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Effects of vermicompost and urea on the seed germination and growth parameters of *Vigna mungo* L. and *Vigna radiata* L. Wilzek

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Abstract
Growth attributes of *Vigna mungo* and *Vigna radiata* crop influenced by level and type of fertilizers. The present study was carried out to evaluate and compare the effects of organic (vermicompost) and inorganic (urea) fertilizers on the germination percentage and seedling growth of *V. radiata* (Green gram) and *V. mungo* (Black gram). Fresh weight and dry weight of tested plant samples at 10th days of growth stage were also determined. Vermicompost was used as organic fertilizer and urea as inorganic fertilizer. Experimental results showed that vermicompost and urea both has positive effect on seedling growth parameters of *V. mungo* and *V. radiata* [average root length (6.1cm and 6.7cm)] , shoot length (6.5cm and 8.3cm), leaf area (312.2 sq.cm and 334.1 sq.cm] as compared to control set [average root length (4.4cm and 4.3cm)] , shoot length (6cm and 5.9cm), leaf area (282.7 sq.cm and 305.5 sq.cm). But urea exerts negative effect on seed germination percentage in *V. mungo* and *V. radiata* (58% and 50%) as compared to control (77%). Vermicompost exhibited better result in above parameters in comparison to urea. *V. mungo* showed increased value in comparison considering *V. radiata* in case of organic, inorganic fertilizer treated as well as control sets. As composition of locally available fertilizers is unknown, the application of these fertilizers for improving germination percentage and growth parameters of tested crop need to be evaluated. Present work may provide the suggestive approach for usage of these tested fertilizers in field level trial.

Keywords: Agricultural Practices, Biofertilizer, Organic Fertilizers, Seedling Growth

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INTRODUCTION

Germination of seed is the principal requirement of growth of the plants and influenced by various physical and chemical parameters either present in the surrounding environment or may be added into the substratum. Amount of nutrients present in the soil influence the quality of yield of the crop. Soil additives used to improve nutrient quantity and quality of the soil are usually chemical or organic compounds. The mineral fertilizers provide only plant nutrients in the soils but unable to improve soil health significantly (Chattopadhyay, 2005). Application of excessive inorganic or chemical fertilizers deteriorates chemical, physical, and biological properties of soil (Mahajan *et al*., 2008). Indiscriminate use of chemical fertilizers decreases soil fertility level. Apart from that toxic substances accumulate within the vegetables and generate negative effects in humans and animals (Savci, 2012). On the other hand organic fertilizers increase supply of nutrients, soil nutrient accessibility and soil microbial action (Chand *et al*., 2006). Vermicompost as a organic fertilizer reported to contain a number of mineral nutrients, soil enzymes and microbes (Domínguez, 2004) and reported to improve seed germination, seedling vigor, and plant productivity rather than inorganic mineral nutrient (Gopalakrishnan *et al*., 2012). Moreover, as soil additives, vermicompost provide required amounts of nutrient, increase water holding capacity of soil and cation exchange capacity thus reduce the use of mineral fertilizers in cultivation of crop (Tejada and Gonzaler, 2009). Vermicomposts contain bioactive substances like plant growth regulators (Arancon *et al.,* 2005).

Some plant growth regulators like indole acetic acid, gibberellins and cytokinins extracted from aqueous solutions of vermicomposts and have their significant effects on plant growth (Atiyeh *et al.,* 2002).

