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Impact of organic substance on growth attributes of mat type rice seedlings in the trays for machine transplanting

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ABSTRACT

Rice seedling for mechanical transplanting must fulfill the prerequisites of guideline seedling block with uniform density of seedlings and between bending pulls for rolling. The present study was carried out at the Farm Power and Machinery Department, Sylhet Agricultural University, Sylhet during Boro season/2018-19 with the objective to assess the impact of organic substance on agronomic attributes of mat type rice seedling. The seedling was raised on plastic rigid tray utilizing sandy clay loam (SCL) and sandy clay (SC) soil blending with the organic fertilizer of cow-dung (CD), rice bran (RB), rice husk (RH) and tea wastage (TW) at the rate of 0.0, 5, 10, 15 and 20%, respectively. Averaged across the rate of soil mixture, 5 to 15% of CD and RB with the both types of soil gave higher seedling height, leaf length and stem length while 20% of CD and TW also showed better result for number of leaves and stem thickness. Considering all parameters, 15 to 20% rice husk and tea wastage mixed with the sandy clay loam soil and 10 to 15% with the sandy loam soil gave good result. Be that as it may, seedling quality differed among the natural composts with the two kinds of soil more or less like CD > RB > TW > RH. Water requirement in the SC soil was more compared to SCL soil. It was observed that crack was formed on the sandy clay soil in tray. For both types of soil, the density of seeds in the mat at the rate of 6-7 seeds cm^{-2} was found at 80% of soil mixture along with rice bran. The findings of the study could be promoted widely in farmer's field to raise better quality of mat type seedling for better performance of the mechanical rice transplanter which ultimately leads to getting better rice yield.

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I. Introduction

Rice (*Oryza sativa*) is the significant food crop of Bangladesh and involved the most noteworthy zone among all the harvests crops in the country. About a major portion of the populace relies upon rice as its vitality providing food grain. In Asia, more than two billion people depend on rice and its products for 60-70 percent of their calorie requirement (FAOSTAT, 2014). Rice development is a work escalated task that couldn't be practiced without any problem. Labor wages represents the greatest input cost for rice cultivation (Clayton, 2010). The number of labor requirement for rice cultivation in one hectare of land is about 156.2 man-days of which 44.5 man-days is required for rice seedling production, uprooting, transportation and transplanting which is 28.24% of the total number of labor requirement (Rahman, 1997). Across South Asia, labor scarcity is a vital problem and there is a need to explore establishment methods for rice that require less labor but still allow the crop to be transplanted traditionally. Thus the use of mechanical rice transplanter for transplanting purposes is an alternative way to address this issue.

Modernization in rice cultivation, for example seedling production and seedling transplanting, needs to improve in Bangladesh to decrease the expense of rice cultivation. Rice is cultivated either by direct sowing or by transplanting. Rice seedling transplanting using mechanical device needs significantly fewer labor and time (1-2 $ha^{-1}person^{-1}day$) compare to the traditional transplanting (0.07 $ha^{-1}person^{-1}day$) (IRRI, 2007). In manual transplanting, 40-50 days old manual uprooted and root washed seedlings are utilized whereas 18-30 days old special type mat type rice seedlings are regularly utilized in mechanical transplanting. Late in rice seedling transplanting from typical date of planting causes decrease in rice yield by 9 percent (Islam et al., 2008). A good quality of mat type seedling raising media is prerequisite to establish quality seedling. Potential outcomes of utilizing diverse media as an option in contrast to regular soil media have been concentrated by several studies (Ko, et al., 2005; Shiratsuchi et al., 2008; Ikeura et al., 2012). Soil collection and seedling tray filled with soil (around 5-6 kg/tray) is the major problem of seedling raising for mechanical transplanting. On the off chance that dirt medium can be supplanted by any lightweight, ease, and effectively accessible materials that would be extraordinary assistance to the rice ranchers. Rice husk, a result of the rice processing industry, was discovered to be a reasonable model for soilless culture because of the properties of good air circulation and lightweight (Islam, 2008). Also it can be overcome by rolling up the seedling as seedling mat to carry easily (Hossen et al, 2018a). Adequate quality of the rice seedling mat is needed for warping. The quality of rice seedling mat rolling up is a significant factor to convey seedling from the nursery bed to the principle rice field and to set in the seedling tray of rice transplanter. It is influenced by seedling growing and covering media, moisture content, organic matter and root growth. Cow dung, rice husk, rice bran, tea wastage etc. are available organic fertilizer and good sources of nutrient used in field as they improve the growth of plants. Haytham et al. (2010) saw that that warping up of the rice seedling mat is imperative to decrease the seedling volume that assists with conveying mass volume to the principle field.

