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Seedling Root Dip in Phosphorus and Micronutrient Treatment in Lowland Rice Based Cropping System in Lawngtlai District Mizoram

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ABSTRACT

A field experiment has been conducted with high yielding variety of rice (cv RCM 6) during 2023-24 *kharif* season to determine impact of Phosphorus (P) treatment in association with vermicompost and seedling root dip in PSB on length of root at 30 and 45 day after transplanting, height of the plant, number of tiller per hill at 30, 45, 60 DAT and at harvest including seed yield. The experiment was carried out at Sihtlangpui, Krishi Vigyan Kendra Farm, Lawngtlai district, Mizoram. The height of the crop was significantly higher as 72.6, 112.3, 145.6 and 144.6 cm at 30, 45, 60 days after transplant and at harvest respectively in T3 over control and T2. The same trend was seen in number of tillers per hill. The length of the root also increased significantly from control at 30 and 45 DAT. The highest yield (4.9 t/ha) was observed in T3- Seedling root dip + Vermicompost + RDF which was significantly higher over control. It was evident that dipping the seedling root in Phosphorus Solubilizing Bacteria (500ml/L) mixed well with 5kg compost incorporated with recommended dose of fertilizer (80:60:40 NPK/ha) and vermicompost (10t/ha) during land preparation resulted in highest yield and could be recommended to farmers to augment the yield of lowland rice in Lawngtlai distict.

Key Words: Height, Phosphorus Solubilizing Bacteria, Tillers, Vermicompost, Yield.

INTRODUCTION

Rice is a *Kharif* season crop adapted to warmer region during the monsoon season. It is mainly grown from June to September. In India the maximum rice producing states includes Odisha, West Bengal, Bihar, Andhra Pradesh, Uttar Pradesh, Punjab, Chhattisgarh and Tamil Nadu with production of 7.168 million MT during 2019-20 which constitute 7.42% and 6.03% respectively to the total area as well as production of rice in India (Laitonjam *et al*, 2022). Mizoram is a hilly state of North East India sharing International border with Myanmar and Bangladesh as well as national border with Tripura, Assam and Manipur. Lawngtlai District is situated at the South end of the State. It is located between the coordinates of 92.30^0 -93^0 E Longitude and 21.58^0 – 22.60^0 N latitudes. The distance from the capital Aizawl is 296 kms with an area of 2557.10 sq.km and is covering 12.13 per cent area of the State (Bhalerao *et al,* 2015). The weather in Lawngtlai district is ideal for growing rice crop with temperatures ranging from 8-24^0C during winter and 18-32^0C during summer months. The average annual rainfall is 2,947mm.

Phosphorus is a primary and essential element for the growth of plant and development. However, large portion of it is unavailable for uptake by crops as it gets fixed (50-90% of added P fertilizer) in the soil and remain in insoluble pool especially in acidic soil of North East India. The Phosphorus remains fixed in the form of insoluble phosphates of Fe^{+2} and Al^{+3} in acidic soil (Kalidas and Thakuria, 2018). This phosphorus fixation leads to low P efficiency, as low as 15-20%. The use of phosphate solubilizing microbes perform an important vital role in solubilizing the insoluble form of phosphorus. Inoculating the roots of the crop with Phosphorus Solubilizing Bacteria and other microbial inoculants in these soil became necessary and advised to maintain and also restore the effective microbial population for solubilizing the fixed phosphorus to produce sustainable yield of rice crop (Raghuveer *et al,* 2015). They further reported that increase in phosphorus level increased the dry matter yield and this can be

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explained from better root proliferation of P treated crops. Similarly, Kalidas and Thakuria (2018) also reported that dipping rice seedling root in compost microbe slurry before transplanting enhances rice yield. Verma *et al* (2017), Koushik *et al* (2021), Ramteke *et al* (2018) reported that incorporating integrated nutrient management with inorganic and organic nutrient management practice gave best and higher yield in lowland rice as well as better biological and physical health of the soil. Thus, the present analysis was undertaken to study the length of the plant root, number of tiller per hill present, height of the crop, and lowland rice yield as affected by phosphorus treatment coupled with other nutrient management practices as well as microbial inoculation of root of rice.

