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Evolution of alternative filling materials replace to the soil media for raising nursery seedlings in fileds of Chittoor district

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■ **ABSTRACT :** This study was conducted to investigate on alternative tray filling materials to replace the soil media on crop growth, yield characteristics and yield attributes in The Mechanized System of Rice Intensification (MSRI). Focusing on the different alternative filling materials suitable to replace the soil media with 100% seed germination, Ten treatments with different combinations were experimented and a fine thin layer of well decomposed farm yard manure was spread over all ten treatments o bed filling material [(*i.e.*, T_1 - 10% groundnut shell + 90 % soil; T_2 - 10% vermin-compost+ 90% soil; T_3 - 10% rice husk+90% soil; T_4 - 25% vermin-compost + 75% soil; T_5 - 25% rice straw + 75% soil; T_6 - 25% rice husk + 75% soil; T_7 - 10% rice straw+ 90% soil; T_8 - 25% groundnut shell +75% soil; T_9 - Field soil (100%) (MT); T_{10} - Manual plantin (MP)]. The observation of transplanted hills was also noted in root growth and leaf number, leaf area index and number of tillers and panicle number, panicle length and grain number per panicle, grain filling and 1000-grain weight and straw weight. The raising nursery with different bedding materials transplanted with machine significantly influenced grain yield per hectare. The results revealed that highest grain yield per hectare was observed with T_8 (25% GS) as 4858.5 kg/ha and followed by T_4 (25% VC) as 4685 kg/ha. However, the lowest grain yield was recorded at 2212.6 kg/ha was observed in T_6 (25% RH), due to lowest N, P, K contents in rice husk bed material. It is also observed from transplanted crop that root length was highest with T_5 (25% RS) as 11.39 cm followed by T_3 (10% RH) as 11.16 cm, whereas lowest root length 9.10 cm, root spreading was highest with T_8 (25% GS) as 20.72 cm followed by T_1 (10% GS) as 19.46 cm, T_2 (10%VC) as 19.00, T_4 and 9 are comparable with each other and is 18.47 cm. whereas lowest root spreading 13.08 cm was observed in T_{10} (manual planting). Finally it has been concluded that there is significant effect of bedding materials on crop growth and yield parameters.

■ **KEY WORDS :** MSRI, SRI, Bedding materials, Yield, Crop parameters

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Rice (*Oryza sativa* L.) is a member of Gramaine family and is relished as staple food. It is most important crop in India, covering an area of about 44 million hectares with an annual production of 90 million tonnes and productivity of 2086 kg/ha. Across South Asia, labour scarcity is a major problem and there is a need to explore establishment methods for rice that require less labour but still allow the crop to be transplanted on time. Mechanical transplanting of rice is the process of transplanting young rice seedlings, which have been

grown in a tray nursery, using a self-propelled rice transplanter. In conventional manual transplanting practice, 8-12 laborers' are required to transplant one acre. However, if a self propelled rice transplanter is used, three people can transplant up to four acres in a day. The nursery was prepared in trays. Trays are filled with good soil and each tray is filled by approximately 5 kgs soil required. The seed rate in nursery trays was 110-120 g. The number of required nursery trays was 160 trays per hectare of the field. The seed rate was about 30 kg seed and 90 kg of soil for filling the trays is soil required for transplanting of 1 ha area. To fill the tray, dry soil need to be procured, pulverized and screened soil. The availability of dry soil during sowing season is very limited due to rains, hence the farmer need to procure dry soil in advance and stored in roofed structure. This is not only cost involving process but also time consuming process. To reduce the difficulty and reduce the cost of raising nursery the experiment was conducted to suggest suitable readily available (farm waste) alternative material for seed bed preparation in the trays for MSRI.

