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RESEARCH ARTICLE

INFLUENCE OF BIO FERTILIZERS AND CHEMICAL FERTILIZERS ON THE EXO-MORPHOLOGICAL CHARACTERS OF VIGNA MUNGO (LINN.) HEPPER

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ABSTRACT

The influence of bio fertilizers and chemical fertilizers (NPKS) on the exo morphological characters of black gram (Vigna mungo). The soil quality was monitored during the experiment followed by growth and productivity. In a vermicompost 50% there has been a significant improvement in soil qualities in plots treated with vermiwash 10% and chemical fertilizer (NPKS). The growth and yield of black gram was significantly higher in pots treated with vermicompost 50%. The bio fertilizer can be economically and environmentally suitable for the soil environment.

INTRODUCTION

The agriculture development strategy for India in the 21st century must be through increasing productivity of the land under cultivation, with reduced costs of production and higher use efficiency of input with no harm to the environmental quality. The prime requisite is the promotion of health of the soil-plant-environment system to be free from economic exploitation, overuse and abuse of the input as if with impunity (Ayala and Prakasa Rao, 2002). No doubt, the use of chemical fertilizers was boon for the past but ban for the present. Now it is time to reanalyze the technological development at the cost of nature's destruction.

Several mammoth problems related to soil structure and changes in the soil pH , soil acidifications and lower humic acid contents are some key problems of overuse of synthetic fertilizers. The poor soil respiration rate and complete vanishing of natural decomposer communities from agro ecosystem has questioned the land sustainability and future food security (Suthar, 2008 a). Similarly, the escalation in the cost of chemical fertilizers, particularly that of N, coupled with concerns about pollution have focused attention on the use of combined application of nutrients through organic and inorganic source in crop production. Therefore, nutrients supply in crop system should be economically viable, environment friendly and socially acceptable without affecting the gross plant production. It has been realized that soil fertility can be managed in complete harmony with sustainable agriculture development by careful analysis of current issues of sustainable land productivity (Saleh, 2008; Srinivasarao *et al.*, 2008). The organic manure is an eco – friendly and economically viable and has played a significant role in soil biology, chemistry and physics. It is interesting that each year, human livestock and crop produce approximately 38 billion metric tons of organic waste worldwide, which may be an efficient source of organic matter supply in soils. According to a conservative estimation, around 600 – 700 million tons (mt) of agriculture waste (including 272 million tons of crop residues) are available in India but most of it remains unutilized. This huge quantity of wastes can be converted into nutrient rich bio fertilizer (Vermicompost) for sustainable land restoration practices (Suthar, 2008 b; Elumalai *et al.,* 2015).

The earthworm processed organic wastes, often referred to as vermicomposts, are finely divided peat like materials with high porosity, aeration, drainage and water holding capacity (Edwards and Burrows, 1988). Vermicomposting is bio oxidation and stabilization of organic material involving the joint action of earthworms and micro organisms. Although, microbes are responsible for the biochemical degradation of the organic matter, earthworms are the important drivers of the process, conditioning the substrate and altering biological activity (Aira *et al*., 2002: Suthar 2008). Studies have revealed that vermicompost may be potential source of nutrients for

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field crops if applied in suitable ratio with synthetic fertilizers. Also, vermicompost may contain some plant growth stimulating substances. The plant hormone like substance is extensively reported in worm-processed materials possibly due to higher microbial populations (Krishnamoorthy and Vajranbhaian 1986, Muscolo *et al*., 1999). Suthar *et al.,* (2008a) also reported a hormone like effect of earthworm body fluid on seedling growth of some legumes. The earlier workers have reported a positive effect of vermicompost application on growth and productivity of cereals and legums (Suthar 2008b) ornamental and flowering plants (Kale *et al*., 1986). Vegetables (Edwards and Burrows, 1988; Atiyeh *et al*., (2000). Concluded that vermicompost, whether used as soil addivitives or as components of greenhouse bedding plant container media, have improved seed germination, enhanced seedling growth and development and increased overall plant productivity.

