Journal of Applied Agriculture and Biotechnology 2016 1(2): 38–47
ISSN (print): 2415-6728
ISSN (online): 2415-6736

Research article

Effect of vermicompost and phosphorus on crop growth and nutrient uptake in mungbean

Muhammad Arsalan [1], Shoaib Ahmed [2], Junaid Nawaz Chauhdary [3*], Muhammad Sarwar [4]

HIGHLIGHTS

- Mungbean is drought resistance crop so it is most suitable for arid regions
- Vermicompost is best organic manure that makes nutrient availability to plants readily
- Organic fertilizers can be used instead of chemical fertilizers to reduce crop production cost

Authors' affiliation
[1] Barani Agricultural Research Institute, Chakwal, Pakistan.

[2] Land Resources Research Institute, NARC, Islamabad, Pakistan.

[3] Water Management Research Centre, University of Agriculture, Faisalabad, Pakistan.

[4] Land Resources Research Institute, NARC, Islamabad, Pakistan.

****Corresponding author***
Junaid Nawaz Chauhdary
Email: mjunaidnawaz@yahoo.com

How to cite
Arsalan M., A. Shoaib, J.N. Chauhdary and M. Sarwar. 2016. Effect of vermicompost and phosphorus on crop growth and nutrient uptake in mungbean. J. Appl. Agric. Biotechnol., 1(2): 38-47.

ABSTRACT

A field experiment was conducted to study the effect of vermicompost and three different levels of phosphorus fertilization on nutrient uptake in grain, straw, their total uptake and yield in mungbean at wheat program research area NARC, Islamabad. Application of phosphorus and vermicompost plays an important role in growth, development and maturity of crop and also in development of roots and nodulation. The soil was low in organic matter (0.8%), available nitrogen (1.76mg kg^{-1}), phosphorus (2.9mg kg^{-1}) and medium in available potassium (120mg kg^{-1}). Application of vermicompost (2 t ha^{-1}) with full dose of phosphorus (75 kg P_2O_5 ha^{-1}) treatment (V1P2) fertilization markedly influenced the nutrient concentration in grains (2.56% of N, 0.3% of P, 1.23% of K), their uptake (62 kg ha^{-1} N, 12 kg ha^{-1} P, 39 kg ha^{-1} K) and yield (1410 kg ha^{-1}) over control in mungbean. Economically significant nutrient contents in grain (2.44% N, 0.37% P, 1.17% K), nutrient uptake (52 kg ha^{-1} N, 8.91 kg ha^{-1} P, 31.5 kg ha^{-1} K) and yield (1282 kg ha^{-1}) was observed from the treatment where half dose of fertilizer (37.5 kg P_2O_5 ha^{-1}) with 2 t ha^{-1} vermicompost (V1P1) over control.

Key words: Phosporus, Mungbean, Vermicompost, Nutrient uptake

1. Introduction

Mungbean [*Vigna radiata* (L.) is a common pulse crop of Pakistan. Due to drought resistant, it can withstand in arid conditions, and is successfully cultivated in rain fed areas. Mungbean is high in protein; 22-24% (Malik, 1994), rich in vitamins A, B, C and minerals such as potassium, phosphorus and calcium, which are necessary for human body. Owing to all these characteristics it is considered a good substitute of animal protein and forms a balanced diet when it is taken with cereals (Mansoor, 2007; Delic *et al*., 2011). Application of phosphorus plays an important role in growth, development and maturity of crop. Phosphorus helps to increase grain yield, seed quality, regulate the photosynthesis, govern physico-bio chemical process and also in development of roots and nodulation. Therefore application of phosphorus is must incentive coupled with increased use of phosphorus with organic manure (Vermicompost). Many investigators reported that crop utilizes only 15- 20 % of the applied phosphorus and rest is retained in the form which is not readily available to the crop. To compensate the supply of phosphorus and high price of chemical fertilizers, use of organic sources like vermicompost has to be encouraged as it supplies essential plant nutrients and improves physical, chemical and biological conditions of the soil, soil microbial activities, soil structure, and water holding capacity and thereby increase the fertility and productivity of soil. Vermicompost is a potential source due to the presence of available plant nutrients, growth enhancing substances like nitrogen fixing, phosphorus solubilizing and cellulose decomposing organism. Vermicompost alone or in combination with fertilizer improve the N, P and K status of soil.