Appropriate seedling height, number of leaf during transplanting, stem thickness are also important parameters for quality transplanting to reduce the absent plant in transplanting by improving suppressed plants under soil, picker missing, floating hills and mechanical damage hills. Hoshino (1978) suggested that 80-150 mm mat type seedling height raised in tray is suitable for mechanical transplanting. Numerous specialized factors need to be taken in consideration for effective activity of the mechanical rice seedling transplanter. For instance, in mechanical transplanting, rice seedling ought to be grown in the plastic tray or polythene sheet with extraordinary consideration. Mat type rice seedling for mechanical transplanting needed right age of seedling, growing media and improve nursing especially plastic tray, tray soil, covering soil, seed management, sowing, and watering. Height of seedling at around 3 leaf stages is required for mechanical transplanting (Kitagawa et al., 2004). In Bangladesh, suitable mat type seedling growing media and impact of organic fertilizer on plants for quality mechanical transplanting is as yet obscure. Tray soil and mixture of organic fertilizer with bed soil in the seedling plate would have incredible effect on seedling stature, number of leaf, stem thickness and hence on plant establishment with minimum missing hills. Soil and manure type, ratio of manure mixture with soil and different covering media are of considerable importance factors for quality seedling. Under this circumstance, this experiment have been conducted to identify suitable growing and covering media in combination with soil and other organic substance (rice husk, rice bran,

waste of tea etc.) for quality seedling raising in terms of agronomical standards that ultimately helps to popularize mechanical transplanter in Bangladesh.

II. Materials and Methods

The experiment have been executed in the Farm Power and Machinery Department, Sylhet Agricultural University, Sylhet during the Boro season 2018-19 and the latitude and longitude of the location is 24°54'33.9"N 91°54'05.2"E.

Experimental design and treatments

Two-way factorial design with 3 replications was followed to conduct the study. Organic substance was used as factor A and percentage of soil mixture was used as factor B for both type of soil separately (**Table 01**). Five different categories of organic substance (cow dung, rice bran, rice husk, tea wastage) and two types of soil (sandy clay loam and sandy clay) were mixed separately at different rate (100%, 95%, 90%, 85% and 80%) to identify the suitable mixing ratio of the organic fertilizer with the seedling bed soil as per the treatments **(Table 02).** The temperature and humidity during the seedling growing period were collected from local weather station (**Figure 01** and **figure 02**).

Table 01. Experimental arrangement

Soil type	Organic substance (Factor A)	Percentage of soil mixture (Factor B)
Sandy clay loam (SCLS: Type I) Sandy clay (SCS: Type II)	Cow dung (CW) Rice bran (RB) Rice husk (RH) Tea wastage (TW)	100% soil (Control) 95% soil 90% soil 85% soil 80% soil

Table 02. The basic information of the experiment

Season	Variety	1,000 grains weight (g)	Soaking date	Sowing date	Germination (%)	Growing period
Boro/ 2018–19	BRRI dhan28	23.10	08 Dec, 2018	12 Dec, 2018	86	12 Dec, 2018 to 12 Jan, 2019