Effect of organic and inorganic fertilizer in germination rate, growth parameters, yield attributes and nutritional status of different crops were evaluated by several researchers. The vermicompost increases the yield of rice and thus can be a substitute to chemical fertilizer to some extent (Sharma *et al*., 2008). It has also been found that in case of rice and lentil the application of vermicompost showed better result in terms of improving soil physical and chemical properties and increased grain yield and productivity in comparison to chemical fertilizers (Karmakar *et al*., 2015). A significant increase and the maximum dry matter, number of pods, pod yield (g) and seed yield (g) per plant of black gram was observed when vermicompost incorporated with the PSB seed inoculation (Kadam *et al*., 2014). Plant growth, nodulation and yield of black gram [*Vigna mungo* (L.) Hepper] in different soil amendment was evaluated. It was observed that, nodule number was significantly increased by addition of either of the two strains of nitrogen fixing *Bradyrhizobium japonicum* (TAL- 102 and MN-S) strains in NPK treated and un-amended soils. (Javaid, 2009). Effects of vermicompost on Bengal gram (*Cicer arietinum* L.) var. RSG-896 were studied. Plants were harvested at three stages i.e. pre-flowering, peak-flowering and post-flowering stages. Increased levels of vermicompost level increased root length, shoot length, root dry weight, shoot dry weight, and total dry weight (Shrimal and Khan, 2017). Similarly application of aqueous extract of vermicompost reported to improve plant health, crop yield, and nutritive quality in pakchoi (Pant *et al*., 2009). Urea was used as fertilizer to evaluate the growth parameters like germination, survival, seedling height and root/shoot ratio were studied on the seeds of *Pisum sativum, Vigna radiata* and *Vigna catjang* with high nutritional and medicinal value (Ramteke *et al*., 2013).

Green gram (*V. radiata* L.) locally known as "*moong*" is one of the important and widely cultivated crop in India, and usually cultivated in arid and semi arid region. Black gram (*V. mungo* L.) is also one of the important pulse crops grown in India. This is also grown as a cover crop as well as catch crop due to short duration. Pulses are the cheapest source of quality protein for human being. These also known to increase soil fertility by fixing atmospheric nitrogen in soil symbiotically and improve the productivity of succeeding crop.

Excessive and indiscriminate use of nutrients by farmers is the most vital limiting factor for crop productivity especially in pulses. Therefore, comparison of the effects of vermicompost (organic) and urea (inorganic) fertilizers on the germination and growth parameters of *V. radiata* (Green gram) and *V. mungo* (Black gram) are necessary to optimize the fertilizer application as soil amendments.

MATERIALS AND METHODS

Experiment was carried out during the month of February to May in the year of 2017-2019.

Plant material: Certified homozygous seeds of Black gram (*Vigna mungo* L.var PU-31) and Green gram (*Vigna radiata* L. Wilzek var PDM-139) were procured from the Seed Testing Laboratory of State Agricultural Centre, A.D. Nagar, Agartala, Tripura, India, for the present study. Homozygous seeds were preferred over heterozygous type to minimize the phenotypic variation in respect of morphological features. Vermicompost was used as organic fertilizer and Urea as inorganic fertilizer. Vermicompost and urea (composition unknown, locally available) were procured from the local market.

Preparation of soil: Substratum was prepared for sowing of seeds by mixing of soil and sand in 3:1 ratio for different fertilizer treated sets as well as for control set.

Experimental sets: Control set: Soil contained no fertilizer. Black gram Control (BGC) and Green gram Control (GGC) were taken as control.

Vermicompost (Organic fertilizer) treated sets: 4gm of soil contained 1gm of vermicompost. Black gram vermicompost treated (BGO) and Green gram vermicompost treated (GGO) were taken as Vermicompost treated sets.

Urea (Inorganic fertilizer): 0.5 gm of inorganic fertilizer was spread over the 10 gm soil. Black gram Urea treated (BGI) and Green gram Urea treated (GGI) were taken as Urea treated sets.

The fertilizers were used only for the preparation of the seed beds after that no fertilizers were used.

Sowing of seeds: Germination trays were used for seed sowing. Pre-soaked seeds were sown in the prepared soil at a depth of 0.5 to 1.0 cm. 100 seeds were sown (2 replicates of 50 seeds) for each experimental sets. Mist spraying bottle was used for regular watering.