METHODOLOGY

The experiment was conducted at Agricultural Farm, Agricultural Research Station, Acharya N.G. Ranga Agricultural University, Perumalapalli, Tirupati and Andhra Pradesh. Perumallapalli was geographically situated at 13.61°N latitude, 79.33°E longitude and at an altitude of 150 m above the mean sea level. The experimental plots were planted at a general spacing of 30 x 14 cm by using mechanical transplanter by running length wise of the field on the puddled and levelled. The seedlings were transplanted within 30 minutes after uprooting and 3-7 seedlings were placed in each hill. The water level in the field was kept at 2 cm only to avoid floating of seedlings. Four and five seedling per hill and young seedlings of 12 to 14 days old, quality seeds ensure vigorous seedling growth, absolute establishment in the field, uniform plant population and accelerated growth rate, resistance against pest and diseases and uniform maturity at harvest. Most importantly a quality seed was selected to have above 90 per cent germination rate.

For the experiment a fine thin layer of well decomposed farm yard manure (FYM) was spread over all the soil and different bed filling material (*i.e.,* 10% Rise straw + 90 % soil, 25% rice straw +75% soi1,10% vermi-compost, 25% vermi- compost+75 soi1,10% ground nut shell+ 90% soil, 25% ground nut shell+ 75% soil, 10% rice husk + 90% soil, 25% rice husk+ 75% soil and 100% soil) were used for rising nursery. Rice straw was used as a covering material over the trays for retention of soil moisture. The nursery was raised upto 15 days and the seedlings are transplanted on 17th day of sowing. Soil is an important resource exhausting day by day due to different reasons. The conservation of soil is important aspect to be considered. In MSRI, the basic material for filling tray is soil. It requires 6 kg of soil in one tray. For growing nursery for one acre 75 trays are required. It means it require 450 kg of soil. The requirement of soil for one hectare is 1125 kg which is more than one tonne per hectare. For excavation and transportation requires lot of labour and money. The excavation of soil also leads to imbalance of eco system. If this soil is replaced by any filling material which costs less than this cost of soil leads to compensate all the above problems.

RESULTS AND DISCUSSION

The following data were collected from the day of sowing of the crop for assessing the effect of soil media on growth parameters of the crop. For periodical observations 10 plants per each in experiment was selected randomly from each treatment and was tagged. Plant height, no of tillers and yield parameters. Plant height was measured at 15 DAT from date of transplanting. Numbers of tillers were measured at 30, 60 and 90 days after transplanting and the numbers of tillers were summed upto the previous number.

Plant height:

Plants height at 10 DAT was highest with T_1 (10% G.S) as 8.40 cm followed by T_4 (25% V.C) as 8.30 cm, whereas lowest plant height was at 10 DAT, 7.20 cm was observed in T_7 (10% R.S). Ahmed *et al*. (2008) confirmed these results. Transplanting of seedlings from younger stage provides sufficient nutrients for vegetative growth and also for reproductive phase which ultimately leads to increased plant height. Similar finding was reported by Krishna *et al.* (2008) and Dhananchezhiyan *et al*. (2013).

Number of tillers:

Numbers of tillers at 15 DAT were numerically

higher with treatment 10 (manual planting) as 6.75, whereas lowest number of tillers was at 15 DAT, 5.00 were observed in treatment 2 (l0% WC). However, number of tillers at 30 DAT showed significant variability among the treatments and highest tiller number was recorded with treatment 8 (25% GS) as 14.50 followed by treatment 10 (manual planting) as 13.25, whereas lowest number of tillers was at 30 DAT. 9.50 was observed in treatment 2. Number of tillers per plant was also varied significantly at 60 DAT and superiority of MSR1 method of transplanting was clearly evidenced compared to manual planting, which recorded lowest number of tillers per plant (24.00). Among the different nursery bedding materials, treatment 3 (10% RH) recorded highest number of tillers per plant (36.75) and other treatments T_4 (36.501.T_5 0430) To 435:10 pec T_8 (34.50) recorded at par values, whereas lowest number of tillers (23.7) were recorded in treatment 9 (field soil). as shown in Table 1 and depicted in Fig.1 to was significantly influenced by different bedding material used for nursery rising.