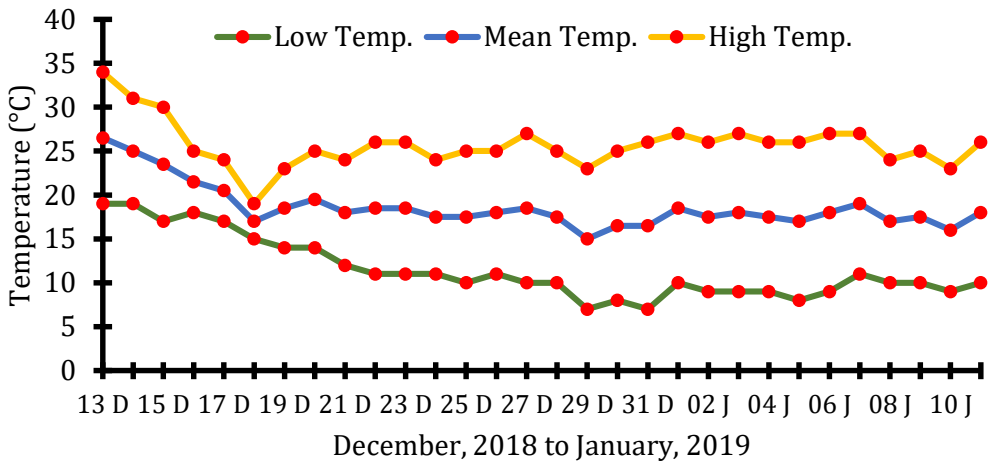

Figure 01. Temperature during seedling growing period

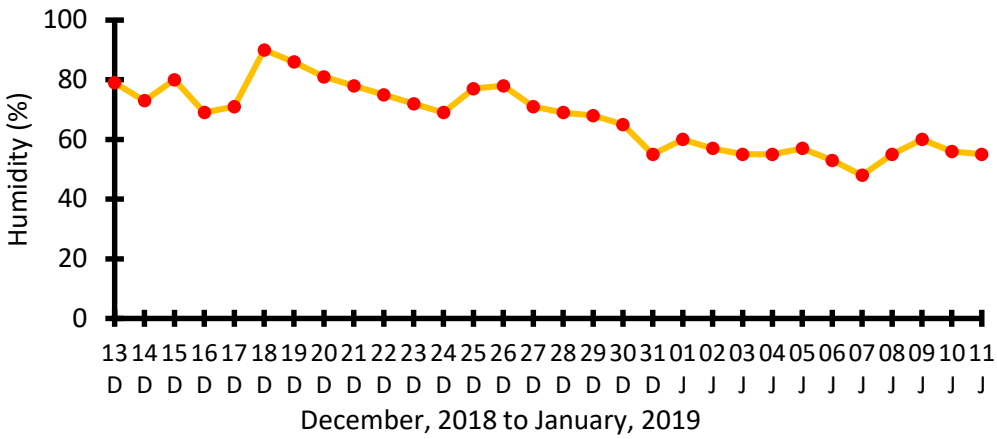

Figure 02. Air humidity during seedling growing period

Physical properties of the growing media

Soil samples were analyzed in the Soil Resource Development Institute (SRDI) lab at Bypass road, Chondipul, Pirijpur, Sylhet (Table 03).

Table 03. Physical characteristics of the studied two different soils

Properties	Value	
	Soil type I	Soil type II
Fine sand (%)	59.2	49.2
Silt (%)	14	12
Clay (%)	26.08	38.08
Texture	Sandy clay loam soil (SCLS)	Sandy clay soil (SCS)

Plant tray preparation and seeds sowing

Cow dung, rice bran, rice husk and tea wastage were mixed with sandy clay loam and sandy clay soil manually on a volume basis and filled up the seedling trays at a thickness of 20 mm which is about three fourth of the trays. Pre-germinated seeds (140 g per tray) were sown uniformly on the trays. Soil mixture was utilized as covering soil and spread over the seeds (3–4 mm thick) to cover the seeds.

Data collection

The agronomic characteristics of seedling height, number of leaves, leaf length, stem length and stem thickness were counted after 15 and 30 days of seeds spreading on the trays. The seedling density was measured after 30 days of sowing during and the seedling height, number of leaves, leaf length, stems length and stem thickness were measured by using slide calipers (mm). Nine plants from each replication were collected randomly from collar region of the plants to the tip at 15 and 30 days after seeds sowing and mean height was computed for analysis. Number of leaves also counted randomly from selected nine plants at 15 and 30 days after seeds sowing in the trays. Only the 1st leaf length was measured under this study. Similar plants were used to measure the leaf length at 15 and 30 days later of sowing. The bottom of the first leaf to stem was measured after 15 and 30 days of seeds sowing. Stem thickness was measured at 15 and 30 days after seeds sowing in the trays. A metal sheet box of 100×100 mm^2 size was used to determine the seeding density from each tray.

Statistical Analysis

Collected data of the study were analyzed as a 2-way factorial design (factor A x factor B) according to Gomez and Gomez (1984) using Statistix 10 program (Statistix 10 software, 2013).

III. Results

Seedling height

Seedling height at 15 days after sowing (Soil type I): The single effect of both organic substance and percentage of soil mixture showed significant effect on seedling height (Table 04). Cow dung along with 90% soil mixture showed higher seedling height followed by 95 to 80% soil mixture with cow dung and

95 to 90% soil mixture with rice bran whereas soil without any organic substance showed lower seedling height.

Table 04. Interaction effect of organic substance and percentage of soil mixture (Type I) on seedling height (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	94.27	92.11	90.99	86.62	90.99
95	101.32	97.75	93.76	91.30	96.03
90	107.09	102.02	92.25	95.08	99.11
85	100.61	93.96	91.70	95.03	95.33
80	97.96	91.86	94.43	92.62	94.22
Mean	100.25	95.54	92.63	92.13	-
CV, %	5.96				
LoS	O= **, S=* and O× S= NS				
LSD $_{0.05}$	O= 4.19 and S= 4.68				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Seedling height at 15 days after sowing (Soil type II)

Organic substance and soil mixture percentage showed significant effect on seedling height individually (Table 05). Among the organic substance, cow dung scored significantly higher value followed by tea wastage. 95% soil mixture with organic substance scored significantly higher value followed by 90% soil mixture with organic substance. Significantly lower value was observed for 100% of soil when additional substance was not used.

