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Effect of Nutripriming Treatments on Growth Parameters of Rice Seedlings in Nursery Tray

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ABSTRACT

An experiment was carried out at Agricultural Research Station, Mannuthy, Kerala to evaluate the effect of nutripriming on tray nursery technique in rice. Nutripriming treatments viz. priming with 0.1% urea, 0.01% borax, 0.05% $ZnSO_4$, combinations of urea with borax and $ZnSO_4$, combination of urea, borax and $ZnSO_4$, 1% Pseudomonas fluorescens and 1% PGPR mix I were applied to seeds grown in seedling trays filled with growing media containing 60% rice husk charcoal + 20% soil + 20% coir pith compost. Combined application of urea, zinc and borax was superior with respect to growth parameters of seedling and mat characteristics. Higher Ca, Mg, S and B uptake was also observed in this treatment. Hence, nutripriming with 0.1% Urea + 0.05% $ZnSO_4$ + 0.01% Borax was found to be a better practice for quality tray nursery production in rice.

KEYWORDS

Nutripriming, Growing media, Zinc, Boron, Urea, Tray nursery

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INTRODUCTION

In Kerala, paddy is cultivating in almost all districts during three unique seasons of virippu, mundakan and puncha. It occupies 1.94 lakh ha with an annual production of 5.21 lakh tonnes with an average productivity of 2684 kg ha^{-1} (Anonymous, 2019). Nowadays, Kerala is facing drastic decline in paddy cultivation due to labour shortage. In the context of labour shortage and growing commercialization of agriculture, mechanization is very important for ensuring timeliness and precision of operation. Mechanical transplanting of rice seedling is the key link to the entire mechanization of paddy cultivation. Lack of proper standardization of tray nursery production technologies are one of the hurdles against the appropriate exploitation of transplanting machineries.

Early germination, better seedling development, uniform crop establishment and good strength of mat are major determinants of good quality tray nursery for proper mechanical transplanting. A survey conducted under the project entitled 'Soil based plant nutrient management plan for agro-ecosystems of Kerala' by Kerala State Planning Board reported widespread deficiency of Zn and B in soils of Kerala (Anonymous, 2020). Both macro and micro nutrients play very important role in crop growth, development and yield. Imbalance or lack of any essential element causes suppression or complete inhibition of plant growth (Mengel *et al*, 2001). In order to obtain healthy and vigorous seedlings, proper nutrient management is inevitable. In this regard, nutripriming technique is an effective means for nutrient supply. Seeds primed with nutrients act as a channel for the delivery of specified quantities of fertilizer and may help for proper exploitation of yield potential of rice crop.

Nutripriming is a novel seed invigoration technique which includes restricted hydration of seeds in nutrient solution and drying process (Farooq *et al*, 2011). It is a simple and low cost technique for improved germination, seedling growth and increased yield (Yilmas et al., 1998) and also practiced to overcome micro and macro nutrient deficiencies of soil (Harris *et al*, 1999).

MATERIALS AND METHODS

In this context, A study was conducted to assess the effect of different nutripriming techniques for production of quality tray nursery of rice. Experiment was conducted at Agricultural Research Station, Mannuthy in Thrissur district of Kerala during July, 2015. The research station is situated at a latitude 10°31'12.9" N, longitude 76°13'14.4" E and altitude 40.29m above mean sea level. The experiment was designed under CRD with 9 treatments and replicated thrice using rice variety Jyothi. Trays of dimension 60 x 22 cm were used to raise the seedlings of rice in nursery. Trays were filled using Automatic Rice Mat Nursery Sowing Machine with growing media of 60% rice husk charcoal + 20% soil + 20% coir pith compost (Table 1). Nutripriming treatments viz. priming with 0.1% urea, 0.01% borax, 0.05% $ZnSO_4$, combinations of urea with borax and $ZnSO_4$, combination of urea, borax and $ZnSO_4$, 1% Pseudomonas fluorescens and 1% PGPR mix I were studied. Nutrient solutions were prepared by dissolving the required quantity of nutrient in water to get desired concentration as per treatment. Seeds were

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soaked in the nutrient solutions of required concentration (w/v) for 12 h under room temperature. Seeds were taken out of solution after 12h and dried to its original weight under shade. Biometric observations viz. days to 50% germination, seedling height, biomass production, shoot dry weight and dry matter production were recorded at transplanting (15DAS). Mat characteristics viz. mat weight per unit area, shearing strength and slippage of mat were also recorded.