MATERIALS AND METHODS

The present investigation was carried out during the year 2014-2015 at Arakkonam, Vellore Dt., Tamil Nadu, India. Vermicompost was prepared in pit method with all convenient dimension. Vermiwash unit was setup by the method suggested by Ismail (1997). The plant species utilized in the present investigation is *Vigna mungo* (L), Hepper, belonging to family *Fabaceae*. Authentic samples of seeds procured from Indian agro centre, Arakkonam, Vellore were used to raise plants for the experiments. Pot experiments with *V. mungo* were carried out applying different concentration of chemical fertilizer and vermicompost, vermiwash as foliar sprays with deionised water as control to study the difference in the exo-morphological characters that may develop in response to their applications. To the foliar spray solution 0.01% of teepol was added to act as a surfactant which enhances adherence of the spray solution to the leaves. The spraying was done using an atomizer until there was run-off of the excess spray solutions. The various concentrations of chemical fertilizer, vermicompost and vermiwash that was used as foliar sprays for *V.mungo* are given in Table 1.

Bio and Chemical fertilizer

Seedling of *V. mungo* were raised in wide posts of 60 cm diameter and transplanted to pots of uniform size of 30cm diameter. The pots were filled with sand, red soil and farm yard manure in the ratio of 1:1:1. The plants were maintained under garden land conditions. There plants were grown in each pot and three pots were maintained for each treatment including controls. Plants were irrigated with well water uniformly throughout the period of experiment. Experiments were started when the plants were 10 days old since it has a life cycle of 40-45 days only. The spraying was done at the end of each week for five consecutive weeks. The following exo morphological characters were carried out in control and treated plants.

Exo-Morphological Studies

At the end of every week of spray and at zero hour i.e. just before giving the spray application the following exo-morphological data were recorded in the control and treated plants. Experiments were repeated thrice in order to make sure that uniform results and analyzed in each of the studies under taken. 1. Height of the plants, 2.Length of Inter node, 3.Number of leaves and 4.Number of branches.

Measurements of Plant growth Parameters

Plant height and length of internode (cm) was recorded using a measuring tape. Number of leaves and Number of branches were counted.

Statistical Analysis

Data on morphological parameters was subjected to statistical analysis. All data were expressed as mean and standard error. The difference between groups were statistically analyzed by analysis of variance (ANOVA). The level of significance was set at $P<0.05$.

Table 1. Showing the various concentration of vermicompost, vermiwash and chemical fertilizers

S. No	Treatment	Biofertilizer used	Concentration
1.	Control	----	100ml Deionised Water
2.	Vermicompost (50%)	Vermicompost	50% VC + Soil
3.	Vermiwash (10%)	Vermiwash-I	10+90ml Deionised Water
4.	Chemical fertilizer (50%)	Chemical fertilizer	50% CF with soil

Table 2. Effect of bio and chemical fertilizer on shoot length (cms) of *V. mungo*

Treatment	I – Week	II – Week	III – Week	IV – Week	V – Week
Control	8.10^{AB}±0.14 (+48.6)	8.93^{AB}±0.45 (+53.58)	9.92^{AB}±0.19 (+59.52)	11.41^{AB}±0.40 (+68.46)	12.12^{AB}±0.43 (+72.2)
Vermicompost-50%	8.16^{AB}±0.22 (+49.0)	9.33^{AB}±0.20 (+56.0)	12.8^{AB}±0.30 (+76.8)	14.6^{AB}±0.31 (+87.6)	15.2^{AB}±0.32 (+91.3)
Vermiwash – 10%	9.58^{AB}±0.41 (+57.48)	10.63^{AB}±0.45 (+63.78)	13.02^{AB}±0.45 (+65.12)	13.52^{AB}±0.48 (+67.6)	14.22^{AB}±0.64 (+71.6)
Chemical fertilizers	8.33^{AB}±0.19 (+49.98)	9.31^{AB}±0.19 (+55.86)	11.08^{AB}±0.25 (+66.48)	12.00^{AB}±0.40 (+72.00)	13.24^{AB}±0.30 (+79.40)