The results were in accordance with the reports of Aime *et al*. (2014). This advantage of SRI method in enhancing tiller numbers has been reported by Gani *et al*. (2002).

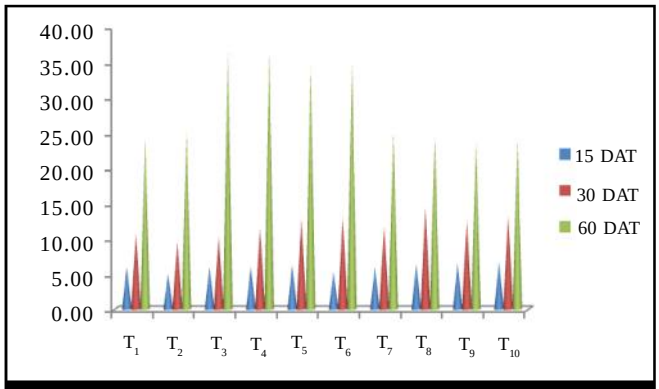

Fig. 1 : Mean number of tillers in different treatments at different DAT

Yield and grain yield parameters:

Grain yield parameters are *i.e*. panicle length, number of productive tillers, unproductive tillers, filled grains, unfilled grains and total grains are taken the data was analyzed with procedure of Randomized Block Design. ANOVA test was performed at 5 per cent level of significance and the results are presented in table. The results revels that grain yield parameters *i.e*. the panicle length, number of productive tillers, unproductive tillers, filled grains, unfilled grains and total grains as shown in Table 2 and depicted in Fig. 2 to 4 was significantly influenced by different bedding material used for nursery rising.

Panicle length:

Panicle length was height with treatment 9 (Field soil) as 20.90 cm, followed by T_4 (25%VC) as 20.36 cm, T_{10} (manual planting) as 20.31 cm, T_2 (10% VC) as 20.25 cm, T_7 (10% RS) and T_5 (25% RS) as 20.12 cm and 20.02 cm, T_6 (25% RH), T_8 (25% GS) as 19.63,

Table 1 : Mean number of tillers per plant in different treatments at different days after transplantation

Treatments	Number of tillers at 15days	Number of tillers at 30 days	Number of tillers at 60days
T_1	6.00	10.75^{bc}	24.25^{b}
T_2	5.00	9.50^{c}	25.25^{b}
T_3	6.00	10.25^{bc}	36.75^{a}
T_4	6.00	11.50^{abc}	36.50^{a}
T_5	6.25	12.75^{ab}	34.50^{a}
T_6	5.25	13.00^{ab}	35.00^{a}
T_7	6.00	11.75^{abc}	25.00^{b}
T_8	6.50	14.50^{a}	24.50^{b}
T_9	6.50	12.50^{ab}	23.75^{b}
T_{10}	6.75	13.25^{ab}	24.00^{b}
Mean	6.025	11.97	28.95
C.D. (P=0.05)	NS	1.86*	2.32*
CV(%)	22.07	15.21	7.83