Current trend in agriculture focus on reducing the use of chemical fertilizers by the application of biofertilizers such as vermicompost (Haj Seyed Hadi, 2011). The management practices and use of organic materials influence agricultural sustainability by improving physical, chemical and biological properties of soils (Saha *et al*., 2008). Organic agriculture provides a constant increase of biological fertility and release of nutrients to the plants (Sofia *et al*., 2006). Vermicomposting process is the biological degradation of organic waste by earthworms and other microorganisms to form vermicompost (Edwards & Burrows, 1988) which is important for organic agriculture, now a days. The leisurely and progressively released nutrients by vermicompost into the rhizosphere provide the appropriate conditions for plant uptake (Ansari & Sukhraj, 2010). It has been confirmed that vermicompost has the capacity to supply both macro and micronutrients in the soil for optimum plant growth (Harris *et al*., 1990). These plant nutrients are adsorbed on the humic acid molecules and are released slowly and gradually into the soil solution and made available for plant growth and development processes (Arancon *et al*., 2005; Guiterrez-Miceli, 2007). Numerous reports have indicated that slow and gradual release of nitrogen through vermicompost increased the concentration of carotene in a wide range of fruits and vegetables, including carrots (Mozafar, 1993). Application of vermicompost realized highest number (24.33) of nodules /plant (Rajkhowa, *et al*., 2002). Nutrients in vermicompost are present in readily available forms for plant uptake; e.g. NO_3, exchangeable P, K, Ca and Mg (Edwards and Burrows, 1988). Better plant growth and yield of different crops have been reported when vermicompost was combined with artificial fertilizer in a certain ratio. Senthil kumar *et al*. (2004) found that vermicompost ± NPK fertilizers significantly enhanced Rose sp growth, yield and quality over the control, especially when used in combination. Plant available N, P and K were higher in plots supplied with both vermicompost and NPK fertilizers (Senthilkumar *et al*., 2004).

2. Materials and methods

A field experiment was conducted to check the effect of vermicompost and phosphorus fertilization on crop (Mungbean) growth and crop nutrient uptake at experimental field area of National Agricultural Research Centre (NARC) Islamabad. Physical and chemical characteristics of the experimental soil are presented in Table 1. The nutritional analysis of vermicompost is given in Table 2. The experiment was laid out in a randomized complete block design with three replications. Two levels of vermicopost (0, 2 t ha^{-1}) and three levels of phosphorus (0, 37.5 kg ha^{-1} and 75 kg ha^{-1}) were applied at the time of sowing. The factorial and combined details of experimental treatments are given in Table 2 – 3, sowing of mungbean was completed during the last week of February 2015. Data on pods $plant^{-1}$, grains pod^{-1}, thousand grain weight (g), grain yield (kg ha^{-1}) and percentage of NPK in grain and seed was analyzed to study nutrient uptake.

Table 1: Soil Physical and chemical properties of the experimental site

Soil Property	Unit	Value
pH	-	7.70
EC	dSm^{-1}	0.29
Organic matter	%	0.8
Phosphorus	$mgkg^{-1}$	2.96
NO_3 –N	$mgkg^{-1}$	1.76
Potassium	$mgkg^{-1}$	120
Class	-	Clay loam

Table 2: Nutrient content of vermicompost Plant height (cm)

Nutrient elements	Unit	Vermicompost
Organic carbon	*%*	> 25
Nitrogen	*%*	1-2
Phosphorus	*%*	0.2-0.3
Potassium	*%*	0.8-2
Magnesium	*$mg\ kg^{-1}$*	300-500
Zinc	*$mg\ kg^{-1}$*	> 100
Copper	*$mg\ kg^{-1}$*	> 20
Iron	*$mg\ kg^{-1}$*	> 1000-1500
CN ration	-	13-20
EC	*dSm^{-1}*	< 3.5
pH	-	6.5-7.5
Colour	-	Dark brown to black
Moisture	*%*	20-30

Data on number of pods $plant^{-1}$ were recorded by randomly selected ten plants in each plot and their pods were counted and averaged. For thousand grain weights data, a random sample of thousand grains was taken from the grain yield of each plot and then weighed with an electronic balance. In case of grain yields data, four central rows were harvested at their maturity from each plot, tied into bundles separately. The bundles were sun dried and weighed by spring balance for calculating biological yield (kg ha^{-1}). For grain yield (kg ha^{-1}), their pods were removed from the harvested plants, dried, threshed and weighed with the help of an electronic balance. Standard analytical methods were followed for analyzing soil and plant samples for NPK concentration in soil and plant.

