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IMPACT OF PHOSPHATE SOLUBILIZING BACTERIA ON VEGETATIVE PARAMETERS OF RADISH (*RAPHANUS SATIVUS* L.) VAR. IVORY WHITE

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ABSTRACT

The present investigation was conducted at the Horticulture Research Farm, [CRC-1] Department of Horticulture, School of Agriculture, ITM University, Gwalior (M.P.), India. Radish (*Raphanus sativus L.*) is most important root crop is grown widely all over the India, especially near the city markets. It is a popular vegetable in the tropical as well as temperate regions. Radish can cultivated under poly house or glass house for early market but large scale production in field is more common in India. Among various factors responsible for low production of radish, nutrient management is of prime importance for maintaining higher yield and soil fertility. The increasing use of chemical fertilizers to increase vegetable production has been widely recognized but in long run it had detrimental effect on soil health, ecology, natural resources, living organisms including beneficial soil microorganism and human being. Biofertilizers in combination with organic manures found as effective component in organic farming for reliable and cheap supply of nutrients. The experiment was laid out in the Randomized Block Design with three replications. Each replication was comprised of ten treatments consisting phosphate solubilizing bacteria with different RDF doses of fertilizers were applied in radish (*Raphanus sativus* L.). Result concluded that the different RDF doses of fertilizers with use of phosphate solubilizing bacteria were significantly influence different vegetative and yield parameters of radish. The treatment T_7 (30gm/kg P.S.B. + 50:90:50) was found the significantly superior treatment as compared to all other treatments and it also gave the maximum vegetative, yield and economical parameters, whereas the treatment T_0 (50:100:50-Control) observed the minimum vegetative, yield and economical parameters rest of all treatments.
Keywords **:-**Radish, PSB, Fertilizers

Introduction

Radish (*Raphanus sativus L.*) it is most important root crop is grown widely all over the India, especially near the city markets. It is a popular vegetable in the tropical as well as temperate regions. Radish can cultivated under poly house or glass house for early market but large scale production in field is more common in India. Radish is grown for various parts of the plants including roots, leaves and sprouts but mainly for its young tuberous root which is consumed either cooked or raw (Mehwish *et al.,* 2016). Among various factors responsible for low production of radish, nutrient management is of prime importance for maintaining higher yield and soil fertility. The increasing use of chemical fertilizers to increase vegetable production has been widely recognized but in long run it had detrimental effect on soil health, ecology, natural resources, living organisms including beneficial soil microorganism and human being (Mani and Anburani *et al.,* 2018). Biofertilizers in combination with organic manures found as effective component in organic farming for reliable and cheap supply of nutrients. These combinations were ecologically safe and improve soil fertility by improving the soil physical, chemical and biological condition (Sharma *et al.,* 2013).

Material and Methods

The experiment was conducted at the Horticulture Research Farm, [CRC-1] Department of Horticulture, School of Agriculture, ITM University, Gwalior (M.P.). The experiment was laid out in the Randomized Block Design with three replications. Each replication was comprised of ten treatments (i.e. T_0 = 50:100:50 (Control), T_1= 10gm/kg P.S.B. + 50:90:50, T_2 = 10gm/kg P.S.B. + 50:80:50, T_3 = 10gm/kg P.S.B. + 50:70:50, T_4= 20gm/kg P.S.B. + 50:90:50, T_5= 20gm/kg P.S.B. + 50:80:50, T_6= 20gm/kg P.S.B. + 50:70:50, T_7= 30gm/kg P.S.B. + 50:90:50, T_8= 30gm/kg P.S.B. + 50:80:50 and T_9= 30gm/kg P.S.B. + 50:70:50) consisting phosphate solubilizing bacteria with different RDF doses of fertilizers were applied in radish (*Raphanus sativus* L.).

Result and Discussion

It was reported from the result that the different RDF doses of fertilizers with use of phosphate solubilizing bacteria were found no significant influence on germination percent of radish. It was observed that the treatment T_7 (30gm/kg P.S.B. + 50:90:50) gave the maximum germination percent (%) and also was superior rest of all treatments.

However, the minimum germination percent (%) was recorded in treatment T_0 (50:100:50-Control). Similar results for most of the characters were also reported by Mehwish *et al.* (2016), Mali *et al.* (2018), Singh *et al.* (2018) and Shormin and Kibria (2019).

