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EFFECT OF BEDDING MATERIAL AND FOLIAR NUTRITION ON GROWTH AND DEVELOPMENT OF RICE SEEDLINGS FOR MACHINE TRANSPLANTING

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ABSTRACT

Nursery management experiment was carried out at Regional Agricultural Research Station, Tirupati campus of Acharya N.G. Ranga Agricultural University during *rabi*, 2014-15 for the standardization of suitable bedding material and foliar nutrition for tray nursery technique in rice for machine transplanting under Mechanized System of Rice Intensification (MSRI). The treatments consists of four bedding materials (soil alone, soil: farm yard manure, soil: vermicompost and soil: pressmud cake in the ratio of 70 : 30) and five foliar applications (control, urea @ 0.5%, DAP @ 0.5%, 19-19-19 @ 0.5% and 13-00-45 @ 0.5%) tested in Randomized Block Design with factorial concept, replicated thrice. The bedding material comprised of soil with press mud cake in 70 : 30 ratio recorded significantly better seedling shoot length, root length, dry matter production and seedling vigour index over soil with farmyard manure and soil alone as bedding materials but, comparable to soil with vermicompost at 13 and 16 DAS and the lowest seedling vigour index was recorded with soil alone as bedding material. Foliar sprays and their interaction with bedding materials recorded non significant differences with respect to growth parameters (seedling shoot length, root length and dry matter production) at 13 and 16 DAS. However, better growth parameters were recorded numerically with the foliar application of urea @ 0.5% as compared to other foliar applications.

KEYWORDS: MSRI, tray nursery, bedding material, foliar application, seedling growth and seedling vigour

INTRODUCTION

Rice is a staple food for more than 65 per cent of the Indian population and accounts for more than 42 per cent of food production. In Andhra Pradesh state, rice is the principal food crop cultivated in an area of 2.20 M ha with a production of 12.35 Mt and productivity of 5.59 t ha^{-1} (Statistical Year Book, 2019).Historically, rice cultivation is a labour intensive task that could not be accomplished easily. Land preparation, transplantation and harvesting are the expensive and time consuming operations for successful rice cultivation. Mechanization increases land and labour productivity by timely completion of farm operations and reduces the drudgery of humans and animals. Mechanization in transplanting through rice transplanter using mat nursery reduces the cost of cultivation since large area can be transplanted within a very short period (Mohanty *et al.,* 2014). Mechanized System of Rice Intensification (MSRI) is attaining wider adoptability due to machine transplanting and higher grain yield. The success of mechanical transplanting depends on the success of the nursery. It requires lesser area compared to conventional nursery. Root damage during uprooting of seedlings from conventional nursery bed can be completely avoided using tray nursery since the mats are directly fed to the transplanter without separation. Raising tray nursery is necessitated with the introduction of mechanical transplanters. For machine transplanting, seedlings should be raised with special care in plastic trays. Soil is packed into it and the seeds are sown and then these are arranged on plain land and the seedlings are raised. About 3 leaf stage, 12-15 cm height seedlings are used for machine transplanting (Kitagawa *et al.,* 2004). Soil media is used for raising tray nursery in rice. However, nursery raising by tray method is posing hurdles for further popularization. During rainy season, obtaining large quantities of fertile soil (1000 kg ha^{-1}) is herculean task for farmers who opt for machine transplanting. It is necessary to identify low volume, nutrient rich alternate growing media so as to reduce the drudgery to the farmers. Research work on alternate media for tray nursery is still in infant stage. A suitable media for raising mat tray nursery is needed to bring easiness in transportation of mat nurseries for commercial cultivation. Possibilities of using different media as an alternative to conventional soil media have been studied by research workers (Mamun *et*

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al., 2013). For obtaining uniform and healthy growth of seedlings, foliar nutrition would be best option. If the quantity of soil media required in tray nursery can be reduced by identifying light weight nutrient rich materials like farm yard manure, vermicompost and pressmud cake, it would help rice growers for easy transportation and raising healthy and vigorous nursery in trays for commercial cultivation. In traditional rice system, nursery management techniques and foliar nutrition studies for paddy nursery are very well documented however, research work on tray nursery management under mechanized system of rice intensification (MSRI) is scanty. Considering this situation field study was conducted to standardize the suitable bedding material and foliar application of nutrients for tray nursery technique for mechanical transplanting of rice under MSRI.