2.1. Statistical analysis

The data recorded were analyzed statistically by statistics 8.1 using analysis of variance techniques appropriate for randomized complete block design.

3. Results and discussion

Vermicompost affected plant height as shown in the Table 5. Data shows that vermicompost @ 2 t ha^{-1} along with 75 kg P_2O_5 ha^{-1} significantly increased plant height (62.67cm) over control (32.67 cm). The application of vermicompost gave higher germination of mungbean (*Vigna radiata*) compared to the control. Better results were also observed from the treatment V1P1 (55.67 cm) even when inorganic phosphorus was reduced to 50% as compared to V1P2. This indicates that application of vermicompost increases the efficiency of inorganic phosphorus. Actually organic fertilizers help to increase the organic matter contents of soil, thus reducing the bulk density and decreasing compaction. Thus plants get a suitable growing environment which promotes better growth and development. Combination of organic and inorganic fertilizers was reported better by Channaveerswami (2005) in groundnut and Rajkhowa *et al*. (2002) in green gram than only inorganic fertilizers.

3.1. 1000-seed weight (g)

1000-seed weight of treatment 6 differed significantly due to the interaction effect phosphorus and vermicompost. Highest 1000-seed weight (46.67 g) was recorded from the combination of P_2O_5 @ 75 kg ha^{-1} and vermicompost @ 2 t ha^{-1} (V1P2). Better results were also shown by the treatment V1P1 (39.00 g) where half phosphorus was applied that is most economical. Interaction of no phosphorus and no vermicompost (V0P0) gave the lowest 1000-seed weight (20 g) among the treatments but no significant difference was observed by V1P0 (26.33 g) and V0P1 (30.67 g) respectively. It is revealed from the result that combination of vermicompost dand inorganic phosphorus fertilizers increased the 1000-seedweight. Similar results were reported by Channaveerswami (2005) in groundnut and Rajkhowa *et al*. (2002) in green gram. Patil (1998) reported that in groundnut the maximum1000-seed weight was recorded with the application of vermicompost @ 2.50 t ha^{-1} + fly ash @ 30 t ha^{-1} + RDF, whereas, the lowest 1000-seed weight was recorded with the application of RDF alone. Results are shown in Table 5.

3.2. Number of pods plant^{-1}

Highest number of pods plant^{-1} (19.00) was recorded from the combination of P_2O_5 @ 75 kg ha^{-1} and vermicompost @ 2 t ha^{-1} (V1P2) and economically better results were also found from the treatment V1P1 (16.33) where P_2O_5 @ 37.5 kg ha^{-1} and vermicompost @ 2 t ha^{-1} was used. Application of no phosphorus and no vermicompost (V0P0) gave the lowest number of pods plant^{-1} (4.67) among the treatments. Combination of vermicompost and inorganic phosphorus fertilizers increased the number of pods plant^{-1} than there was no use of inorganic fertilizer and vermicompost. This may be because combination of vermicompost and inorganic fertilizers improves soil physical properties, which provide health and favorable soil conditions to enhance nutrient use efficiency. Channaveerswami (2005) reported that combined application of vermicompost @ 2.5 t ha^{-1} + RDF (25:50:50 kg NPK ha^{-1}) + copper ore tailing recorded higher number of matured pods (17.06) in groundnut. Abbas *et al.* (2011) found that application of DAP at 124 kg along with 10 t ha^{-1} of poultry litter yielded maximum number of pods plant^{-1}. Results are shown in Table 5.

3.3. Number of seeds pod^{-1}

Number of seeds pod^{-1} of the treatment V1P2 differed significantly due to the interaction effect of phosphorus and vermicompost treatments. As described in Table 5, highest number of seeds pod^{-1} (9.33) was recorded from the combination of P_2O_5 @ 75 kg ha^{-1} and vermicompost @ 2 t ha^{-1} (V1P2) and economically better results (7.33) were found from the combination of V1P1 where 50% less phosphorus was used than the treatment V1P2. Application of no phosphorus and no vermicompost (V0P0) gave the lowest number of seeds pod^{-1} (3.00) among the treatments. No significant difference was observed from the treatment V0P1 (5.00) and V1P0 (4.33). It is revealed that combination of vermicompost and inorganic phosphorus fertilizers increased the number of seeds pod^{-1}.Similar results were reported by Channaveerswami (2005) in groundnut and Rajkhowa *et al*. (2002) in green gram.