***** indicate significance of value at P=0.05**.** NS=Non- significant

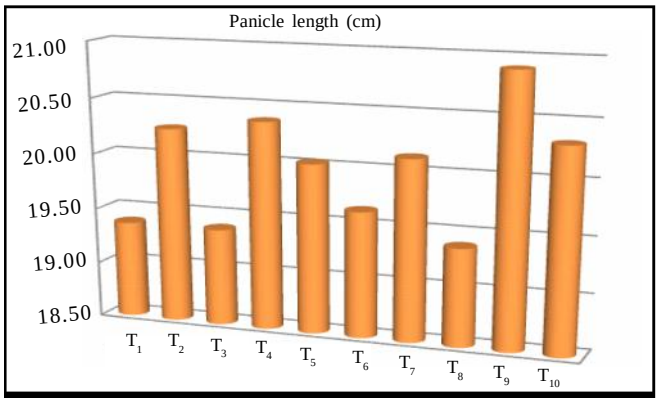

Fig. 2 : Mean panicle length in different treatments at DAT

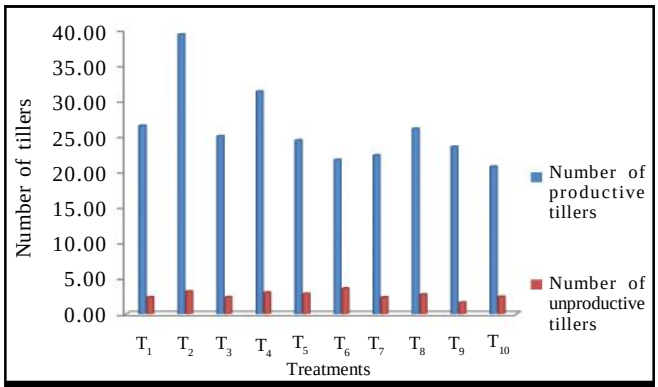

Fig. 3 : No. of productive tillers and unproductive tillers in different treatments at different DAT

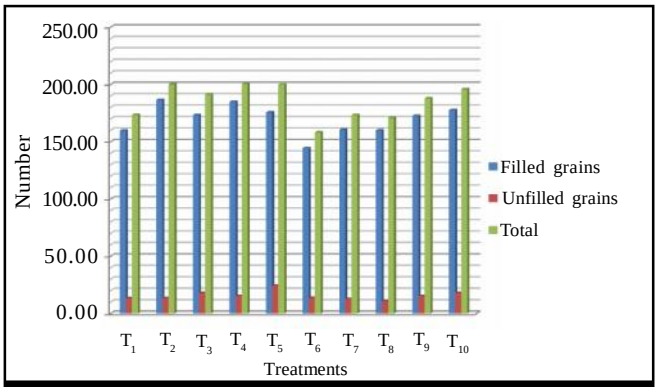

Fig. 4 : Filled grains, unfilled grains and total grains in different treatments at different DAT

19.38, whereas lowest panicle length was observed with T_1 (10% GS) and T_3 (10% RH) as 19.37cm. This was in accordance with results of Srinivasulu *et al*. (2014).

Number of productive tillers :

Number of productive tillers was highest with T_2 (10%VC) as 39.45 followed by T_4 (25% VC) as 31.37, T_1 (10% GS) as 26.57, T_8 (25% GS) as 26.15, T_3 (10% RH) as 25.10, T_5 (25% RS) as 24.50, T_9 (Field soil) as 23.60, T_7 (10% RS) as 22.40 and T_6 (25% RH) as 21.77, whereas lowest number of productive tillers was observed as 20.80 with T_{10} (manual planting).

Number of unproductive tillers:

Number of unproductive tillers was highest in T_6

Table 2 : Mean plants heights, panicle length, number of productive tillers, unproductive tillers, filled grains, unfilled grains and total grains in different treatments at different days after transplantation

Treatments	Panicle length (cm)	Number of productive tillers	Number of unproductive tillers	Filled grains	Unfilled grains	Total grains
T_1	19.37^{c}	26.57^{c}	2.37^{bc}	159.93^{bc}	13.55	173.47^{bc}
T_2	20.25^{ab}	39.45^{a}	3.20^{ab}	186.58^{a}	13.65	200.22^{a}
T_3	19.37^{c}	25.10^{cd}	2.40^{bc}	173.33^{ab}	18.12	191.45^{ab}
T_4	20.36^{ab}	31.37^{b}	3.05^{ab}	185.05^{a}	15.40	200.45^{a}
T_5	20.02^{bc}	24.50^{cd}	2.87^{ab}	175.65^{ab}	24.32	199.97^{a}
T_6	19.63^{bc}	21.77^{cd}	3.62^{a}	144.53^{c}	13.75	158.27^{c}
T_7	20.12^{bc}	22.40^{cd}	2.37^{bc}	160.55^{bc}	12.80	173.35^{bc}
T_8	19.38^{c}	26.15^{c}	2.77^{abc}	160.00^{bc}	10.90	170.90^{bc}
T_9	20.90^{a}	23.60^{cd}	1.62^{c}	172.65^{ab}	15.30	187.95^{ab}
T_{10}	20.31^{ab}	20.80^{d}	2.47^{abc}	177.70^{ab}	18.20	195.9^{0a}
Mean	19.97	26.17	2.67	169.59	15.60	185.19
C.D. (P=0.05)	0.49*	3.14*	0.74*	15.01*	NS	13.40*
CV(%)	2.41	11.71	27.03	8.62	33.37	7.05