MATERIAL AND METHODS

Field experiment was carried out during *rabi*, 2014-15 at F.No. 18 of Regional Agricultural Research station, Tirupati, Andhra Pradesh situated at an altitude of 182.9 m above mean sea level at 13°5' N latitude and 79°5' E longitude in Southern agro climatic zone of Andhra Pradesh. Trays of dimension 60 cm × 30 cm were used to raise the mat nursery seedlings of rice. Bedding materials were prepared by mixing Soil and Farm yard manure, vermicompost, pressmud cake in 70 : 30 ratio on volume basis. The components of growing media *viz.,* soil, farmyard manure, vermicompost and pressmud cake as well as the different combinations of growing media were air dried and passed through 2 mm sieve. A representative sample of sieved material was used for analyzing physical and chemical properties of the media (Table 1). Nursery management experiment was conducted in Randomized Block Design with factorial concept replicated thrice with four bedding materials [B_1 : soil alone (SA), B_2 : soil : farmyard manure in 70:30 (SFYM), B_3 : soil : vermicompost in 70 : 30 (SVC) and B_4 : soil : pressmud cake in 70 : 30 (SPMC)] and five foliar applications (F_1 : Control, F_2 : foliar application of urea @ 0.5%, F_3 : foliar application of DAP @ 0.5%, F_4 : foliar application of 19-19-19 @ 0.5%, F_5 : foliar application of 13-00-45 @ 0.5%). Foliar applicationof nutrients was imposed at 10 DAS. Biometric observations on germination and seedling establishment, seedling shoot length, root length and dry matter production were recorded at 7, 10, 13 and 16 DAS. The number of days taken to germinate 50% seeds in the tray was considered as the mean germination time. Measured quantity of seed is sown in marked area of 100 sq. cm randomly at two places in the tray and the number of seedlings emerged in that area were recorded and the mean is expressed as germination percentage. The length from the collar region to tip of the top most seedling leaf was measured as shoot length and the length from collar region to the tip of the root was measured as root length and mean value of 10 seedlings was expressed in cm. Ten seedlings were taken at random from the trays along with the roots as per treatment at 7, 10, 13 and 16 DAS for dry matter production and the mean values are expressed in g. Seedling vigour index (SVI) was recorded at 16 DAS and calculated by adopting the formula suggested by Abdul-Baki and Anderson (1973). SVI = Establishment percentage × (Root length + Shoot length).

RESULTS AND DISCUSSION

Bedding materials had no significant effect on germination and establishment. Bedding materials and foliar applications had no significant effect on growth parameters like shoot length, root length and dry matter production at 7 DAS. Mean germination time for different bedding materials was five days and germination percentage was 96 to 97 irrespective of the bedding material used.

Effect on seedling vigour index (SVI)

Seedling vigour index showed variation due to bedding material. Pressmud cake with soil (B_4) recorded highest seedling vigour index (2420) followed by soil with vermicompost (2304) and soil with farmyard manure (2065). Lowest SVI (1851) was with soil alone as bedding material. Soil with either pressmud cake (B_4) or vermicompost (B_3) resulted in higher SVI since both the materials have high water holding and nutrient retaining abilities leading to optimum growth of seedlings compared to soil alone (Table 2). These results are in confirmation with the findings of Dhananchezhiyan *et al.* (2013) and Mamun *et al.* (2013). Higher SVI was recorded with foliar application of urea @ 0.5% followed by DAP @ 0.5%.

Effect on shoot length

Seedling shoot length significantly varied due to bedding materials. Among the different bedding materials, soil with pressmud cake (SPMC) (11.33 and 14.57 cm) followed by soil with vermicompost (SVC) (11.01 and

Table 1. Physical and chemical characteristics of bedding material used in tray nursery

	Farmyard manure (FYM)	Vermicompost (VC)	Pressmud cake (PMC)
Bulk density (g cm^{-3})	0.51	1.16	0.46
pH	7.2	6.9	7.4
EC (dS m^{-1})	0.94	1.74	1.92
OC (%)	18.6	32.5	40.8
Nitrogen (%)	0.53	1.02	0.98
Phosphorus (%)	0.22	0.79	2.56
Potassium (%)	0.59	1.92	0.68
Iron (mg kg^{-1})	2120	3610	322
Copper (mg kg^{-1})	13	71	64
Zinc (mg kg^{-1})	61	874	126
Manganese (mg kg^{-1})	76	348	298