Table 05. Interaction effect of organic substance and percentage of soil mixture (Type II) on seedling height (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	60.67	63.41	60.41	68.2	63.17
95	89.95	68.84	81.16	79.19	79.78
90	86.64	70.02	72.00	79.52	77.05
85	83.89	68.81	70.89	73.51	74.27
80	67.00	63.91	67.33	66.21	66.11
Mean	77.63	66.99	70.36	73.33	-
CV, %	8.91				
LoS	O= **, S=** and O× S= NS				
LSD $_{0.05}$	O= 4.75 and S= 5.31				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Seedling height at 30 days after sowing (Soil type I)

Insignificant effect of organic substance and percentage of soil mixture was observed on seedling height while single effect of both organic substance and soil mixture percentage showed significant effect (Table 06). Rice bran along with 85% soil mixture showed mathematically higher seedling height followed by 90 to 80% soil mixture with cow dung, 90% soil mixture with rice bran and 85% soil mixture with rice husk whereas 80% soil mixture with tea wastage exposed lower seedling height at 30 days.

Seedling height at 30 days after sowing (Soil type II)

Combined effect of organic substance and percentage of soil mixture was significant on seedling height as were significant of the single effect of both organic substance and soil mixture percentage (Table 07). Significantly higher seedling height was observed for cow dung along with 80% soil mixture followed

by cow dung along with 85% soil mixture whereas 90 and 95% soil mixture with rice husk, 95% with tea wastage and 100% soil gave significantly lower seedling height at 30 days after sowing.

Table 06. Interaction effect of organic substance and percentage of soil mixture (Type I) on seedling height (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	94.99	93.19	95.93	89.83	93.48
95	100.79	98.41	94.03	89.60	95.70
90	108.16	107.64	97.89	87.39	100.27
85	107.64	111.74	102.54	92.02	103.48
80	104.22	97.98	97.86	85.15	96.30
Mean	103.16	101.79	97.65	88.80	-
CV, %	6.60				
LoS	O= **, S= ** and O× S= NS				
LSD $_{0.05}$	O= 4.77 and S= 5.34				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Table 07. Interaction effect of organic substance and percentage of soil mixture (Type II) on seedling height (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	77.68	82.71	81.16	84.01	81.39
95	81.38	89.91	76.59	77.63	81.38
90	93.64	89.79	76.87	81.92	85.56
85	97.85	87.04	89.22	82.16	89.07
80	104.03	91.25	86.52	80.25	90.51
Mean	90.91	88.14	82.07	81.20	-
CV, %	6.82				
LoS	O= **, S= ** and O× S= **				
LSD $_{0.05}$	O= 4.32, S= 4.83 and O× S= 9.65				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Number of leaf per plant

No. of leaf per plant at 15 days after sowing (Soil type I): Interaction effect of organic substance and soil mixture was not significant of both organic substance and percentages of soil mixture on number of leaf per plant (Table 08). Higher values were observed for rice bran with 90% of soil mixture whereas rice husk with 85% of soil mixture slowed lower number of leaf.

Table 08. Interaction effect of organic substance and percentage of soil mixture (Type I) on number of leaf per plant

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	2.00	2.00	2.33	2.67	2.25
95	2.33	2.67	2.67	2.67	2.58
90	2.00	3.00	2.67	2.67	2.58
85	2.67	2.67	2.00	2.67	2.50
80	2.33	2.33	2.33	2.33	2.33
Mean	2.27	2.53	2.40	2.60	-
CV, %	20.62				
LoS	O= NS, S= NS and O× S= NS				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

No. of leaf per plant at 15 days after sowing (Soil type II): Both combined and single effect of organic substance and soil mixture were insignificant on number of leaf per plant (Table 09). Higher values were observed for cow dung with 95% of soil mixture. 95% soil mixture with organic substance scored higher value whereas 80% soil mixture with organic substance and 100% soil scored lower value.

Table 09. Interaction effect of organic substance and percentage of soil mixture (Type II) on number of leaf per plant

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	2.00	2.00	2.00	2.00	2.00
95	2.67	2.00	2.33	2.00	2.25
90	2.33	2.33	2.00	2.00	2.17
85	2.33	2.33	2.00	2.00	2.17
80	2.00	2.00	2.00	2.00	2.00
Mean	2.27	2.13	2.07	2.00	-
CV, %	13.20				
LoS	O= NS, S= NS and O× S= NS				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

No. of leaf per plant at 30 days after sowing (Soil type I): The interaction effect of organic substance and soil mixture on number of leaf per plant did not vary significantly (Table 10). The higher values were observed for cow dung with 80% of soil mixture whereas cow dung along with 95% of soil mixture and 100% soil showed lower number of leaf.

