 ha/day using a rice transplanter. The other advantages of MT include uniform spacing, optimum plant density, less transplanting shock and better employment opportunities for rural youth through the development of custom service business (Illangakoon *et al*., 2017). It is also capable of adjusting desired within row space, seedlings number per hill and planting depth.

MT has useful to work mechanical weeder for weed control and working of rotary weeder churns the soil and provides greater aeration which helps in buildup of enormous microbial growth, thereby enhancement of nutrient supply to root which ultimately result in healthy plant growth and higher yields at lower costs (Archana *et al*., *2016).*

Among the different agronomic practices, planting geometry and depth of planting play a vital role in achieving higher yield levels of improved varieties of rice (Archana *et al*., 2016). It is because the proper distributions of rice plants per unit area and efficient utilization of available nutrient and other resources. Therefore, the research was conducted to study the impact of different depths of transplanting by machine transplanter on growth and yield of rice.

Materials and Methods

Field trail was conducted at Rice Research Station, Paranthan, Kilinochchi; situated in Low Country Dry Zone (DL_3) during *Maha* 2016/2017. The experimental site receives an average rainfall of 750 mm and average temperatures of 34.5ºC (max.) and 19.7ºC (min.). Five planting depth levels; 0.7 cm (T_1), 1.4 cm (T_2), 2.1 cm (T_3), 2.8 cm (T_4) and 3.7 cm (T_5) were tested as treatments. Planting depth of 0.7 cm and 1.4 cm were considered as shallow depth of planting and 3.7 cm planting depth was considered as deep depth of planting. Other two depths; 2.1 cm and 2.8 cm were taken as medium depth of planting.

The field trial was laid in a Randomized Complete Block Design (RCBD) with four replicates in each depth level. The plot size was 6 m x 4.5 m. Red pericarp high yielding rice variety Bw 361 was selected. Seedlings were raised in a dapog nursery to use in MT. Seedlings of 2-3 leaf stage (15 days) were fed to transplanter. The man-propelled paddy KUBOTA walk-behind type (Model SPW 48c) transplanter with four rows was used for planting at 3-4 seedlings per hill throughout the treatments. The seedlings were transplanted at 30 cm row spacing and 16 cm within the row spacing.

Fields were ploughed twice and puddling and leveling were done before transplanting. Fertilizer application was done according to the recommendation of irrigated rice in Dry zone (Srisena, 2013). Pretilachlor (300 g/L EC) was applied for weed control

at the rate of 1.6 L/ha on 3rd day after establishment. Plots were maintained under irrigated condition and all other management practices were done based on the recommendation made by the Department of Agriculture.

Data collection

The growth and yield parameters were recorded on plant height (cm) at different growth stages of 30 (vegetative), 75 (reproductive) and 110 (maturity) days after planting, number of tillers per hill, root length (cm), panicle length (cm), number of panicles per hill (productive tillers per hill) and grain yield (t/ha).

Ten hills were randomly selected from each plot and averages were taken for evaluation of growth and yield parameters. Plant height was measured from the base to the tip of the highest leaf. Tillers and productive tillers were individually counted. Panicle length was measured from the base of collar to tip of panicle. Root length was measured from the crown of the root to the tip of the root. Grain yield was measured by taking grain dry weight of treatment plots by using electronic balance at the level of 13 % moisture and converted to t/ha.

Data analysis

ANOVA was performed by using software SAS (version 9.1) and mean separation was done in Duncan's Multiple Range Test (DMRT) at $\alpha \leq 0.05$ (Schlotzhauer and Littell, 1997).

Results and Discussion

Plant height

There was significant difference in plant height with different depths of planting in vegetative stage. Deep transplanting (3.7 cm) showed less plant height compared to shallow depth of transplanting (0.7 cm) in vegetative stage. Archana *et al*. (2016) and Saburo (1962) had shown the similar findings. But