MATERIALS AND METHODS

The experiment was conducted at the field located at Sihtlangpui, KVK Research and Demonstration Farm during the year 2023-24 to study the impact of different amount of Phosphorus treatments in Lowland Paddy at Lawngtlai District. The study area is situated at 22°25'2"N 92°56'12"E. The Experimental field has clay loam textured soil with moderate to high acidic soil (5.2 pH) possessing relatively high Organic Carbon content (1.19%). The chemical analysis of the soil (top 15 cm) showed available nitrogen (188.16kg/ha) determined by Alkaline Potassium permanganate ($KMnO_4$) method, Phosphorus (42.7kg/ha) determined by Bray P1 method and Potassium (724 kg/ha) by Flame photometer (Jackson, 1973). This experimental study was set out in randomized block design (RBD) with three treatments viz., T1- Control, T2- Phosphorus root dip + Vermicompost, T3- Phosphorus root dip + Vermicompost + RDF with three replications (R1, R2 and R3). Recommended dose of fertilizer (80:60:40 NPK/ha) was applied on T3 at transplanting period while nitrogen has been applied in split doses, by broadcasting at 30 and 45 days after transplanting. Well rotten vermicompost (10t/ha) was applied at land preparation in T2 and T3. Similarly, root dipping is done in Phosphorus Solubilizing Bacteria (500ml/L) for 1 hour right before transplanting mixed with well rotten compost (5kg) slurry. The length of the root was recorded at 30 and 45 DAT to check the effect of root dipping in Phosphorus, the height of the plant was measured at 30, 45, 60 DAT as well as at harvest period. Similarly, the number of tillers is recorded at 30, 45, 60 DAT and then when harvested. The data of yield were recorded at harvest *i.e.,* 91 DAT. The statistical analysis was done with one-way ANOVA through statistical software OPSTAT developed by CCS HAU, Hisar (Sheoran *et al,* 1998) and Statistical Error Mean (SEm±) and critical differences were computed.

RESULTS AND DISCUSSION

Length of the root

The length of the root measured after 30 days after transplanting showed significant increase over control (Table 2). Length of the root in control was 11.6cm whereas in T2 and T3 the length of the root was 13cm and 16cm, respectively. Similarly, the length of the root measured at 45 days after transplanting also showed gradual increase over control ranging from 27.3 cm to 31.6 cm. This could very well be the result of positive impact of dipping the root in PSB solution. This finding was in line with Verma *et al* (2017), Singh and Thakuria (2018), Aung *et al* (2020).

Height of the plant

The height of rice crop at 30 DAT ranges between 54.6 to 72.6 cm which were statistically comparable ($p>0.05$, 1 way ANOVA). Similarly, the 45 DAT plant height ranged from 76 to 112.3 cm and 94.6 to 145.6 cm at 60 DAT as well as 95 to 144.6 cm during harvest. The height of the plant gradually and significantly increased with increase in dose of nutrients from Control (T1) to Phosphorus root dip + Vermicompost + RDF (T3). This can be attributed to higher availability of plant growth promoting nutrients with advancing dose of treatments. These findings validated the findings of Meena *et al* (2015)

Number of tillers/hill[1]

The data showed that the number of tillers per hill increased gradually till 45 days after transplanting and a decreasing trend at 60 days after transplanting following increase at the day of

Table 1. Plant height and Numberof tillers/hill at 30, 45, 60 DAT and at the time of harvest in paddy under different treatments

Treatment	Plant height (c m)				Number of tillers/hill			
	30DAT	45DAT	60DAT	Harvest	30DAT	45DAT	60DAT	Harvest
T1	54.6	76	94.6	95	10.3	14.3	11.6	16.3
T2	60.3	82.6	105.6	108.3	11	14.6	12.3	17.6
T3	72.6	112.3	145.6	144.6	12.3	16.3	14.6	26
SEm±	2.06	3.92	3.13	2.95	0.30	0.60	0.45	1.65
CD@5%	8.32	15.81	12.64	11.9	1.25	NS	1.82	6.65

Table 2. Data of Length of Root at 30 and 45 DAT and Yield at harvest

Treatment	Length of Root (cm)		Yield (t/ha)
	30 DAT	45 DAT	Harvest
T1	11.6	27.3	2.5
T2	13	29	3.3
T3	16	31.6	4.9
SEm±	0.60	0.94	0.17
CD@5%	2.45	NS	0.72

harvest (Table 1). The decreasing trend can be attributed to aging and senescence resulting to drying of secondary and tertiary tillers. The highest tiller number per hill was recorded against the combined application of Phosphorus seedling root dip + Vermicompost + RDF (T3) at varying stages of crop development. The magnitude of increase over control were 17%, 13%, 22% and 45% at 30, 45, 60 DAT and at the time of harvest respectively. This increase in number of tillers could be due to better supply of phosphorus (P) with other nutrients and bio organic sources efficiently utilized by rice crop for better growth, multiplication and development of cells. Similar findings were reported by Haque (2021).

Seed yield

The highest grain yield was recorded against treatment with Phosphorus seedling root dip + Vermicompost + RDF which was 4.9 t/ha which exhibited a superiority of 64% and 39% over Control and Seedling root dip + Vermicompost treatment (Table 2). The seed yield showed a gradual significant increase with advance in treatment (T1<T2<T3). This can be attributed to higher photosynthetic activity due to higher leaf area and number of effective tillers ultimately resulting in higher dry matter production which directly lead to higher seed yield. Similar opinion was asserted by (Hague, 2021; Bayan and Lourduraj 2000.

CONCLUSION

It was concluded from the present investigation that incorporating vermicompost in soil and treating the root of rice crop with effective microbes like Phosphorus Solubilizing Bacteria (PSB) along with augmenting with recommended dose of fertilizer shows better yield and could be recommended to farmers.

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