3.4. Number of seeds plant^{-1}

Number of seeds plant^{-1} from the treatment V1P2 differed significantly due to the interaction effect of phosphorus and vermicompost treatments. Highest number of seeds plant^{-1} (164.67) was recorded from the combination of P_2O_5 @ 75 kg ha^{-1} and vermicompost @ 2 t ha^{-1} (V1P2). Economically better results were also observed by V1P1 (114.33) where 50% half P_2O_5 @ 37.5kg ha^{-1} and vermicompost @ 2 t ha^{-1} was applied whereas control treatment (V0P0) gave the lowest number of seeds plant^{-1} (14.00) among the treatments. Results from the treatment V1P0 (30.67) and V0P1 (36.67) were showed no significant difference that indicates that combination of vermicompost and inorganic phosphorus fertilizers increased the number of seeds per plant (Table 5). Similar results were reported by Channaveerswami (2005) in groundnut and Rajkhowa *et al*. (2002) in green gram. Patil (1998) reported that in groundnut the maximum number of seeds pod^{-1} was recorded with the application of vermicompost @ 2.50 t ha^{-1} + fly ash @ 30 t ha^{-1} + RDF, whereas, the lowest number

Table 3: Treatments of different levels of phosphorus and vermicompost

Factor 1:			Factor 2:	
P levels			VC levels	
P0 No Phosphorus	P1 (50%) Phosphorus @ 37.5 kg ha^{-1}	P2 (100%) Phosphorus @ 75 kg ha^{-1}	V0 No vermicompost	V1 Vermicompost @ 2 tons ha^{-1}

of seeds pod^{-1} was recorded with the application of The authors describe the assessment of exposure to naphthalene by means of quantification of blood naphthalene in car mechanics and car spray painters in Pakistan. The object of this manuscript is of interest, since there are no many articles on the use of blood naphthalene as biomarker of exposure. Nevertheless, Methods lack of quality control, Results are not adequately presented, tables and figures are confused, Discussion is too long. For these reasons, the paper is not acceptable in the present form. Major Compulsory Revisions Specific Comments: Introduction Line 17: Molecular weight is not a "carcinogenic attributes of PAHs", Please, rephrase. Methods: Data collection: The recruitment of control subjects should be better described. Were the exposed subjects belonging to the same industry? Who were the controls? Did the subjects sign the informed consent? It is written that the samples were taken on spot during work hours. Which precautions were taken to avoid contamination? Procedure: The entire paragraph is taken, unless very small changes, from the article by Al-Daghri (number 14 of the reference list). I think that the authors should recall the reference at the beginning of the paragraph, writing something like: "Blood naphthalene was analyzed according to Al-Daghri and so on". In addition, important information is lacking, in particular: the analytical limit of detection and the analytical quality control (accuracy, precision and so on) for the analysis of naphthalene must be specified; the analytical quality and the brand of the reagents used; the HPLC column used. For quantification of naphthalene, a rough method is used. Have the Authors the possibility of using a calibration curve? Please specify what is the standard used for the quantification (see formula): concentration (how was it assessed??), was it prepared in the lab? In solvent (which?) or in blood? Was it pursued by a commercial supplier? (which one?) Please specify which were the criteria for the classification of the working ambient: what is the difference between "better" (I think that should be replaced with "good") and "satisfactory"? Statistical analysis: Were the data normally distributed? If not, was a log-transformation used? Student's t-test can be used only on normally distributed data. In that case, Pearson correlation should be use, while Spearman correlation is to be used only on not normally distributed data. Results: Third and fourth paragraph: If data are not normally distributed (very probable), median is a better descriptive parameter than mean. The last sentence of fourth paragraph ("Comparison between pairs of groups…") should be anticipated in the third paragraph, before the splitting of the data for smoking habit. Third paragraph, last line: when talking about controls, two p values are given: it is not clear what are the terms of comparison. Figure 2: in these graphics, I can count only about 30 subjects: who are these subjects? Only exposed? Only smokers? Please, describe better. Discussion and Conclusions: It is really too long, with many repetition and not necessary observations. I think it must be significantly reduced.RDF alone.