Table 1: ifferent experimental treatments

Treatments	Descriptions
T_1	0.1 % Urea
T_2	0 .01% Borax
T_3	0.05% $ZnSO_4$
T_4	0.1% Urea + 0.01% Borax
T_5	0.1% Urea + 0.05% $ZnSO_4$
T_6	0.1% Urea + 0.05% $ZnSO_4$ + 0.01% Borax
T_7	1.0% Pseudomonas fluorescens
T_8	1.0% PGPR mix-1
T_9	Control (water soaking)

Shearing strength of mat was measured as the force required for tearing the nursery mat using a special device fabricated by Mathew (2015). Weight applied on the rope of the device at the time of breaking the mat was recorded and strength of the mat was expressed as force per unit area in kg m^{-2}. For the measurement of slippage, nursery mats were kept on the seedling platform of mechanical transplanter and marked its original position. Transplanter was kept on movement for a specified period of time (1 min.) and distance of slipping from original position was measured using a ruler and expressed in mm min^{-1}. Macro and micro nutrient contents of the seedlings at the time of transplanting were determined (Jackson, 1958) and multiplied with the dry matter production at the time of transplanting to get nutrient uptake by the seedlings and expressed as g $tray^{-1}$. Statistical package Web Agri Stat Package (WASP 2.0) was used for the statistical analysis of data.

RESULTS AND DISCUSSION

All the treatments were found to be similar with respect to the days to 50 % germination. The mean days to 50% germination was 3.26 (Table 2). Seedling height could be considered as an indicator of healthy nursery (Dhananchezhiyan *et al*, 2013). In the present study, mean plant height was 13.15cm (Table 1). The tallest seedlings were produced with urea priming and priming with combined solution of urea+ borax+ $ZnSO_4$ which were significantly superior to other treatments. Biomass production and shoot dry weight were also significantly influenced by the treatments. Combined application of urea, borax and $ZnSO_4$ through priming contributed to the build up of significantly higher biomass and shoot dry weight. According to Marschner *et al* (1997), N related processes like protein and chlorophyll synthesis influence the photosynthesis and lead to the elongation of stem. Boron is essential for the formation and development of new cell in the plant meristem Tisdale *et al* (1995). Zn is involved in the cell proliferation and differentiation as it is an integral part of transcription factors (Vallee and Falchuk, 1993). All these might have contributed to the increased seedling growth in the combined nutripriming. Seed priming with solution of urea+ borax+ $ZnSO_4$ produced higher dry matter also.

Table 2: Effect of nutripriming treatments on growth parameters of seedlings in tray nursery ofrice (15 DAS)

Treat-ments	Days to 50% germination	Seedling height (cm)	Biomass production (mg)	Shoot dry weight (mg)	Dry matter production (mg)	Mat weight per unit area (kg/m^2)
T_1	3.00^a	14.02^a	96.50^{ab}	10.77^{ab}	15.00^a	11.25^c
T_2	3.67^a	13.21^b	83.80^{cd}	9.77^{cd}	13.63^b	11.90^b
T_3	3.33^a	12.73^{bc}	88.67^{bcd}	10.17^{bc}	14.50^a	11.90^a
T_4	3.00^a	13.16^b	90.13^{abc}	10.83^{ab}	14.53^a	10.00^{cd}
T_5	3.33^a	12.76^{bc}	89.43^{bcd}	10.60^b	14.73^a	13.00^a
T_6	3.00^a	14.41^a	99.83^a	11.40^a	15.27^a	11.90^b
T_7	3.67^a	12.86^{bc}	79.80^d	9.13^d	12.07^c	8.10^d
T_8	3.00^a	12.83^{bc}	85.97^{cd}	9.37^d	13.53^b	13.10^a
T_9	3.33^a	12.41^c	89.37^{bcd}	10.77^{ab}	14.97^a	11.30^c

* The means superscripted by common alphabets in a column do not differ significantly at 5% level in DMRT

All the mats were light in weight as the growing media contained only a small proportion of soil and high proportion of rice husk charcoal. Light weight mats are more preferred in commercial mat nursery production due to the easiness in transporting. Light weight mats were produced by 1.0% Pseudomonas fluorescens treatment. It might be due to low biomass production noticed in this treatment. However, light weight caused from low biomass production can't be considered as a good quality with regard to quality mat nursery. Lower density of mat was also observed with this treatment. Shearing strength is an index of stiffness of mat. Mats should be stiff enough for easy handling and proper picking by finger of transplanter. In this study, the highest shearing strength was recorded by the 1% PGPR mix I treatment (Figure 1). Longer roots and higher root dry weight observed with this treatment might attributed for the higher shearing strength of mat. Longer roots lead to the proper entanglement of root and there by contributed to the strength of mat. Slippage indicates the extent of slipping of mat nursery from original place on seedling platform of mechanical transplanter during working of the machine. Seedling mat with less slippage was found to be ideal for smooth transplanting under mechanisation. Lower slippage was observed in priming with PGPR mix I, Pseudomonas fluorescens and urea+ borax+ $ZnSO_4$ (Figure 2). This indicated adequate formation of mat for mechanical transplanting in these treatments.