Values are mean ± S.E of 06 individual observations
Values in parentheses are percent change over control
a – Represents significance of variance between periods
b – Represents significance of variance between treatments
Degrees of freedom F ≤ 0.05

RESULTS

Plant height

All treatments showed significant value for plant height when compared to control with maximum shoot length observed in vermicompost 50% followed by vermiwash and chemical fertilizers. Plant height at zero hour i.e at the time of starting experiment is 8.5cm. After the first apply and spray, the height of all the treated plants showed a significant increase over that of control. Similar effect was observed at the end of the second, third and fifth week sprays (Table 2). The plant height consistently increased to a maximum of 15.2cm in plants treated with vermicompost 50% and 14.22cm in plants treated with vermiwash, followed by plants treated with chemical fertilizer (13.24 cm). The mean height was 12.12cm in the control plants.

Length of Inter node

The mean length of inter node at zero hour was 0.1cm. After the first apply and spray the length of inter node shows a significant increase over that of control in all the treated plants. The increase in internode length is maximum (2.1cm) at the end of fifth week of spray in plants treated with vermicompost 50% followed by the plants treated with vermiwash-I (1.68 cm) and chemical fertilizer(1.58cm). Inter node length is minimum in the control plants (1.50cm) (Table 3).

Number of Leaves

The mean number of leaves at zero hours is 2. After the apply the number of leaves shows a significant increase over that of control in all the treated plants. Increase the number of leaves is maximum (22.5) at the end of fifth weeks of spray in plants treated with vermicompost 50% followed by plants treated with vermiwash (14.63) and chemical fertilizer(13.3). The number of leaves is minimum in the control plants (10.2) (Table 4).

Table 3. Effect of bio and chemical fertilizer on internodal length (cms) of *V. mungo*

Treatment	I-Week	II – Week	III – Week	IV – Week	V – Week
Control	0.35 ^{ab}±0.04 (+2.10)	0.60 ^{ab}±0.09 (+3.6)	1.10 ^{ab}±0.09 (+6.6)	1.43 ^{ab}±0.11 (+8.6)	1.5 ^{ab}±0.07 (+9.0)
Vermicompost-50%	0.4 ^{ab}±0.04 (+2. 40)	0.6 ^{ab}±0.04 (+3.6)	1.1 ^{ab}±0.09 (+6.6)	1.5 ^{ab}±0.12 (+9.0)	2.1 ^{ab}±0.23 (+14.3)
Vermiwash – 10%	0.4 ^{ab}±0.04 (+2.40)	0.7 ^{ab}±0.08 (+3.50)	1.04 ^{ab}±0.09 (+5.2)	1.3 ^{ab}±0.1 (+6.5)	1.68 ^{ab}±0.10 (+10.08)
Chemical fertilizers	0.36 ^{ab}±0.04 (+2.16)	0.62 ^{ab}±0.06 (+3.0)	1.06 ^{ab}±0.13 (+5.3)	1.4 ^{ab}± 0.13 (+7.0)	1.58 ^{ab}±0.20 (+9.48)

Values are mean ± S.E of 06 individual observations
Values in parentheses are percent change over control
a – Represents significance of variance between periods
b – Represents significance of variance between treatments
Degrees of freedom F ≤ 0.05

Table 4. Effect of bio and chemical fertilizer on the leaf number (n) of *V. mungo*