Germination percentage and other growth parameters: The shoot and root length were measured on $5^{th,}$ 7^{th} and 10^{th} day. Germination percentage was calculated on the basis of data collected on 10^{th} day using following formula (Eq. 1) (Javed and Panwar, 2013).

Germination (%) = Number of seeds germinated/ Number of seeds put for germination × 100

…. Eq. 1

After 10^{th} day of sowing, plants were carefully pulled out of the soil and fresh weight of the samples of each experimental set. The dry weights of the samples were also recorded.Prior to the germination experiment seed sample lots were grown

in pot culture treated separately with different concentrations of urea solutions for seven days. Adverse effects induced by urea solutions on morphology of tested plant samples were observed to determine suitable concentrations level of urea for treating experimental sets (Dhanalakshmi *et al.,* 2014).

RESULTS AND DISCUSSION

Experimental results of present study revealed that maximum germination percentage was observed in *V. mungo* L.var. PU-31 (94%) followed by *V. radiata* L.var. PDM-139 (73%) in case of organic fertilizer (vermicompost) treated experimental sets. However, it was evident that among two crops, highest germination percentage was achieved by *V. mungo*. Minimum percentage of germination was recorded in inorganic fertilizer (urea) treated set of *V. mungo* (58%) followed by *V. radiata* (50%). Present findings also revealed that control sets exhibited better germination percentage than inorganic fertilizer treated set in case of both the crops (Table 1). It was found that, in *V. mungo* maximum seed germination percentage was observed for vermicompost treated soil (Javed and Panwar, 2013) which substantiated the present experimental results.

Regarding growth parameters of *V. mungo* and *V. radiata* growing under different experimental conditions, results also showed that maximum root length (6.1cm and 6.7cm), shoot length (6.5cm and 8.3cm) and average leaf area (312.2 sq.cm

Table 1. Germination percentage of *V. mungo* and *V. radiata.*

Tested Samples		***V. mungo***			***V. radiata***		
Germination	Per-	Control	Inorganic	Organic	Control	Inorganic	Organic
centage		77%	58%	94%	66%	50%	73%

Table 2. *Seedling growth parameters of V. mungo and V. radiata***.**

Different treatments	**Average length of root (cm)**			**Average length of shoot (cm)**			**Average Leaf Area (Square mm)**		
	5th Day	**7th Day**	**10th Day**	**5th Day**	**7th Day**	**10th Day**	**5th Day**	**7th Day**	**10th Day**
V. mungo (Control)	3.3	3.8	4.4	4.0	5.3	6	195.6	203.4	282.7
V. mungo (Inorganic)	4.6	5.0	5.4	4.7	5.4	6.1	199.5	210.0	299.5
V. mungo (Organic)	5.4	5.9	6.1	5.1	5.7	6.5	212.6	258.9	312.2
V. radiata (Control)	3.7	4.0	4.3	4.5	5.1	5.9	194.2	237.6	305.5
V. radiata (Inorganic)	5.3	5.5	6.3	5.0	5.3	6.4	201.6	255.5	310.8
V. radiata (Organic)	5.6	6.2	6.7	5.5	6.1	8.3	213.8	275.3	334.1