Table 10. Interaction effect of organic substance and percentage of soil mixture (Type I) on number of leaf per plant

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	3.33	4.00	3.67	3.67	3.67
95	3.33	3.67	4.00	4.00	3.75
90	3.67	3.67	3.67	4.00	3.75
85	4.00	3.67	4.00	3.67	3.83
80	4.33	4.00	4.00	3.67	4.00
Mean	3.73	3.80	3.87	3.80	-
CV, %	12.07				
LoS	O= NS, S= NS and O× S= NS				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

No. of leaf per plant at 30 days after sowing (Soil type II): Individual effect of organic substance and percentages of soil mixture did not show significant effect on number of leaf per plant (Table 11). Higher values were observed for rice bran with 90 and 85% of soil mixture whereas cow dung along with 90% of soil mixture, rice husk along with 95 to 90% and 100% soil gave lower number of leaf per plant.

Leaf length

Leaf length at 15 days after sowing (Soil type I): The influence of organic substance and percentage of soil mixture on leaf length were insignificant while single effect of the both factor showed significant effect on leaf length (Table 12). Cow dung along with 90% soil mixture showed higher leaf length followed by 95 and 85% soil mixture with cow dung, 90% soil mixture with rice bran and 80% soil mixture with tea wastage whereas 85% soil mixture with rice husk, 80% soil mixture with rice bran and soil without any substance showed lower leaf length.

Table 11. Interaction effect of organic substance and percentage of soil mixture (Type II) on number of leaf per plant

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	3.33	3.00	3.33	3.67	3.33
95	3.33	3.67	3.00	3.33	3.33
90	3.00	4.33	3.00	3.33	3.42
85	3.33	4.33	4.00	3.67	3.83
80	3.33	3.67	3.33	3.33	3.42
Mean	3.27	3.80	3.33	3.47	-
CV, %	16.12				
LoS	O= NS, S= NS and O× S= NS				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Table 12. Interaction effect of organic substance and percentage of soil mixture (Type I) on leaf length of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	56.86	57.92	57.14	55.82	56.94
95	68.11	59.68	57.04	60.97	61.45
90	69.62	65.57	60.49	60.95	64.16
85	64.49	60.62	53.40	67.11	61.40
80	59.95	54.74	60.88	58.09	58.41
Mean	63.81	59.71	57.79	60.59	-
CV, %	8.48				
LoS	O= *, S=** and O× S= NS				
$LSD_{0.05}$	O= 3.79 and S= 4.24				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Leaf length at 15 days after sowing (Soil type II): The influence of organic substance and percentage of soil mixture did not show significant effect on leaf length. On the other hand single effect of both organic substance and soil mixture percentage showed significant effect on leaf length (Table 13). Cow dung along with 95% soil mixture gave mathematically higher leaf length followed by 90 and 85% soil mixture with cow dung and 95% soil mixture with rice husk whereas 80% soil mixture with rice husk and tea wastage and also soil without any substance showed precisely lower leaf length.

Table 13. Interaction effect of organic substance and percentage of soil mixture (Type II) on leaf length of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	41.65	39.54	42.98	46.37	42.64
95	57.63	43.76	55.44	49.62	51.61
90	57.19	46.36	44.88	49.70	49.53
85	55.26	44.12	44.97	46.34	47.67
80	42.14	42.16	38.61	40.70	40.90
Mean	50.78	43.19	45.38	46.55	-
CV, %	10.30				
LoS	O= **, S=** and O× S= NS				
$LSD_{0.05}$	O= 3.54 and S= 3.96				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Leaf length at 30 days after sowing (Soil type I): The organic substance and percentage of soil mixture did not showed significant effect on leaf length as well as single effect of soil mixture

percentage while single effect of organic substance was found significant (Table 14). Cow dung along with 95% soil mixture gave higher leaf length whereas 80% soil mixture with tea wastage gave lower leaf length.

Table 14. Interaction effect of organic substance and percentage of soil mixture (Type I) on leaf length of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	61.30	67.65	60.68	60.38	62.50
95	69.21	62.44	62.00	57.69	62.83
90	67.78	66.50	61.43	56.06	62.94
85	68.29	67.21	63.67	59.17	64.59
80	65.35	60.79	61.43	55.57	60.79
Mean	66.39	64.92	61.84	57.77	-
CV, %	7.47				
LoS	O= *, S= NS and O× S= NS				
LSD $_{0.05}$	O= 3.46				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Leaf length at 30 days after sowing (Soil type II): The influence of organic substance and percentage of soil mixture showed significant as well as single effect of organic substance whereas soil mixture percentage did not show significant effect on leaf length (Table 15). Cow dung along with 80% soil mixture gave significantly higher leaf length followed by 90 to 85% soil mixtures with cow dung, 95 to 90% soil mixture with rice bran, 85% soil mixture with rice husk and 90% soil mixture with tea wastage. On the other hand, 95% soil mixture with rice husk gave significantly lower leaf length.