Treatment	I- Week	II – Week	III – Week	IV - Week	V – Week
Control	5.30 ^{ab}±0.19 (+32.00)	6.80 ^{ab}±0.55 (+41.00)	8.80 ^{ab}±0.49 (+53.00)	9.80 ^{ab}±0.37 (+59.00)	10.02 ^{ab}±0.49 (+61.80)
Vermicompost-50%	6.16 ^{ab}±0.55 (+37.0)	9.0 ^{ab}±0.50 (+54.0)	13.0 ^{ab}±0.61 (+78.0)	17.83 ^{ab}±0.62 (+107.0)	22.5 ^{ab}±0.70 (+135.0)
Vermiwash – 10%	5.30 ^{ab}±0.19 (+32.0)	7.4 ^{ab}±0.53 (+44.4)	8.10 ^{ab}±0.24 (+49.0)	10.20 ^{ab}±0.66 (+56.0)	14.63 ^{ab}±0.45 (+87.78)
Chemical fertilizers	5.00 ^{ab}±0.01 (+30.0)	5.50 ^{ab}±0.84 (+33.0)	9.20 ^{ab}±0.66 (+46.0)	12.60 ^{ab}±0.54 (+63.0)	13.30 ^{ab}±0.28 (+79.8)

Values are mean ± S.E of 06 individual observations
Values in parentheses are percent change over control
a – Represents significance of variance between periods
b – Represents significance of variance between treatments
Degrees of freedom F ≤ 0.05

Table 5. Effect of bio and chemical fertilizers on the number of branches (n) of *V. mungo*

Treatment	I-Week	II – week	III – week	IV - week	V – week
Control	2.33 ^{ab}±0.22 (+14.0)	3.30 ^{ab}±0.19 (+20.0)	4.66 ^{ab}±0.30 (+28.0)	5.03 ^{ab}±0.28 (+32.0)	5.73 ^{ab}±0.44 (+34.38)
Vermicompost-50%	3.40 ^{ab}±0.20 (+21.0)	4.83 ^{ab}±0.28 (+29.0)	6.17 ^{ab}±0.28 (+37.0)	7.16 ^{ab}±0.57 (+43.0)	8.16 ^{ab}±0.24 (+49.0)
Vermiwash – 10%	2.60 ^{ab}±0.23 (+16.0)	3.20 ^{ab}±0.19 (+19.0)	4.60 ^{ab}±0.31 (+28.0)	5.33 ^{ab}±0.31 (+32.0)	6.33 ^{ab}±0.35 (+38.0)
Chemical fertilizer	2.60 ^{ab}±0.23 (+16.0)	3.30 ^{ab}±0.19 (+20.0)	4.50^{ab}±0.30 (+27.0)	5.10 ^{ab}±0.29 (+31.0)	5.86 ^{ab}±0.41 (+35.16)

Values are mean ± S.E of 06 individual observations
Values in parentheses are percent change over control
a – Represents significance of variance between periods
b – Represents significance of variance between treatments
Degrees of freedom F ≤ 0.05

Number of branches

The mean value of number of branches at zero hour is (2.0). In the experimental period, the number of branches shows a significant variation over that of control in all the treated plants. The maximum increase of number leaves is 8.16 at the end of fifth weeks of spray in plants treated with vermicompost 50% followed by plants treated with vermiwash 6.33 and chemical fertilizer 5.83. The number of branches is minimum in the control plants 5.80 (Table 5).The comparative table shows a significant increase of all the exo-morphological characters in the experimental plants at the different intervals (Table 6).

However, very little information is available that demonstrates the potential of the organic liquid fertilizer and their role in providing a balanced nutrient supply. The present work is taken up in *Vigna mungo* in order to evaluate the growth promoting effects of vermicompost and vermiwash in comparison with chemical fertilizers. The porosity of soil depends upon the texture and aggregation of the soil. The increased porosity in vermicompost treated pots in the present investigation in probably due to aggregation of the soil particles by the action of micro organisms in the vermicompost which produce polysaccharides providing a cementing action between the soil particles (Six *et al.,* 1998) and possibly also by fungal mycelia.