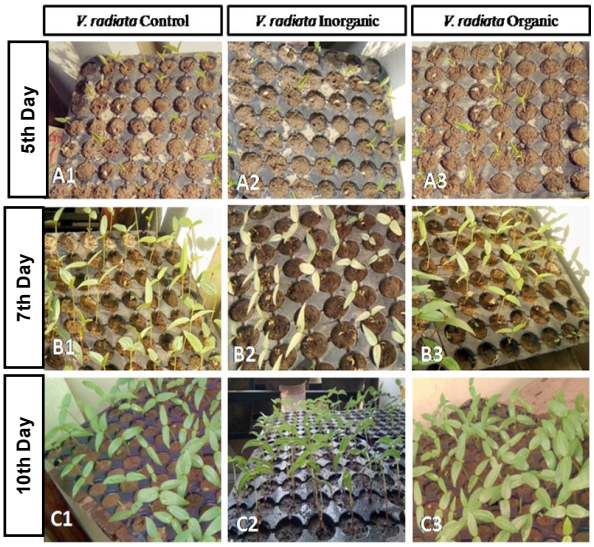

Fig. 1. *Showing plant growth on three different (control, inorganic and organic) treatments of V. radiata after 5 days (A1,A2,A3), 7 days (B1,B2,B3) and 10 days (C1,C2,C3).*

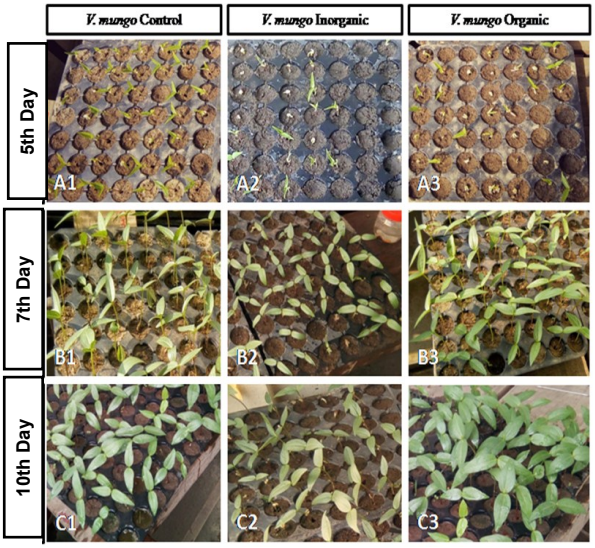

Fig. 2. *Showing plant growth on three different (control, inorganic and organic) treatments of V. mungo after 5 days (A1,A2,A3), 7 days (B1,B2,B3) and 10 days (C1,C2,C3).*

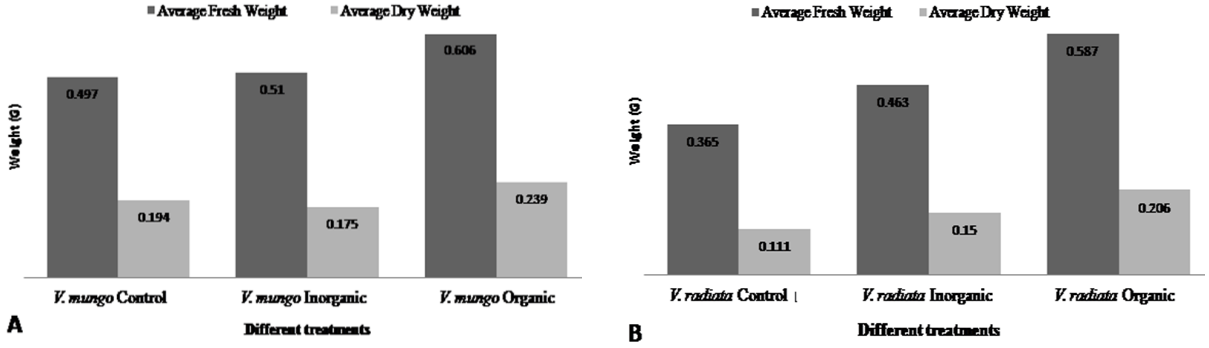

Fig. 3. *Fresh and dry weight of A. V. mungo, B. V.radiata plants in organic fertilizer and inorganic fertilizer treated soil in pot culture experiment.*

and 334.1 sq.cm) were obtained in case of seed sown in organic fertilizer treated sets followed by inorganic fertilizer treated batch (Fig. 1 and 2). Control sets for both the crops exhibited lowest vales in respect of growth parameters (Table 2).