Table 15. Interaction effect of organic substance and percentage of soil mixture (Type II) on leaf length of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	49.52	54.32	46.21	51.74	50.45
95	50.90	57.82	44.75	50.49	50.99
90	58.54	58.29	46.53	54.80	54.54
85	58.86	52.34	57.41	50.17	54.70
80	64.49	47.73	48.58	48.88	52.42
Mean	56.46	54.10	48.70	51.22	-
CV, %	11.16				
LoS	O= **, S= NS and O× S= *				
LSD $_{0.05}$	O= 4.34 and O× S= 9.71				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Stem length

Stem length at 15 days after sowing (Soil type I): The organic substance showed significant effect on stem length (Table 16). Rice husk along with 85% soil mixture experimentally gave higher stem length whereas 85% soil mixture with tea wastage gave lower stem length.

Stem length at 15 days after sowing (Soil type II): The soil mixture percentage showed significant effect on stem length (Table 17). Cow dung along with 95% soil mixture gave higher stem length whereas soil without any organic substance gave lower stem length.

Table 16. Interaction effect of organic substance and percentage of soil mixture (Type I) on stem length of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	37.41	34.19	33.85	30.80	34.06
95	33.22	38.07	36.72	30.33	34.58
90	37.47	36.45	31.76	34.13	34.80
85	36.12	33.34	38.31	27.92	34.92
80	38.01	37.12	33.55	34.54	35.81
Mean	36.45	35.83	34.84	31.55	-
CV, %	13.65				
LoS	O= *, S=NS and O× S= NS				
LSD $_{0.05}$	O= 3.50				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Table 17. Interaction effect of organic substance and percentage of soil mixture (Type II) on stem length of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	19.02	23.87	17.43	21.83	20.54
95	32.32	25.07	25.72	29.57	28.17
90	29.45	23.65	27.12	29.82	27.51
85	28.63	24.69	25.92	27.18	26.60
80	24.86	21.76	28.72	25.51	25.21
Mean	26.85	23.81	24.98	26.78	-
CV, %	19.72				
LoS	O= NS, S=** and O× S= NS				
LSD $_{0.05}$	S= 4.17				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Stem length at 30 days after sowing (Soil type I): Only individual influence single effect of organic substance and soil mixture percentage showed significant effect while interaction effect was insignificant effect on stem length (Table 18). Rice bran along with 85% soil mixture mathematically gave higher stem length followed by cow dung along with 90 to 80% soil mixture, rice bran along with 90% soil mixture and 90 to 85% soil mixture with rice husk whereas soil without any organic substance gave lower stem length.

Table 18. Interaction effect of organic substance and percentage of soil mixture (Type I) on stem length of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	33.68	25.54	35.25	30.78	31.31
95	31.58	35.97	32.03	33.91	33.37
90	40.38	41.15	39.79	33.33	38.66
85	39.35	44.53	38.87	34.85	39.40
80	38.87	35.86	36.43	31.58	35.69
Mean	36.77	36.61	36.47	32.89	-
CV, %	11.35				
LoS	O= *, S= ** and O× S= NS				
LSD $_{0.05}$	O= 2.99 and S= 3.35				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Stem length at 30 days after sowing (Soil type II): Interaction effect of organic substance and percentage of soil mixture showed significant effect on stem length as were single effect of the both factor (Table 19). Rice bran along with 80% soil mixture gave significantly higher stem length followed by cow dung along with 85 to 80% soil mixture and rice husk along with 80% soil mixture whereas tea wastage along with 95 to 90% soil mixture and soil without any organic substance gave significantly lower stem length.

Table 19. Interaction effect of organic substance and percentage of soil mixture (Type II) on stem length of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	28.16	28.39	34.94	32.27	30.94
95	30.48	32.09	31.85	27.14	30.39
90	35.10	31.50	30.34	27.13	31.02
85	38.99	34.70	31.81	31.99	34.37
80	39.54	43.53	37.94	31.38	38.10
Mean	34.45	34.04	33.38	29.98	-
CV, %	11.56				
LoS	O= **, S= **and O× S= *				
LSD $_{0.05}$	O= 2.82, S= 3.15 and O× S= 6.30				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Stem thickness

Stem thickness at 15 days after sowing (Soil type I): Only individual influence of organic substance and soil mixture percentage showed significant effect on stem thickness (Table 20). Cow dung along with 80% soil mixture showed higher stem thickness followed by 95 to 85% soil mixture with cow dung, 80% soil mixture with rice bran and 90 to 80% soil mixture with rice husk whereas soil without any organic substance showed lower stem thickness.