3.5. Straw yield ($kgha^{-1}$)

Highest straw yield (2821 kg ha^{-1}) was recorded from the combination of V1P2. Highest straw yield was due to the combination of phosphorus @ 75kg ha^{-1} and vermicompost @ 2 t ha^{-1}. The treatment of no phosphorus and no vermicompost (V0P0) gave lowest straw yield (879 kg ha^{-1}) whereas no significant difference was observed from V1P0 (1219 kg ha^{-1}) and V0P1 (1487 kg ha^{-1}). It is shown from the result that combination of vermicompost and inorganic phosphorus fertilizers increased straw yield (Table 5). Rajkhowa (2002) was also of the opinion that application of 2.5 t ha^{-1} vermicompost recorded the maximum straw yield of mungbean which was significantly higher than the same dose of FYM.

3.6. Seed yield (kg ha^{-1})

Seed yield ha^{-1} of treatment V1P2 differed significantly due to the interaction effect of phosphorus and vermicompost treatments. Highest seed yield (1410 kg ha^{-1}) was recorded from the combination of P_2O_5 @ 75 kg ha^{-1} and vermicompost @ 2 t ha^{-1} (V1P2) but economically better results were observed by the treatment V1P1 (1282 kg ha^{-1}) where phosphorus was reduced to 50% as compared to V1P2. Interaction of no phosphorus and no vermicompost (V0P0) gave the lowest seed yield (592 kg ha^{-1}) among the treatments. Statistically similar results were found from the treatments V1P0 (741 kg ha^{-1}) and V0P1 (796 kg ha^{-1}). The detail results are shown in Table 5. These results indicate integrated effect of vermicompost and inorganic phosphorus increased seed yield in mungbean. Similar results were reported by Channaveerswami (2005) in groundnut and Rajkhowa *et al.* (2002) in green gram. Patil (1998) reported that in groundnut the maximum seed yield ha^{-1} was recorded with the application of vermicompost @ 2.50 t ha^{-1} + fly ash @ 30 t ha^{-1} + RDF whereas, the lowest seed yield ha^{-1} was recorded with the application of RDF alone. Abbas *et al.* (2011) found that application of DAP at 124 kg along with 10 tons ha^{-1} of poultry litter yielded maximum seed yield ha^{-1}. Rajkhowa *et al.*(2002) reported that the application of 100 per cent RDF along with vermicompost @ 2.5 t ha^{-1} recorded significantly higher plant height (52.7 cm), number of pods per plant (12.67), seeds per pod (12.00), 100 seed weight (4.6 g), seed yield (5.35 q ha^{-1}), seed yield (5.4 q ha^{-1}) and it was on par with the application of 75% or 50% RDF + vermicompost (2.5 t ha^{-1}) over control in mungbean.

3.7. Nitrogen contents (%)

Total N content of treatment 6 differed significantly due to the interaction effect of phosphorus and vermicompost treatments. Highest N content in seed (2.56%), in shoot (0.919%) and total uptake (62.01 kg ha^{-1}) was recorded from the combination of P_2O_5 @ 75 kg ha^{-1} and vermicompost @ 2 t ha^{-1} (V1P2) but economically better results were also obtained from the treatment 5 (V1P1) where highest N content in seed (2.44%), shoot (0. 875%) and total (52.33 kg ha^{-1}) was observed. No significant difference in N uptake was observed by the treatment V0P1 (25.83 kg ha^{-1}) and V1P0 (25.84 kg ha^{-1}) respectively. Interaction of no phosphorus and no vermicompost (T1) gave the lowest N content in seed (1.79%), in shoot (0.645%) and total (16.30 kg ha^{-1}) among the treatments in Figure 1. Yadav (2001) conducted that application of vermicompost also recorded significantly higher nitrogen, phosphorus and potassium uptake over control and FYM. Since uptake of nutrients is a function of their content and yield, increase in grain and straw yield along with higher content of N, P and K might have resulted in higher uptake of these nutrients in the corps.