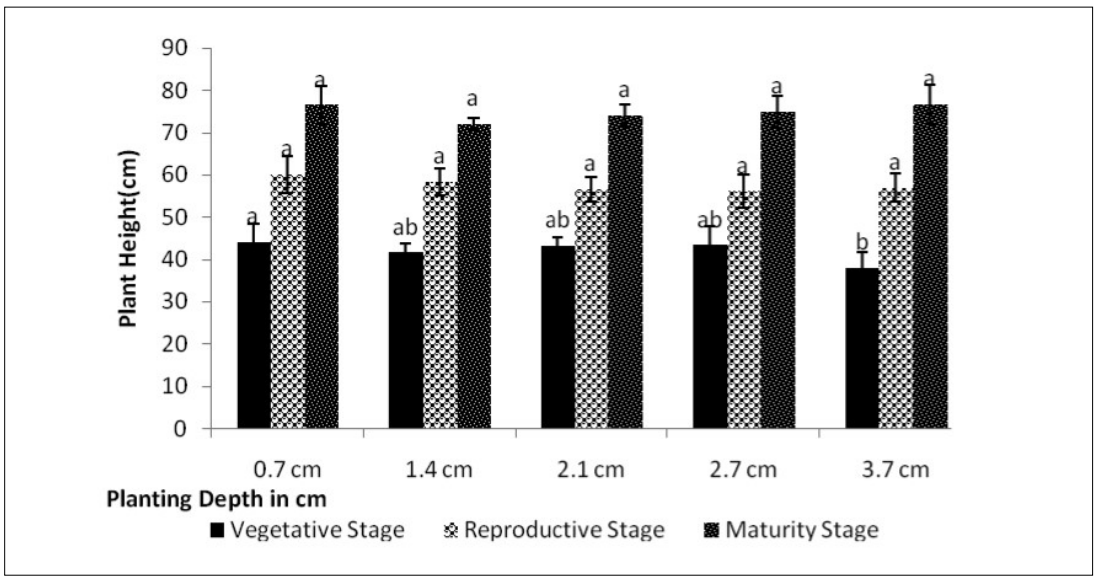

Figure 1: Plant Height variation in different growth stages

there were no significant difference in reproductive and maturity stage in different depths of planting.

Number of tillers per hill and panicle number per hill

Number of tillers produced per hill under the different depth of planting was presented in Table 1. The number of tillers per hill was significantly (p<0.05) differed among different depth of planting. A positive correlation was observed between depth of planting and tillers per hill up to 2.1 cm depth. The total number of tillers per hill and number of panicle per hill were significantly higher in medium depth of 2.1 cm planting. The maximum numbers of panicle per hill were recorded in the plots planted at the depth of 2.1 cm. Lowest number of tillers per hill and panicle numbers per hill were observed in the planting depth of 3.7 cm. Deep transplanting caused decreased in number of tillers and panicles. Similar results were shown by Archana *et al*. (2016).

Panicle Length (cm)

The data (Table 1) revealed that there was no significant difference in the panicle length among different depth of transplanting, means panicle length has not influenced by different depth of planting.

Root Length (cm)

There was no significant difference in the root length (Table 1) among the different depth of transplanting. Higher root length was observed in 2.1 cm depth of planting and lowest in 3.7 cm depth of planting.

Grain yield (tons/ha)

The effect of different depth of planting on grain yield is presented in Table 1. Grain yield was significantly (p<0.05) influenced by the planting depth. Grain yield was higher (5.625 t/ha) in 2.1 cm depth of planting and the lower yield (3.906 t/ha) was recorded in deep transplantation of 3.7 cm It may be, the primary ill-effect of deep transplantation seemed to be the retardation of rooting caused elongation of tiller node which induced the decreasing of number of tillers and consequently panicle numbers, that may be the reason for reduction in the yield. But yield was significantly greater under medium (2.1 cm) depth compared to deep planting (3.7 cm) by machine transplanter.

Table 1: Variation of Growth and Yield Parameters at Different Planting Depths

Depth Category	Treatment	Number of tillers /Hill	number of panicle /Hill	Root Length (cm)	Panicle Length(cm)	Yield (t/ha)
Shallow	0.7 cm	10.96±0.4 ^{b}	10.70±0.3 ^{b}	22.00±2.8 ^{a}	20.83±1.2 ^{a}	4.218±1.2 ^{ab}
	1.4 cm	11.33±1.1 ^{b}	11.13±1.3 ^{b}	21.50±0.5 ^{a}	20.50±0.4 ^{a}	4.270±0.9 ^{ab}
Medium	2.1 cm	14.29±1.4 ^{a}	14.23±1.2 ^{a}	22.75±1.6 ^{a}	20.17±0.2 ^{a}	5.625±1.0 ^{a}
	2.7 cm	12.04±3.1 ^{ab}	11.38±2.0 ^{b}	22.50±2.2 ^{a}	20.63±1.4 ^{a}	4.635±0.6 ^{ab}
Deep	3.7 cm	9.92±0.9 ^{b}	9.73±1.0 ^{b}	20.25±1.1 ^{a}	20.96±0.7 ^{a}	3.906±1.0 ^{b}

Results were supported by Archana *et al*. (2016) and Saburo (1962).

Conclusion

Planting depth can play a vital role in rice yield under mechanical transplanting system**.** The growth parameters and yield attributes significantly greater under moderate depth (2.1 cm) of planting than shallow depth of planting and deeper planting depth. Depth of planting at 2.1 cm produced 33.2% higher yield than 0.7 cm shallow depth of planting. The results revealed that the optimum depth of transplantation to be 2.1 cm for Bw 361 rice variety by machine transplanter.

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