Table 20. Interaction effect of organic substance and percentage of soil mixture (Type I) on stem thickness of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	0.86	0.92	0.88	0.83	0.87
95	0.95	0.94	0.87	0.87	0.91
90	1.01	0.93	0.96	0.87	0.94
85	1.04	0.87	0.98	0.93	0.96
80	1.09	1.08	1.00	0.91	1.02
Mean	0.99	0.95	0.94	0.88	-
CV, %	9.67				
LoS	O= *, S=** and O× S= NS				
LSD $_{0.05}$	O=0.07 and S= 0.08				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Stem thickness at 15 days after sowing (Soil type II): Interaction of organic substance and percentage of soil mixture was not significant on stem thickness as were not significant of single effect of soil mixture percentage. In contrast to, organic substance showed significant effect on stem thickness (Table 21). Cow dung along with 95 and 90% soil mixture showed higher stem thickness whereas 80 and 90% soil mixture with rice bran and rice husk respectively showed lower stem thickness.

Stem thickness at 30 days after sowing (Soil type I): Two-way interaction of organic substance and percentage of soil mixture did not show significant effect on stem thickness as were as single effect of both organic substance and soil mixture percentage (Table 22).

Table 21. Interaction effect of organic substance and percentage of soil mixture (Type II) on stem thickness of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	0.82	0.85	0.79	0.82	0.82
95	0.91	0.84	0.85	0.87	0.87
90	0.91	0.89	0.73	0.79	0.83
85	0.87	0.83	0.80	0.76	0.81
80	0.84	0.72	0.74	0.76	0.76
Mean	0.87	0.82	0.78	0.80	-
CV, %	9.78				
LoS	O= *, S=NS and O× S= NS				
LSD $_{0.05}$	O= 0.06				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Table 22. Interaction effect of organic substance and percentage of soil mixture (Type I) on stem thickness of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	0.94	1.12	1.09	1.00	1.04
95	1.19	1.08	1.13	1.10	1.12
90	1.21	1.15	1.07	1.10	1.13
85	1.27	1.21	1.12	0.98	1.15
80	1.20	1.19	1.08	1.10	1.14
Mean	1.16	1.15	1.10	1.06	-
CV, %	12.87				
LoS	O= NS, S= NS and O× S= NS				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Stem thickness at 30 days after sowing (Soil type II): Insignificant effect of interaction of organic substance and percentage of soil mixture was observed on stem thickness. The single effect of both organic substance and soil mixture percentage showed significant effect on stem thickness (Table 23). Cow dung along with 95% soil mixture and rice husk along with 85% soil mixture gave higher stem thickness whereas tea wastage along with 80% soil mixture gave lower stem thickness.

Table 23. Interaction effect of organic substance and percentage of soil mixture (Type II) on stem thickness of seedlings (mm)

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	0.94	0.97	1.00	1.06	0.99
95	1.11	1.05	1.04	0.75	0.99
90	0.99	1.01	0.94	0.89	0.96
85	1.08	1.04	1.09	1.07	1.07
80	0.93	0.96	0.92	0.65	0.87
Mean	1.01	1.01	1.00	0.88	-
CV, %	12.08				
LoS	O= *, S=** and O× S= NS				
LSD $_{0.05}$	O= 0.09 and S= 0.10				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Seeding density

Seeding density at 30 days after sowing (Soil type I): The organic substance did not show significant effect on seedling density (Table 24). Rice bran and rice husk along with 90 and 80% soil mixture gave

significantly higher seedling density respectively whereas 80% soil mixture with rice bran gave significantly lower seedling density.

Table 24. Interaction effect of organic substance and percentage of soil mixture (Type I) on density of seedlings (cm^{-2})

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	16.33	9.00	10.67	12.33	12.08
95	15.67	17.67	12.67	16.00	15.50
90	11.67	18.00	15.33	16.67	15.42
85	11.00	13.33	12.67	15.00	13.00
80	10.00	6.00	18.00	17.67	12.92
Mean	12.93	12.80	13.87	15.53	-
CV, %	23.74				
LoS	O= NS, S= * and O× S= **				
LSD $_{0.05}$	S= 2.70 and O× S= 5.41				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

Seeding density at 30 days after sowing (Soil type II): Combined as well as individual effect of organic substance and percentage of soil mixture showed significant effect on seedling density (Table 25). Tea wastage along with 90% soil mixture gave significantly higher seedling density whereas 85% soil mixture with rice bran gave significantly lower seedling density.