Results revealed that the different RDF doses of fertilizers with use of phosphate solubilizing bacteria were significantly influence the plant height (cm) of radish at different growth stages. It was observed that the maximum plant height (cm) at 30 and 45 DAS was recorded in treatment T_7 (30gm/kg P.S.B. + 50:90:50) and it was found the best treatment among all treatments. It was at par to treatment T_4 (20gm/kg P.S.B. + 50:90:50) and T_8 (30gm/kg P.S.B. + 50:80:50) at 30 and 45 DAS. However, the minimum plant height (cm) at 30 and 45 DAS was observed in treatment T_0 (50:100:50-Control). The increase in plant height might be due to the presence of readily available form of nitrogen through both PSB and inorganic nutrients, wherein inorganic source could have exerted positive influence on extended nutrient availability to match the physiological needs of the crop which triggered to produce elevated stature of the growth components. Similar results for most of the characters were also reported by Choudhary *et al.* (2017), Roshni *et al.* (2019), Shormin and Kibria (2019), Kushwah *et al.* (2020) and Satari *et al.* (2020).

A perusal of data indicates that the different RDF doses of fertilizers with use of phosphate solubilizing bacteria were significantly influence the number of leaf per plant in radish at different growth stages. It was observed that the maximum number of leaf per plant at 30 and 45 DAS was recorded in treatment T_7 (30gm/kg P.S.B. + 50:90:50) and it was found the best treatment among all treatments. It was at par to treatment T_4 (20gm/kg P.S.B. + 50:90:50) and T_8 (30gm/kg P.S.B. + 50:80:50) only at 45 DAS. However, the minimum number of leaf per plant at 30 and 45 DAS was observed in treatment T_0 (50:100:50-Control). It might be due to release of nutrients from Use of PSB in soil enriching available nutrient pool of the soil resulting in more number of leaves per plant. The number of leaves was increased possibly because of available nutrients from inorganic fertilizers and PSB which helps in greater assimilation of food materials by the plant which resulted in greater meristematic activity of cells. These results are supported by the findings of Mani and Anburani *et al.* (2018), Shormin and Kibria (2019) and Kushwah *et al.* (2020).

It was recorded that the maximum leaf area index (cm^2) was recorded in treatment T_7 (30gm/kg P.S.B. + 50:90:50) and it was found the best treatment of different RDF doses of fertilizers and phosphate solubilizing bacteria for influencing the leaf area index of radish. It was at par to treatment T_4 (20gm/kg P.S.B. + 50:90:50), T_5 (20gm/kg P.S.B. + 50:80:50), T_8 (30gm/kg P.S.B. + 50:80:50) and T_9 (30gm/kg P.S.B. + 50:70:50). However, the minimum leaf area index (cm^2) was found in treatment T_0 (50:100:50-Control). The results are in confirmation with the results achieved by Mehwish *et al.* (2016), Mani and Anburani *et al.* (2018), Roshni *et al.* (2019) and Nisar *et al.* (2020).

It is recorded that the maximum root length and diameter (cm)was observed in treatment T_7 (30gm/kg P.S.B. + 50:90:50) and it was found the best treatment of different RDF doses of fertilizers and phosphate solubilizing bacteria for influencing the root length in radish. However, the minimum root length and diameter (cm) was found in treatment T_0 (50:100:50-Control). It might be due to the use of different nutrients and PSB, which are starting materials for biological synthesis and it also plays an important role in plant metabolism and being an essential constituent of different type of metabolically active compounds like purines, pyrimidine's, enzymes, co-enzymes and alkaloids. Thus increased the availability of photosynthesis which consequently led to desirable C : N ratio as carbohydrate supply might be helping in larger storage in the root as well as shoot. Similar results for most of the characters were also reported by Sharma *et al.* (2015), Kiran et al. (2016), Jat *et al.* (2017), Islam *et al.* (2017) and Shormin and Kibria (2019).