13.89 cm)and both were resulted in significantly higher shoot length over soil with farmyard manure (SFYM) (10.31 and 12.90 cm)and soil alone (8.40 and 11.63 cm) at 13 and 16 DAS, respectively. Non significant differences among bedding materials were recorded at 7 DAS, where as SPMC (8.62 cm), SVC (8.26 cm) and SFYM (8.16 cm) recorded statistically at par shoot length but, superior over soil alone (7.27 cm) at 10 DAS. There were no statistically measurable differences in shoot length due to foliar applications at any of sampling stage. However, higher shoot length was with foliar application of urea @ 0.5% (10.52 and 13.59 cm) followed by DAP @ 0.5% (10.39 and 13.42 cm) and shortest shoot length was in control (No foliar application) (9.98 and 12.87 cm) at 13 and 16 DAS, respectively. The interaction of bedding materials and foliar applications had no significant influence on seedling shoot length at all the sampling stages.

Higher shoot length was recorded with bedding material of soil with pressmud cake was due to higher uptake of nutrients by the seedlings leading to cell enlargement, triggering of young tissues or meristematic growth (Kumar and Chopra, 2016). Dhananchezhiyan *et al.* (2013) reported that seedling height can be considered as an indicator of the healthy nursery. Vermicompost contains relatively lower nutrients compared to pressmud cake.

Effect on root length

Adequate root length is required for good anchorage and establishment of seedlings after transplanting in the main field. Root length differed significantly due to different bedding materials at 10, 13 and 16 DAS. At 10 DAS, soil with pressmud cake produced longer root length of 8.39 cm which was comparable with SVC (8.20 cm) and superior over SFYM (7.79 cm) and soil alone (7.51 cm). Soil with pressmud cake (SPMC) recorded higher seedling root length (10.39 and 10.53 cm) which was at par with SVC (9.80 and 9.96 cm) and superior over SFYM (8.43 and 8.57 cm) and soil alone (7.57 and 7.69 cm) at 13 and 16 DAS, respectively and significantly shortest root length was due to soil as bedding material. There were no statistically measurable differences in root length due to foliar applications at different sampling stages. However, higher root length was with foliar application of urea @ 0.5% (9.23 and 9.42 cm) followed by DAP @ 0.5% (9.16 and 9.22 cm) and shortest root length (8.87 and 9.09 cm) with no foliar application at 13 and 16 DAS, respectively. The interaction of bedding materials and foliar applications on seedling root length was not significant at all the seedling sampling stages (Table 3). Longest roots due to bedding material of SPMC and SVC might be due to improvement in soil physical properties as compared with farm yard manure and soil alone. This

Table 2. Seedling establishment percentage, vigour index and drymatter production (g) of rice seedling as influenced by bedding materials and foliar applications

Treatments	Seedling establishment (%)	Seedling vigour index	Dry matter production (g)			
Bedding materials			**7 DAS**	**10 DAS**	**13 DAS**	**16 DAS**
B_1 : Soil Alone (SA)	95.8	1851	0.226	0.294	0.459	0.727
B_2 : Soil and FYM in 70 : 30 (SFYM)	96.2	2065	0.228	0.319	0.556	0.834
B_3 : Soil and Vermicompost in 70 : 30 (SVC)	96.6	2304	0.234	0.331	0.609	0.909
B_4 : Soil and Pressmud cake in 70 : 30 (SPMC)	96.4	2420	0.239	0.340	0.644	0.939
SEm±			0.007	0.010	0.022	0.034
CD (P=0.05)			NS	0.021	0.045	0.071
Foliar applications						
F_1 : Control (No foliar application of nutrients)	96.2	2112	0.227	0.314	0.551	0.828
F_2 : Foliar application of urea @ 0.5%	96.6	2223	0.233	0.323	0.589	0.885
F_3 : Foliar application of DAP @ 0.5%	96.4	2172	0.235	0.324	0.574	0.864
F_4 : Foliar application of 19-19-19 @ 0.5%	96.5	2170	0.234	0.319	0.563	0.846
F_5 : Foliar application of 13-00-45 @ 0.5%	96.3	2126	0.230	0.321	0.558	0.841
SEm±			0.008	0.012	0.025	0.039
CD (P=0.05)			NS	NS	NS	NS
Bedding materials × Foliar applications						
SEm±			0.016	0.232	0.050	0.078
CD (P=0.05)			NS	NS	NS	NS