3.8. Phosphorus contents (%)

Phosphorus content of treatment 6 differed significantly due to the combined effect of phosphorus and vermicompost treatments (V1P2). Highest P content in seed (0.433%), in shoot (0.207%) and total uptake (12.00 kg ha^{-1}) was recorded from the combination of P_2O_5 @ 75 kg ha^{-1} and vermicompost

@ 2 t ha^{-1} (V1P2) but economically better results were also obtained from the treatment 5 (V1P1) where P content in seed (0.367%), shoot (0.175%) and total (8.91 kg ha^{-1}) was observed better as P was used half than V1P2. Interaction of no phosphorus and no vermicompost (T1) gave the lowest P content in seed (0.203%), in shoot (0.097%) and total (2.10 kg ha^{-1}) among the treatments as shown by the graphs. No significant difference was observed in P uptake from the treatments V0P1 (3.91 kg ha^{-1}) and V1P0 (3.26 kg ha^{-1}). The graphical representation of P in grains and shoot and P as whole is given in Figure 1.

Table 4: Experimental treatment combination

Treatments	Combinations
T_1	V_0P_0
T_2	V_0P_1
T_3	V_0P_2
T_4	V_1P_0
T_5	V_1P_1
T_6	V_1P_2

From the results it is clear that combined effect of vermicompost and inorganic phosphorus fertilizers increases the availability of P in plants. Mathur (2000) also observed significantly higher, N, P and K uptake and protein yield of mungbean due to application of 20 kg N through vermicompost.

3.9. Potassium contents (%)

Highest K contents in seed (1.23%), in shoot (0.766%) and total uptake (38.88 kg ha^{-1}) were recorded from the combination of P_2O_5 @ 75 kg ha^{-1} and vermicompost @ 2 t ha^{-1} (V1P2) over control that showed lowest K contents in seed (1.097%), shoot (0.661%) and total uptake (12.313 kg ha^{-1}). The treatments V1P0 (1.12% seed, 0.70 % shoot, total 16.93 kg ha^{-1}) and V0P1 (1.13% seed, 0.71 % shoot, total 19.6 kg ha^{-1}) showed no significant difference. This might be due to the combined effect of vermicompost that enhanced the availability of

Table 5: Interaction effect of Phosphorus and vermicompost on growth and various yield contributing parameters

	Treatments	Plant height	1000 seed weight (g)	No. of pod/plant	No. of seed/pod	No. of seed/plant	Straw yield (kg ha^{-1})	Yield (kg ha^{-1})
V0,P0	T1	32.67 e	20.00 f	4.67 e	3.00 e	14.00 e	879 f	592 f
V0,P1	T2	54.33 c	30.67 d	7.33 d	5.00 cd	36.67 d	1487 d	796 d
V0,P2	T3	60.33 ab	37.33 c	14.33 c	5.67 c	86.00 c	2065 c	1203 c
V1,P0	T4	46.00 d	26.33 e	7.67 d	4.33 d	30.67 d	1219 e	7410 e
V1,P1	T5	55.67 bc	39.00 b	16.33 b	7.33 b	114.33 b	2405 b	1282 b
V1,P2	T6	62.67 a	46.67 a	19.00 a	9.33 a	164.67 a	2820 a	1410 a
	CV (%)	5.21	2.74	7.52	10.79	11.31	6.40	2.36