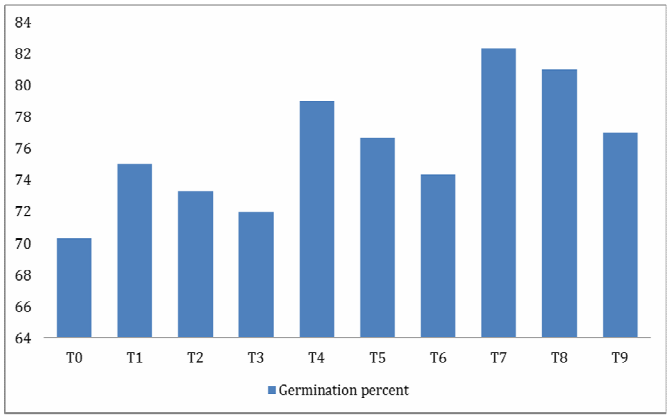

Fig. 1 : Effect of phosphate solubilizing bacteria (P.S.B.) on germination percent of radish

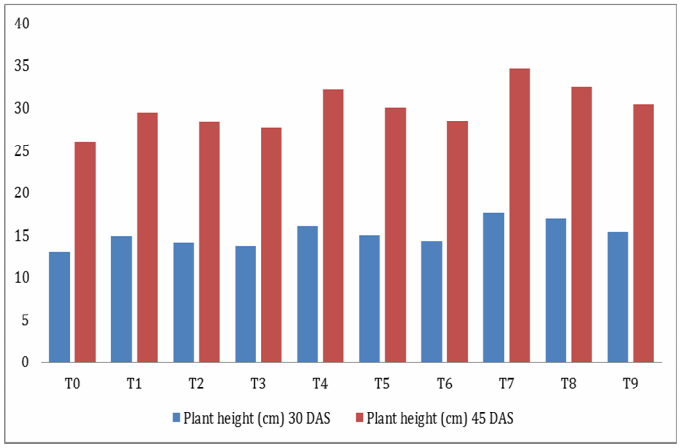

Fig. 2 : Effect of phosphate solubilizing bacteria (P.S.B.) on plant height at 30 and 45 DAS of radish

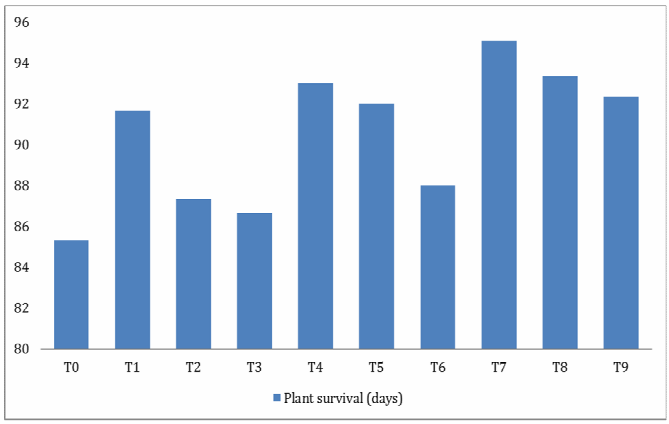

Fig. 3 : Effect of phosphate solubilizing bacteria (P.S.B.) on plant survival (days) of radish

Fig. 4: Effect of phosphate solubilizing bacteria (P.S.B.) on no. of leaf/plant at 30 and 45 DAS of radish

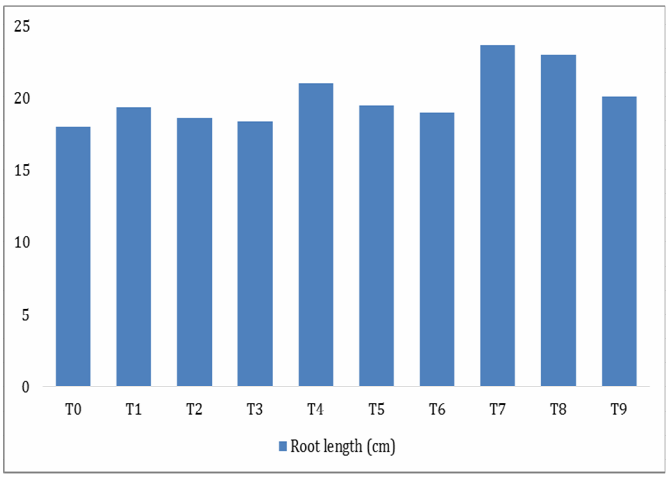

Fig. 6 : Effect of phosphate solubilizing bacteria (P.S.B.) on root length (cm) of radish