Table 25. Interaction effect of organic substance and percentage of soil mixture (Type II) on density of seedlings (cm^{-2})

Percentage of soil mixture	Organic substance				Mean
	Cow dung	Rice bran	Rice husk	Tea wastage	
100	16.00	12.67	11.00	12.00	12.92
95	12.33	14.00	12.67	12.33	12.83
90	16.33	7.33	13.33	18.67	13.92
85	13.00	6.67	12.00	9.33	10.25
80	10.33	10.33	7.67	8.67	9.25
Mean	13.60	10.20	11.33	12.20	-
CV, %	25.73				
LoS	O= *, S=** and O× S= *				
LSD $_{0.05}$	O= 2.25, S= 2.52 and O× S= 5.03				

Note: NS- Not significant, *- significant at 5 %, **- significant at 1 %, LoS- Level of significance, O- Organic substance and S- Soil mixture in percentage.

IV. Discussions

In the present study, interaction and individual influence of soil type, organic fertilizer and mixing ratio were studied for raising quality mat type seedling during the dry (Boro) season, 2019. Cow dung (CD) and rice bran (RB) produced good quality mat type seedling with the both types of soil (sandy clay loam and sandy clay). Cow dung along with 95 to 85% soil mixtures was better with deference than growth attributes of seedlings alongside both sandy loam and clay loam soil. Seedling height and number of leaf varied with tray nursery soil, nutrient availability, ambient condition etc. Sandy clay loam soil produced higher seedling height over sandy clay soil (89 to 111 mm). So also Mamun et al. (2013) depicted that the seedling of BRRI dhan45 and BRRI dhan29 become 110 mm tallness during Boro season which is very comparative with the current investigation in Boro season. It was found that, averaged percentage of soil mixture, 5 to 15% organic fertilizer with the both types of soil was suitable for seedling height, while 20% of cow dung and tea wastage gave better result for number of leaf which was nearly similar with the observation of Hossen et al. (2018b).

The data on seedling agronomic characters revealed that the growing media comprised of high proportion of cow dung and rice bran had a significant role in seedling vigour especially with respect to seedling height of rice seedlings. Cow dung (10%) along with 90% 83 soil mixture and Cow dung (5%) along with 95% soil mixture showed higher seedling height (108-115 mm) at 15 days after sowing (DAS) for type I soil and type II soil respectively. Higher proportion (15% or above) of cow dung in the media produced taller seedlings (85-95 mm) at 30 DAS for both type of soil. According to Mamun et al. (2013), the suitable seedling height of 120 mm could be achieved from 12-16 days old seedlings for mechanical transplanting in rice. This is in affirmation with the current examination. Number of leaf per plant was not significant at 15 and 30 DAS for both type of soil.

Leaf length, stem length and stem thickness varied with seedling growing media, soil fertility, ambient temperature etc. In the study, it was found that, averaged across the percentage of soil mixture, 5 to 15% organic fertilizer with both types of soil was suitable for leaf length and stem length while 20% of cow dung and tea wastage gave better result for stem thickness which was nearly similar with the observation of (Hossen et al., 2018a). Leaf length were higher for cow dung along with 90% soil mixture and cow dung along with 95% soil mixture at 15 DAS for type I soil and type II soil respectively whereas cow dung along with 95% soil mixture and cow dung along with 80% soil mixture gave higher leaf length at 30 DAS for type I soil and type II soil respectively. Stem length were higher for rice husk along with 85% soil mixture and cow dung along with 95% soil mixture at 15 DAS for type I soil and type II soil respectively while rice bran along with 85% soil mixture and rice bran along with 80% soil mixture gave higher stem length at 30 DAS for type I soil and type II soil respectively. Cow dung along with 80% soil mixture and cow dung along with 95 and 90% soil mixture showed higher stem thickness at 15 DAS for type I soil and type II soil respectively but stem thickness at 30 DAS was not significant for type I soil although cow dung along with 95% soil mixture and rice husk along with 85% soil mixture gave higher stem thickness at 30 DAS for type II soil. For both types of soil, the density of seeds in the mat at the rate of 6-7 seeds cm^{-2} was found at 80% of soil mixture along with rice bran.

V. Conclusion

Quality mat type seedlings are the pre-requisite factor of successfully rice transplanter operation in the farmer's field. In the present study, 5 to 15% of cow-dung and rice bran mixed with both sandy clay loam soil and sandy loam soil produce quality mat type rice seedling in terms of agronomic characteristics. In the contrary, 15 to 20% rice husk and tea wastage mixed with the sandy clay loam soil and 10 to 15% with the sandy loam soil gave good result. The findings of the study could be promoted widely in farmer's field to raise better quality of mat type seedling for better performance of the mechanical rice transplanter which ultimately lead to get better rice yield.

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