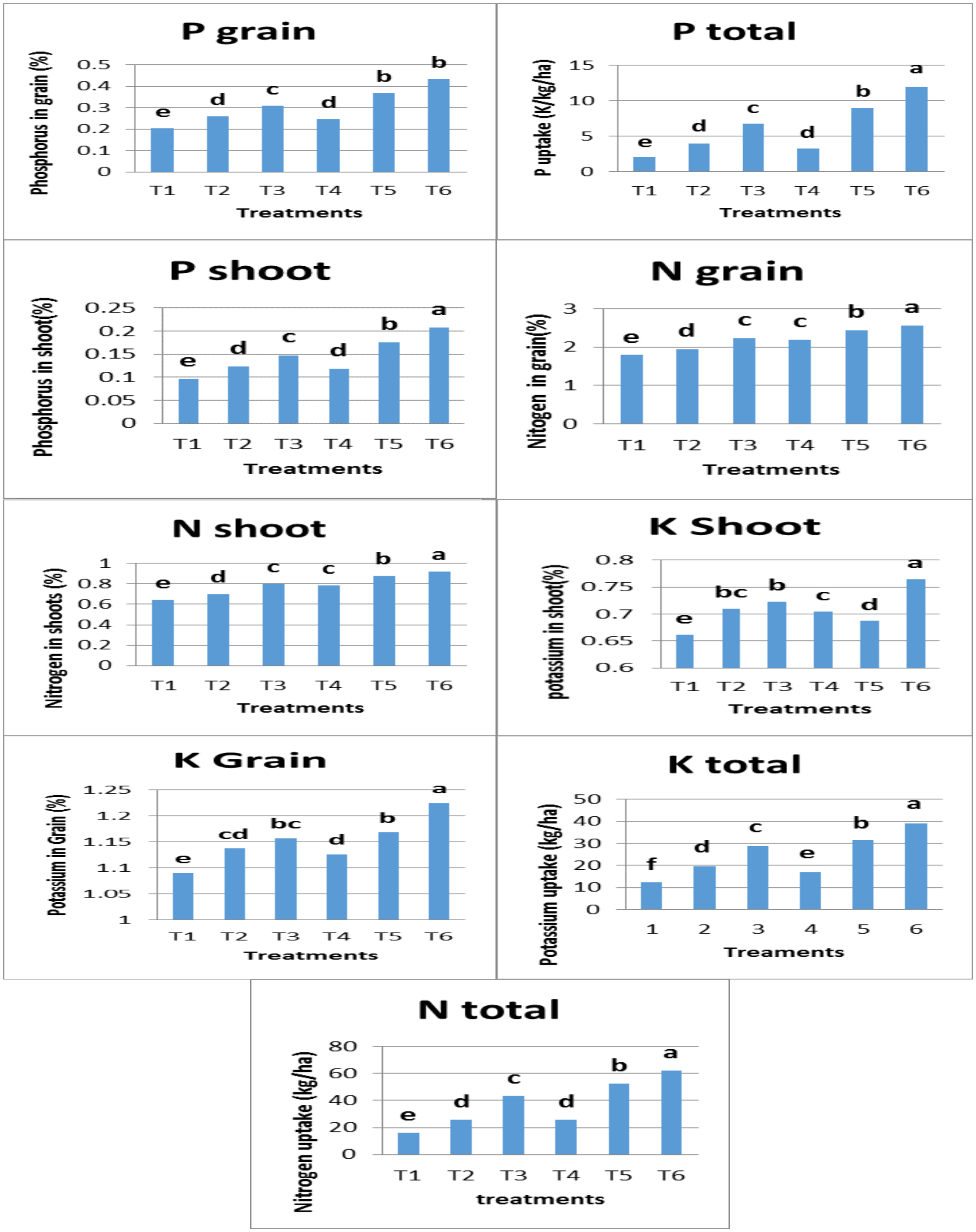

Figure 1: N, P and K concentration and their total uptake in grain of mungbean as affected by vermicompost and phosphorus fertilization

nutrients. Improved potassium supply also enhances biological nitrogen fixation and protein content of potassium (K) and magnesium (Mg) by rice (Oryza sativa) plant was highest when fertilizer was applied in combination with vermicompost (Jadhav *et al*. 1997). The graphical representation of K in grains and shoot and K as whole is given in Figure 1.

4. Conclusion

This study shows that there was a significant effect of combined application of vermicompost and inorganic phosphorus. The treatment 6 V1P2 (P_2O_5 @ 75 kg ha^{-1} and vermicompost @ 2 t ha^{-1}) showed best yield, growth parameters and nutrients uptake. However, economically vermicompost also showed best results when P_2O_5 was reduced to half as compared to full dose of phosphorus fertilizer.

References

Abbas, G., Z. Abbas, M.A. Gill, A.U. Malik, M. Ishaque and F. Hussain. 2011. Effects of organic and inorganic fertilizers on mungbean (Vignaradiata (L.)) yield under arid climate. Int. Res. J. Plant Sci., 2(4):94-98.

Ansari, A.A. and K. Sukhraj. 2010. Effect of vermiwash and vermicompost on soil parameters and productivity of okra (Abelmoschusesculentus) in Guyana. Afric. J. Agric. Res., 5:1794-1798.

Arancon, N.Q., C.A. Edwards, P. Bierman, J.D. Metzger, and C. Lucht. 2005. Effects of vermicomposts produced from cattle manure, food waste and paper waste on the growth and yield of peppers in the field. Ped. Bio., 49: 297-306.