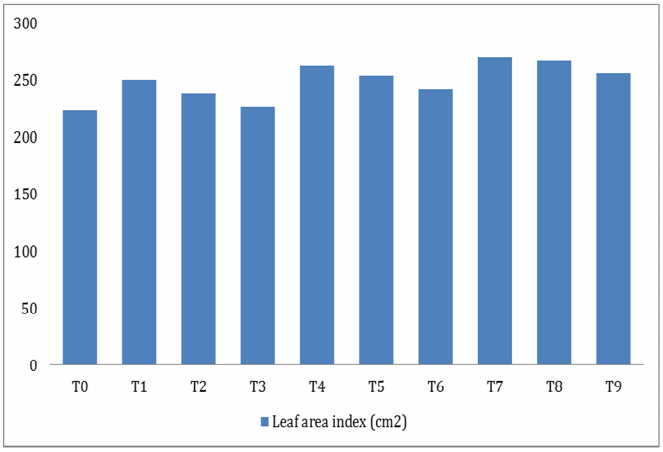

Fig. 5: Effect of phosphate solubilizing bacteria (P.S.B.) on leaf area index (cm^2) of radish

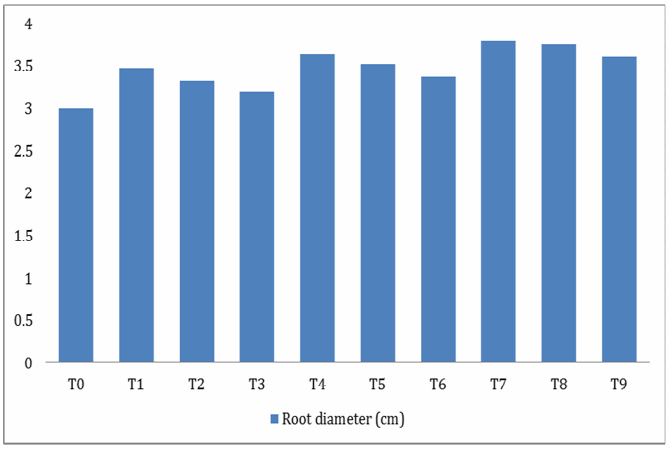

Fig. 7 : Effect of phosphate solubilizing bacteria (P.S.B.) on root diameter (cm) of radish

Table 1 : Effect of phosphate solubilizing bacteria (P.S.B.) on vegetative parameters of radish

Treatment symbols	Treatment details	Germination percent	Plant height (cm)		Plant survival (days)	No. of leaf/plant		Leaf area index (cm^2)	Root length (cm)	Root diameter (cm)
			30 DAS	45 DAS		30 DAS	45 DAS			
T_0	50:100:50 (Control)	70.33	13.00	26.00	85.33	7.00	11.00	223.57	18.00	3.00
T_1	10gm/kg P.S.B. + 50:90:50	75.00	14.89	29.48	91.67	8.18	12.00	249.93	19.37	3.48
T_2	10gm/kg P.S.B. + 50:80:50	73.33	14.00	28.33	87.33	7.66	11.63	238.84	18.67	3.32
T_3	10gm/kg P.S.B. + 50:70:50	72.00	13.67	27.61	86.67	7.34	11.34	226.67	18.33	3.20
T_4	20gm/kg P.S.B. + 50:90:50	79.00	16.00	32.17	93.00	8.74	13.00	262.56	21.00	3.64
T_5	20gm/kg P.S.B. + 50:80:50	76.67	15.00	30.00	92.00	8.45	12.58	253.57	19.47	3.52
T_6	20gm/kg P.S.B. + 50:70:50	74.33	14.33	28.37	88.00	7.82	11.79	242.00	19.00	3.37
T_7	30gm/kg P.S.B. + 50:90:50	82.33	17.67	34.67	95.07	9.97	14.67	270.26	23.67	3.80
T_8	30gm/kg P.S.B. + 50:80:50	81.00	16.84	32.47	93.33	9.03	13.38	267.24	23.00	3.76
T_9	30gm/kg P.S.B. + 50:70:50	77.00	15.35	30.40	92.33	8.71	12.90	255.91	20.04	3.61
	SEm ±	**2.837**	**0.704**	**1.254**	**1.476**	**0.257**	**0.590**	**6.332**	**1.127**	**0.102**
	CD 5%	**NS**	**2.091**	**3.726**	**4.386**	**0.764**	**1.754**	**18.813**	**3.349**	**0.304**

Conclusion

Result concluded that the different RDF doses of fertilizers with use of phosphate solubilizing bacteria were significantly influence different vegetative and yield parameters of radish. The treatment T_7 (30gm/kg P.S.B. + 50:90:50) was found the significantly superior treatment as compared to all other treatments and it also gave the maximum vegetative parameters, whereas the treatment T_0 (50:100:50-Control) observed the minimum vegetative parameters rest of all treatments.

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