Among both the crops, it was observed that *V. radiata* exhibited better results over *V. mungo*, when grown in vermicompost as well as urea treated soil in respect to average root and shoot length and leaf area (Table 2). Maximum average dryand fresh weights were recorded in organic fertilizer applied experimental sets of both the crops. However, *V. mungo* showed increased values in comparison considering *V. radiata* in case of organic, inorganic fertilizer treated as well as control sets (Fig. 3).

For *V. mungo* lowest average dry weight of plant sample was obtained in inorganic fertilizer treated sets, while for *V. radiata* it was lowest value recorded in control set (Fig. 3).

Percentage of seed germination and seedling length and growth parameters such as shoot length, root length, number of leaves per plant and leaf area of tomato increased *(Lycopersicum esculentum*) when seeds grown in vermicompost amended soil as compared to other treated soil (Eswaran and Mariselvi, 2016) which correlated with present findings. Experiment on effects of organic amendments and chemical fertilizer on growth of cowpea revealed that all five treatments of organic fertilizers showed positive effect on root length, shoot length, fresh weight and dry weight of tested plant in comparison to treatment with chemical fertilizer which also supported present experimental findings (Badar *et al*., 2015). The experimental results revealed that application of organic fertilizer (vermicompost) improves seed germination rate and enhanced growth of tested plants. These may be due to that vermicompost provides mineral nutrients in available forms to plants (Grantina-Ievina *et al*., 2015). These plant growth-promoting activity of vermicomposts usually for the high content of humic compounds (Muscolo *et al*., 1999). Significant variation in the plant height of rice was observed, when the field was incorporated with different doses of vermicompost. The present experimental results in respect to shoot and root length also supported increased value in vermicompost treated sets. This may be due to the increased soil moisture content, soil porosity by vermicompost application (Mahmud *et al*., 2016). Present experimental results revealed that application of vermicompost improve average root and shoot length as well as average leaf area of both the tested plant over control set. These can be correlated with earlier observations. Use of vemicompost and FYM at the rate of 5 t/ha significantly improve plant height, root nodules/plant, pods/plant and grains/pod, over control sets with no organic manure (Ghanshyam *et al*., 2010). Three different concentrations (10%, 20% and 30%) of vermiwash were used to evaluate its growth promoting effects considering the seed germination and seedling growth of *V. radiata* and *V. mungo.* Germination percentage increased with increasing concentration of vermiwash in *V. radiata and* in *V. mungo*. Hypocotyls length increased in *V. radiata* ascompare to *V. mungo* whereas, radical length was more in *V. mungo* (Jaybhaye and Bhalerao, 2015). Moreover, results obtained from present study also supported by findings where evaluation of responses of green gram (*V. radiata* L.) to different levels of phosphorus and organic liquid fertilizer revealed that all most all the yield attributes such as number of pods per plant, number of seeds per pod and pod length were influenced by different treatments of organic liquid fertilizer (Patel *et al*., 2017). In a study to find out the effect of different fertilizers, it was observed that in case of *Pisum* sp. and *Cicer* sp. plant grown in vermicompost pre -treated soil showed maximum increase in morphological parameters such as root length, shoot length, number of root branches, number of stem branches, number of leaves, number of flowers, number of pods and number of root nodules in four months sampling in comparison to control set (Sinha *et al*., 2010) which also supported the pre-

sent findings.

Conclusion

Present experimental results showed that the applications of vermicompost induced better germination rate and increased level of growth parameters (average shoot, root length and leaf area) in both the tested samples. Therefore, it may be stated that for *V. mungo* and *V. radiata* organic fertilizers like, vermicompost, may be a better alternative to inorganic fertilizer for improving germination, growth parameter and yield attributes. These experimental results can be applied at larger field levels to improve yield attribute of crop plants for safe and sustainable agricultural practices However, extensive field trials may be needed to conclude that organic fertilizer (vermicompost) should be preferred over inorganic fertilizer (urea) in agricultural practices.

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