***** indicate significance of value at P=0.05; NS= Non- significant

(25% RH) as 3.62 followed by T_2 (10% VC), T_4 (25% VC) as 3.20, 3.05, T_5 (25% RS) as 2.87, T_8 (25% GS) as 2.77, T_{10} (manual planting) as 2.47, T_3 (10%RH) as 2.40, whereas lowest number of unproductive tillers was observed as 2.37 with T_1 (10% GS) and T_7.

Number of filled grains:

Number of filled grains was height T_2 (10% VC) as 186.58 followed by T_4 (25% VC) as 185.05, T_{10} (manual planting) as 177.70, T_5 (25% RS) as 175.65, T_3 (10% RH) as 173.33, T_9 (field soil) as 172.65, whereas lowest number of filled grains was observed as 144.53 with T_6 (25% RH), T_1 as 159.33 with (10% GS) followed by T_8 (25% GS) as 160.00 and T_7 (10% RS) as 160.55.

Number of unfilled grains:

Unfilled grains was height T_5 (25%RS) as 24.32 followed by T_{10} (manual planting), T_3 (10% RH), T_4 (25% VC), T_9 (field soil), T_6 (25% RH), T_2 (10% VC), T_1 (10% GS) and T_7 (10% RS) as 18.12, 15.40, 15.30, 13.75, 13.65, 13.55 and 12.80. Whereas lowest number of unfilled grains was observed as 10.90 with T_8 (25% GS).

Total grains :

Total grains was height T_4 (25% VC) followed by T_2 (10% VC), 5 (25% RS), 10 (manual planting), 3 (10% RH), 9 (Field soil), T_1 (10%GS), T_7 (10% RS) and T_8 (25%GS) as 200.45, 200.22, 199.97, 195.90, 191.45, 187.95, 173.47, 173.35 and 170.90, whereas lowest total grains was observed as 158.27 with T_6 (25% RH).

The DMRT test result of the treatment means at different treatment means are presented. In grain yield parameters *i.e.* panicle length, number of productive tillers, unproductive tillers, filled grains, unfilled grains and total grains are taken. The DMRT test reveals that yield parameters. There is significant difference between treatment means with respect to yield parameters *i.e.* panicle length, number of productive tillers, unproductive tillers, filled grains, unfilled grains and total grains. Further treatments grouping was done based on DMRT for significant parameters. The result reveals that at panicle length, there is significant difference between T_9 is on par with T_4, T_7 and T_{10}. There is significant difference between T_4 is on par with T_{10}, T_2, T_7, T_5, T_6 and T_7 is on par with T_5, T_8, T_3 and T_7.

DMRT test of number of productive tillers, there is significant difference between T_6 with other groups. T_1 is on par with T_8, T_3, T_5, T_9, T_7 and T_6. T_3 is on par with T_5, T_9, T_7, T_6 and T_{10}. The DMRT test reveals that, the number of unproductive tillers, there is no significant difference between T_6 is on par with T_2, T_4, T_5, T_8 and T_{10}. There is no significance difference between T_2, T_4, T_5, T_8, T_{10}, T_3 and T_1. There is significant difference between T_8, T_{10}, T_3, T_1 and T_7. The DMRT test reveals that the filled grains, there is no significant difference between and T_4, T_{10}, T_5, T_3 and T_9. There is no significant difference between T_{10}, T_7, T_5, T_3, T_9, T_7, T_8 and T_1. There is no significant difference between treatment means T_7, T_8, T_1 and T_6. The DMRT test reveals that the unfilled grains, there is no significant difference