Table 3. Shoot length and root lengthof rice seedling as influenced by bedding materials and foliar applications

Treatments	Seedling shoot length (cm)				Seedling root length (cm)			
	7 DAS	10 DAS	13 DAS	16 DAS	7 DAS	10 DAS	13 DAS	16 DAS
Bedding materials								
B_1 : Soil Alone (SA)	6.33	7.27	8.40	11.63	7.09	7.51	7.57	7.69
B_2 : Soil and FYM in 70 : 30(SFYM)	6.35	8.16	10.31	12.90	7.28	7.79	8.43	8.57
B_3 : Soil and Vermicompost in 70 : 30(SVC)	6.41	8.26	11.01	13.89	7.47	8.20	9.80	9.96
B_4 : Soil and Pressmud cake in 70 : 30(SPMC)	6.55	8.62	11.33	14.57	7.57	8.39	10.39	10.53
SEm ±	0.23	0.24	0.30	0.37	0.31	0.23	0.31	0.37
CD (P=0.05)	NS	0.50	0.64	0.78	NS	0.49	0.64	0.74
Foliar applications								
F_1 : Control (No foliar application of nutrients)	6.47	8.12	9.98	12.87	7.38	7.80	8.87	9.02
F_2 : Foliar application of urea @ 0.5%	6.44	8.05	10.52	13.59	7.29	7.96	9.23	9.42
F_3 : Foliar application of DAP @ 0.5%	6.41	8.14	10.39	13.42	7.37	8.05	9.16	9.22
F_4 : Foliar application of 19-19-19 @ 0.5%	6.32	8.09	10.25	13.29	7.22	7.97	9.09	9.20
F_5 : Foliar application of 13-00-45 @ 0.5%	6.40	7.98	10.17	13.06	7.49	8.08	8.89	9.09
SEm ±	0.26	0.28	0.35	0.43	0.35	0.27	0.35	0.41
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Bedding materials × Foliar applications								
SEm ±	0.52	0.55	0.71	0.86	0.69	0.55	0.71	0.82
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

might have helped the roots to proliferate deep into the soil. The results are in confirmation with the reports of Rajendran *et al.* (2005) and Kumar and Chopra (2016).

Seedling dry matter production

Dry matter produced by rice seedlings varied significantly due to bedding materials at 10, 13 and 16 DAS (Table 2). Among the bedding materials, soil with pressmud cake (SPMC) recorded higher seedling dry matter production (0.644 and 0.939 g) followed by soil with vermicompost (SVC) (0.609 and 0.909 g). These were significantly superior over soil with farmyard manure (SFYM) (0.556 and 0.834 g) and soil alone (0.459 and 0.727 g) at 13 and 16 DAS, respectively. Bedding material has no significant influence on seedling dry matter at 7 DAS, whereas SPMC (0.340 g), SVC (0.331 g) and SFYM (0.319 g) produced statistically comparable dry matter but, superior over soil alone (0.294 g) at 10 DAS. Foliar applications had no significant influence on dry matter production at different nursery sampling stages. However, higher dry matter was recorded with foliar application of urea @ 0.5% (0.589 and 0.885 g) followed by DAP @ 0.5% (0.574 and 0.864 g) and shorter shoot length was recorded with no foliar application (0.551 and 0.828 g) at 13 and 16 DAS, respectively. Interaction of bedding materials and foliar applications on seedling dry matter production was found to be non significant at all the stages of sampling.

Growth media comprised of soil with pressmud cake produced the higher dry matter followed by soil with vermicompost over soil with farmyard manure and soil alone at 13 and 16 DAS as the above growth media has produced higher shoot and root length by supplying more nutrients to the rice seedlings which resulted in higher dry matter production. Similar results were reported by Rajendran*et al.* (2005) who recorded increase in biomass production with mat nursery comprising of soil + pressmud cake mixture (1:1).

The study conducted on standardization of bedding material and foliar application of nutrients for tray nursery revealed that, bedding material comprised of soil with pressmud cake (SPMC) can be recommended as media for tray nursery raising for Mechanized System of Rice Intensification (MSRI) and soil with vermicompost (SVC) may be tried as next alternative as both were comparable in growth parameters and were significantly better over soil with farmyard manure (70:30) and soil alone. Foliar application of urea @ 0.5% at 10 DAS can be suggested for tray nursery as it has recorded numerically better growth parameters compared to other foliar applications studied.

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