Table 6. Comparative table for the effect of bio and chemical fertilizers on the exo morphological characters at the end of fifth week of *V. mungo*

Treatments	Shoot length	Length of internode	Number of leaves	Number of branches
Control	12.22 ^{b} ±0.56 (+73.3)	1.50 ^{b} ±0.17 (+9.0)	10.20 ^{b} ±0.45 (+61.0)	5.80 ^{b} ±0.44 (+35.0)
Vermicompost- 50%	15.20 ^{b} ±0.77 (+91.3)	2.10 ^{b} ±0.23 (+14.3)	22.50 ^{b} ±0.70 (+135)	8.16 ^{b} ±0.24 (+49.0)
Vermiwash - 10%	14.22 ^{b} ±0.64 (+81.0)	1.58 ^{b} ±0.30 (+7.91)	10.30 ^{b} ±0.45 (+62.0)	6.33 ^{b} ±0.35 (+38.0)
Chemical fertilizers	13.24 ^{b} ±0.30 (+79.0)	1.64 ^{b} ±0.10 (+8.20)	13.0 ^{b} ±0.28 (+78.0)	5.83 ^{b} ±0.41 (+35.0)

Values are mean ± S.E of 06 individual observations
Values in parentheses are percent change over control
a – Represents significance of variance between periods
b – Represents significance of variance between treatments
Degrees of freedom $F \leq 0.05$

DISCUSSION

The growing concern for an ecologically sound agricultural system without pesticides has added new dimensions to the economics of bio dynamics. Reliance on organic matter sources is a central feature of organic agriculture. It involves the harnessing of soil organisms like bacteria, earthworms and other micro fauna in recycling organic wastes like straw, grass, leaves twigs, weeds etc., and their transformation to produce slow release nutrients as needed by the crop (Murthy and Nigam, 2001). The use of foliar fertilizer in agriculture has been a popular practice with farmers since the 1950s.

Growth and development events in plants are controlled by growth regulators (Moore, 1989). These are found naturally in plants or manufactured. PGRS, a new generation of agrochemicals used as foliar fertilizer, modifies the natural growth right from seed germination to senescence in crop plants. But the production of these agrochemicals is not economically feasible and the optimum conditions at which they can perform is difficult to ascertain. Moreover due to health and environmental pollution problems, the need for an organic liquid fertilizer arises. (Weaver, 1972; Nickel 1978). Though several organic fertilizers in the form of farm yard manure, green leaf manure, bio fertilizer and bio waste have been applied, the need for liquid fertilizers has evinced interest in the production of several such materials to serve as foliar sprays (Sudhakar, 2008).

Vermiwash is an organic liquid fertilizer used in agriculture, is collected after the passage of water through a column of worm activation. It is a collection of excretory and secretary products of earthworm, along with major micronutrients of the soil and soil organic molecules that are useful for plants (Kale, 1988) and also acts as a mild biocide. (Pramoth, 1995).

Among the various foliar treatment used in present investigation, it is obvious from the results that plant height increased with increased duration of treatment. Plant height was maximum in vermicompost-50% and vermiwash-10% and followed chemical fertilizer when compared to control. Maximum plant height was recorded in plants involving vermicompost. Organic manure in the form of vermicompost and vermiwash, when added to soil augments crop growth and yield.

Intermodal length showed a response similar to that of plant height. Intermodal length and diameter is maximum in plant treated with vermicompost followed by vermiwash-10% and chemical fertilizer when compared to control. The thickness of internode is related to the girth increment of the plants. Bio-fertilizers (vermiwash and vermicompost) contribute macronutrients and micronutrients in amount that is required by plants. According to Lalitha *et al.,* (2000), application of organic fertilizers have an pronounced effect on plant growth and production. The soil enriched with vermicompost provides additional substances that are not found in chemical fertilizers (Kale 1998; Ansari and Ismail, 2001; Elumalai *et al.,* 2013). Data clearly indicates an enhanced growth of *V. mungo* using vermiwash and vermicompost than chemical fertilizers.

Conclusion

From the results it can be concluded that the Vermicompost 50% and vermiwash of different combination of animal, agro wastes have better growth and productivity of crops compared to chemical fertilizers. Vermicompost and vermiwash is less expensive than chemical fertilizers, easily producible, eco-friendly and one of the best organic manure for foliar spray on the different crops.

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