Table 3 : Mean grain yield, straw yield and thousand grain weight in different treatments at different days after transplantation

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Thousand grain weight (g)
T_1	4524.80^{a}	5081.00^{a}	13.77^{a}
T_2	4628.30^{a}	4862.00^{ab}	12.80^{b}
T_3	2765.80^{c}	3600.00^{c}	11.37^{cde}
T_4	4685.00^{a}	4975.00^{ab}	13.19^{ab}
T_5	2628.00^{d}	2700.00^{de}	10.94^{cde}
T_6	2212.60^{e}	2300.00^{e}	10.58^{e}
T_7	2765.80^{d}	2853.50^{d}	10.64^{de}
T_8	4858.50^{a}	4903.80^{ab}	13.96^{a}
T_9	4501.50^{a}	4563.00^{b}	11.53^{cd}
T_{10}	3565.50^{b}	3674.50^{c}	11.76^{c}
Mean	3752.78	3944.52	12.05
C.D. (P=0.05)	263.23*	284.41*	0.60*
CV(%)	6.83	7.02	4.85

* indicate significance of value at P=0.05, NS=Non- significant

between treatment means. The DMRT test on total grains, T_4 is on par with T_2, T_5, T_{10}, T_3 and T_9. There is no significant difference between T_3 and T_9, T_1, T_7 and T_8. There is no significant difference between T_1 and T_7, T_8 and T_6.

Yield parameters:

Grain and straw yield and thousand grain weight of rice was significantly influenced by bedding materials used for rising nursery. The data was analyzed with standard procedure of Randomized Block Design. Various treatments (Bedding materials) are differing significantly in respect of grain yield and straw yield and thousand grain weight at 5 per cent level of significance as resulted in ANOVA test as shown in Table 3 and depicted in Fig 5 and 6 was significantly influenced by different bedding material used for nursery rising.

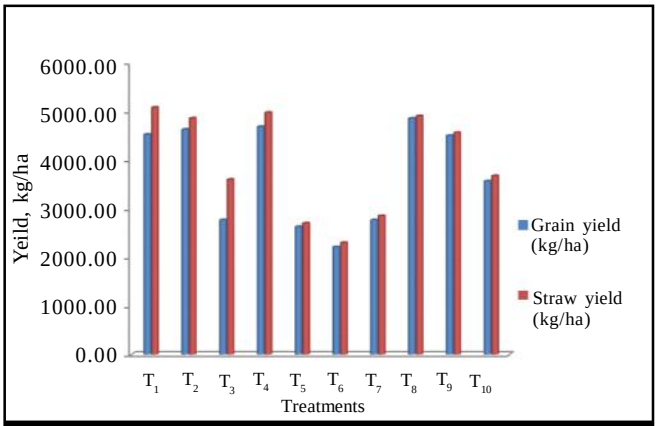

Fig. 5 : Mean grain yield characteristics in different treatments at different days after transplantation

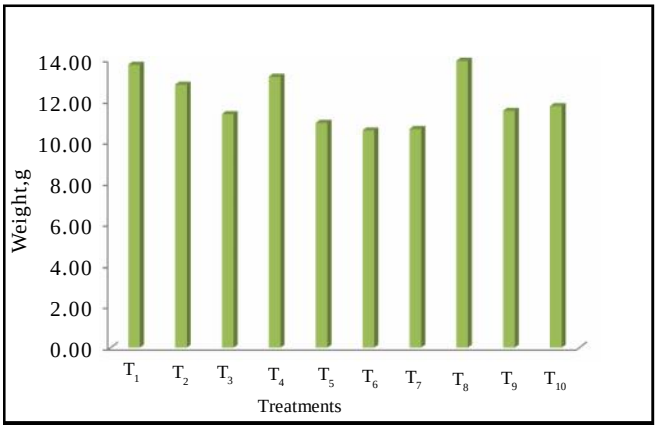

Fig. 6 : Mean in thousand grain weight different treatments at different days after transplantation