CONCLUSION

eeds primed with nutrients act as a channel for the delivery of specified quantities of fertilizer which aids inbetter seedling growth and thereby helping proper development of paddy tray nursery. In this experiment, seedling growth parameters and favourable mat characteristics were obtained with combined application of urea+ borax+ $ZnSO_4$ through seed priming. Hence, it is concluded that nutripriming with 0.1% urea + 0.05% $ZnSO_4$ + 0.01% borax was found to be a better practice for quality tray production and smooth mechanical transplanting in rice.

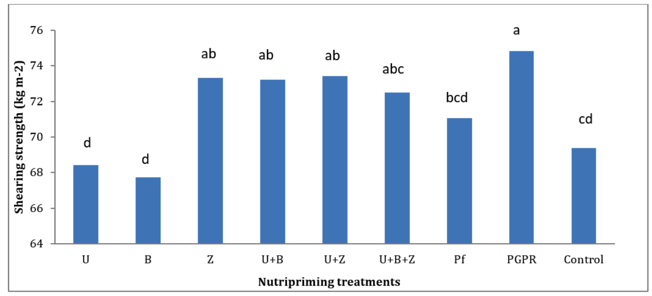

Fig. 1: Effect of nutripriming treatments shearing strength of mat

Combined application of urea+ borax+ $ZnSO_4$ through seed priming improved the Ca, Mg, S and B uptake by the seedlings. N, P and Mg uptake by the seedlings was not significantly influenced by the priming treatments (Table 3).

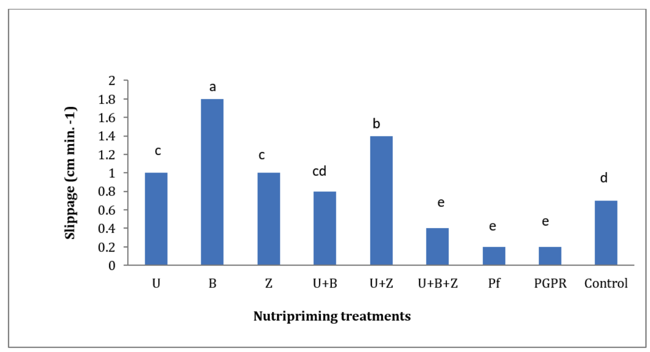

Fig. 2: Effect of nutripriming treatments on slippage of mat

Table 3: Effect of nutripriming treatments on nutrient uptake by the seedlings in tray nursery of rice

Treatments	N(g tray $^{-1}$)	P(g tray $^{-1}$)	K(g tray $^{-1}$)	Ca(g tray $^{-1}$)	Mg(g tray $^{-1}$)	S(g tray $^{-1}$)	Fe(mg tray $^{-1}$)	Zn(mg tray $^{-1}$)	Mn(mg tray $^{-1}$)	B(mg tray $^{-1}$)
T_1	1.62^a	0.68^a	1.67^{ab}	0.32^b	34.19^a	0.27^{ab}	27.69^b	4.36^{de}	19.83^{abc}	0.78^a
T_2	1.51^a	0.56^a	1.33^{cd}	0.24^b	28.17^a	0.23^{abcd}	14.90^b	3.37^e	15.30^{cd}	0.48^{bc}
T_3	1.99^a	0.59^a	1.28^{cde}	0.31^b	33.86^a	0.26^{abc}	17.66^b	6.27^{ab}	15.59^{cd}	0.66^{ab}
T_4	1.24^a	0.57^a	1.83^a	0.26^b	35.76^a	0.21^{bcde}	49.69^a	7.22^a	19.22^{abc}	0.34^c
T_5	1.69^a	0.69^a	1.50^{bcd}	0.32^b	37.40^a	0.26^{ab}	18.69^b	6.16^{abc}	21.99^{ab}	0.69^{ab}
T_6	2.09^a	0.61^a	1.24^{de}	0.44^a	38.99^a	0.28^a	18.48^b	6.51^{ab}	17.52^{bcd}	0.75^a
T_7	1.66^a	0.54^a	1.00^e	0.32^b	31.18^a	0.18^{de}	14.86^b	4.50^{cde}	13.27^d	0.65^{ab}
T_8	1.61^a	0.54^a	1.29^{cde}	0.27^b	33.55^a	0.16^e	15.79^b	5.37^{bcd}	23.44^a	0.27^c
T_9	1.52^a	0.68^a	1.55^{abc}	0.32^b	31.74^a	0.19^{cde}	23.14^b	4.98^{bcde}	14.31^{cd}	0.45^{bc}

* The means superscripted by common alphabets in a column do not differ significantly at 5% level in DMRT

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