Channaveerswami, A.S. 2005. Studies on integrated nutrient management and planting methods on seed yield and quality of groundnut. Ph.D. Thesis, Univ. Agric. Sci., Dharwad, Karnataka, India.

Delice D., O. Stajkovic-Sibrinovic, D. Kuzmanovic, N. Rasulic, V. Mrvic, S. Andjelovic and J. Knezevic-Vukcevic. 2011. Effects of bradyrhizobialinoculation on growth and seed yield of mungbean in Fluvisol and Humoflovisol. Afric. J. Micro. Res., 5: 3946-3957.

Edwards, C.A. and I. Burrows. 1988. The potential of earthworm composts as plant growth media in Neuhauser, C.A. (Ed.), Earthworms in Environmental and Waste Management. SPB Acad. Publi., The Hague, the Netherlands, 211-220.

Edwards, C.A. and I. Burrows. 1988. The potential of earthworm composts as plant growth media. In:Edwards CA and Neuhauser E (Eds.). Earthworms in Waste and Environmental Management. SPB Acad. Press. The Hague, The Netherlands, 21-32.

Gutiérrez-Miceli, F.A., J. Santiago-Borraz, J.A.M. Molina, C.C. Nafate, M. Abud-Archila, M.A.O. Llaven, R. Rincón-Rosales and L. Dendooven. 2007. Vermicompost as a soil supplement to improve growth, yield and fruit quality of tomato (Lycopersicumesculentum). Biores. Tech., 98: 2781-2786.

Hadi, H.S., M.T. Darzi, Z. Ghandehari and G.H. Riazi. 2011. Effects of vermicompost and amino acids on the flower yield and essential oil production from Matricaria chamomile L. J. Medi. Pl. Res. 5: 5611-5617.

Harris, G.D., W.L. Platt, B.C. Price. 1990. Vermicomposting in a rural community. Int. Res. J. Plant Sci., 2: 094-098.

Jadhav, A.D, S.C. Talashilkar and A.G. Pawar. 1997. Influence of the conjunctive use of FYM, vermicompost and urea on growth and nutrient uptake in rice. J. Mahar. Agric. Uni., 22:249–250.

Karmegam, N., K. Alagermalti, and T. Daniel. 1999. Effect of vermicompost on the growth and yield of green gram (Phaseolus aureus Rob.). Tro. Agri., 76:143-146.

Malik, B.A., 1994. Grain Legumes. *In*: Nazir, M.S. (ed.), *Crop Production*. NBF, Islamabad, Pakistan, 301.

Mansoor, M. 2007. Evaluation of various agronomic management practices for increased productivity of Mungbean (Vigna radiate L. Wilszek). Ph.D dissertation, Depart. Agro., Gomal University, Pakistan.

Mathur, K. 2000. Effect of Rhizobium inoculation and various sources of nitrogen on growth and yield of summer greengram [Vignaradiata (L.) Wilckzek]. M. Sc. thesis. CCSHAU, Hisar, India.

Mozafar, A. 1993. Nitrogen fertilizers and the amount of vitamins in plants: A review. J. Plant Nutr., 16: 2479-2506.

Patil B.S. 1998. Studies on integrated nutrient management in summer groundnut (Arachis hyphogea L.). M. Sc. (Agri). Thesis, Univ. Agric. Sci., Dharwad, Karnataka, India.

Rajkhowa D.J., M. Saikia and K. M. Rajkhowa. 2002. Effect of vermicompost with and without fertilizer on Greengram. Legume Res., 25: 295-296.

Saha S., Mina B. L., Gopinath K. L., Kundu S. and H. S. and H.S. Gupta. 2008. Relative changes in phosphatase activities as influenced by source and application rate of organic composts in field crops. Bio. resour. Technol., 99:1750-1757.

Senthilkumar, S., M.V. Sriramach and K. Haripriya. 2004. Effect of vermicompost and fertilizer on the growth and yield of rose. J. Interacademicia. 8: 207-210.

Walia, S.S. and D.S. Kler. 2009. Organic versus chemical farming- A review. J. Res., 46:114-126.

Yadav O.S. 2001. Effect of nitrogen sources and biofertilizer on growth and quality of cowpea. M. Sc. (Ag.) thesis. RAU, Bikaner, India.