Grain yield:

The results revealed that raising nursery with field soil alone and mixed with different bedding material and transplanted with MSRI method significantly influenced by grain yield per hectare was significantly higher with treatment 8 (25% GS) as 4858.5 kg/ha and other treatments 4 (4685.0 kg/ha), treatment 2 (4628.3 kg/ha) and treatment 1 (4524.8 kg/ha) recorded at par values. These treatments also showed significantly higher grain yield over manually transplanted treatment. Superiority of these treatments compared to field soil alone can be explained due higher N,P, K contents and higher seedling growth and early establishment in the field. Lowest grain yield of 2212.6 kg/ha was observed in treatment 6 (25% RH), due to lowest N.P.K contents in rice husk.

Straw yield:

Straw yield was also superior with the seedling transplanted by MSRI method compared to manually transplanted method (3674.5kg/ha). Straw yield was also significantly higher with treatment T_1 (5081.0 kg/ha) compared to other treatments followed by treatment 4 (4975.00 kg/ha), treatment 8(4903.8 kg/ha) and T_2 (4862 kg/ha). Similar to grain yield lowest straw yield of 2300 kg/ha was also recorded in treatment 6 (25% RH). Kakumanu *et al*. (2011).

Thousand grain weight:

Thousand grain weight is an important yield component which also influence grain yield. thousand grain weight was also highest with treatment 8 (25% GS) as 13.86 g followed by treatment 1 (10% GS) as 13.77g. Treatment 8, 3 and treatments are comparable to each other, whereas lowest thousand grain weight, 10.58 g was observed in treatment 6 *i.e.* 25 per cent rice husk as observed in grain and straw yield.

The DMRT test result of the treatment means at different treatment means are presented in grain, straw yield and thousand grain weights, there is significant difference between treatment mean 6 with other groups. The DMRT test reveals that at grain yield (kg/ha), there is significant difference between treatment means with respect to grain yield (kg/ha), straw yield and thousand grain weight. Further treatments grouping was done based on DMRT for significant parameters. The results revels that at grain yield (kg/ha), there is no significant

difference between T_8 and T_4, T_2, T_1 and T_9 was grouped 'a'. There is significant difference between T_{10} and other means and was grouped with 'b'. There is significant difference between T_3 and other means and was grouped 'c'. T_7 is on par with T_5. Treatment means of straw yield shown significant difference between T_{10} and T_3 and other groups and was grouped 'c'. T_1 is on par with T_4, T_8 and T_2 was grouped. T_4 is on par with T_8, T_2 and T_9. T_7 is on par with T_5, T_5 is on par with T_6. Thousand grain weights means shown significant difference between all treatments with each other. T_8 is on par with T_1 and T_2. T_4 is on par with T_2. T_{10} is on par with T_9, T_3 and T_5. T_9 is on par with T_3, T_5 and T_7. T_3 is on par with T_5, T_7 and T_6. Comparatively highest grain yield with T_8 (25% GS) because more nutrient value in groundnut shell useful for plant growth. Finally it has been concluded that there is significant effect of bedding materials used for rising nursery on grain yield, straw yield and thousand grain weights.

Conclusion:

Among the ten different media *viz.*, 10%RH, 10% RS,10%VC, 10%GS, 25%RS, 25%RH, 25%GS, 25%VC and field soil. The picking performance of transplanting was good in the case of vermin compost and ground nutshell media. Higher yields were realised when bedding material was prepared in trays with groundnut shell and vermin compost media.

Higher yields were realised when groundnut shell and vermin compost was used as nursery tray bedding material in certain proportion, it may be due to better initial establishment in the main field.

By replacing soil with different bedding material of N, P and K values were 1.7, 0.72 and 1.9 per cent farmer not only benefitted by displacement soil but also improves the soil health by adding humus in to the soil strata.

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