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Evaluation Effect of Different Level of Vermicompost and Manure on Physiological Parameters of Cowpea (*Vigna unguiculata* L.)

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RESEARCH ARTICLE

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ABSTRACT

BACKGROUND: Vermicompost has many characteristics such as high porosity, ventilation and proper drainage, high moisture absorption and maintenance power, high uptake level for water and food stuffs, and its use in sustainable agriculture is very useful to improve soil porosity and thus more availability of nutrient elements required by plants. Manure plays an important role in improving physical, chemical and biological properties of the soil.

OBJECTIVES: The current study was conducted to assessment effect of different level of vermicompost and several amount of cow manure on growth indices of Cowpea.

METHODS: This research was carried out via factorial experiment based on randomized complete blocks design with three replications along 2015 year. Place of research was located in Ahvaz city at longitude 48°40'E and latitude 31°20'N in Khuzestan province (Southwest of Iran). The first factor included three level of Vermicompost (V_1: nonuse of vermicompost or Control, V_2: 2 $t.ha^{-1}$, V_3: 4 $t.ha^{-1}$) and second factor consisted of cow manure (M_1: nonuse of cow manure or Control, M_2: 10 $t.ha^{-1}$, M_3: 15 $t.ha^{-1}$).

RESULT: Result of analysis of variance revealed effect of vermicompost and cow manure on all studied growth parameters (instead total dry weight) was not significant. Compare different level of vermicompost indicated that maximum leaf area index (LAI), total dry weight (TDM), crop growth rate (CGR) and net assimilation rate (NAR) was noted for 4 $t.ha^{-1}$ and minimum of that belonged to control treatment. Compare different level of cow manure showed the maximum total dry weight belonged to LAI, TDW, CGR and NAR for 15 $t.ha^{-1}$ and minimum of that was for control treatment.

CONCLUSION: Based on the results of current research, treatments of 4 $t.ha^{-1}$ of vermicompost mixed with 15 $t.ha^{-1}$ of animal manure had the highest amount of physiological indicators and can recommended for studied area.

KEYWORDS: *Dry matter, Growth indices, Leaf area index, Nutrition, Pulse.*

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1. BACKGROUND

The use of bio-products for plant nutrition purposes is taken as a basic approach so that Food and Agriculture Organization recently has taken some measure to implement the Integrated Plant Nutrition Management systems for the development of sustainable agriculture in developing countries. In addition, the International Conference on Food Importance and its role in Soil Stability (Rome, 26-28 March 2003) was held to discuss the quality and quantity improvement of foodstuff per unit area through the integration of mineral and organic nutrition of crops as a fundamental challenge facing the realization of World Food Security (WFS). Adequate Input Sustainable Agriculture (AISA) is currently practiced based on the integrated use of chemical and organic fertilizers, especially biofertilizers as an approach to alternative agriculture for producing and maintaining yield at an acceptable level (Dastmozd *et al*., 2015). Vermicompost has many characteristics such as high porosity, ventilation and proper drainage, high moisture absorption and maintenance power, high uptake level for water and food stuffs, and its use in sustainable agriculture is very useful to improve soil porosity and thus more availability of nutrient elements required by plants. In fact, the superiority of vermicompost compared to other organic fertilizers is that its structure has changed well and the number of plant pathogenic microorganisms in it has strongly decreased (Claudio *et al*., 2009). Vermicompost is much valued for arable and gardening soil improvement and is demanded by professionals. Since the 1990s, a raging wave of recycling fans was observed around the world. Since worms are able to eat organic waste equivalent to about half of their weight (an average of seven milligrams) each day, they are frequently used in landfill sites in many regions of the world. Based on what was mentioned, the aim of the present study is to evaluate the effect of vermicompost fertilizer as compared to the biological fertilizer on yield and yield components of wheat (Dastmozd *et al*., 2015). Manivannan *et al*. (2009) indicated that application of vermicompost with inorganic fertilizers improved yield and protein of the *Phaseolus vulgaris* seeds. Vermicompost can provide all nutrients in readily available form and also enhances uptake of nutrients by plants. Suhane *et al*. (2008) reported that the use of only 2.5 $t.ha^{-1}$ vermicompost wheat farm has a better result compared to use chemical fertilizers. Vermicompost could also reduce plant's water requirement by about 30 to 40%. The use of vermicompost increases protein yield, probably this increase is due to the relatively higher amounts of nutrients and increased grain yield. The use of vermicompost has positive effects on the amount of protein and nutrient uptake by the plant. The favorable effect of vermicompost is probably due to relatively higher amounts of nutritional elements and hence increase in availability of macro and micro nutrients which leads to increased protein percentage (Jat and Ahlawat, 2008).

Organic manures including sheep manure, cattle manure and hen manure may be used for crop production as substitute of chemical fertilizers because the importance of organic manures cannot be overlooked (Abbas *et al*., 2012). Manure plays an important role in improving physical, chemical and biological properties of the soil. Manures contain a low concentration of plant nutrients and they have a slow acting nature, organic manure alone may fail to tend the high nutritional requirements of crops (Hossian *et al*., 2002). Continuous addition of manures to the soil increase its organic matter content year after year, improving physical and chemical soil properties (Bohme and Bohme, 2006). Alizadeh Dehkordi (2010) reported combination cow manure and urea fertilizer, even under drought stress, produce higher yield than to use urea fertilizer alone. Plant growth is the result of various processes that are constantly changing during the growing season. In order to identify these effective factors in increasing crop production, it is necessary to study and analyze the indicators that make up growth. Changes in these factors must also be examined and analyzed. Examining trend of dry matter changes and analyzing physiological indicators related to it, reveals more information about how the environmental factors that the crop has faced during growth (Alipon, 2016).

2. OBJECTIVES

The current study was conducted to assessment the effect of different level of vermicompost and several amount of cow manure on the growth indices of Cowpea crop.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This research was carried out via factorial experiment based on randomized complete blocks design with three replications along 2015 year. Place of research was located in Ahvaz city at longitude 48°40'E and latitude 31°20'N in Khuzestan province (Southwest of Iran). The first factor included three level of Vermicompost (V_1: nonuse of vermicompost or Control, V_2: 2 $t.ha^{-1}$, V_3: 4 $t.ha^{-1}$) and second factor consisted three level of cow manure (M_1: nonuse of cow manure or Control, M_2: 10 $t.ha^{-1}$, M_3: 15 $t.ha^{-1}$). This experiment had 27 plots. The size of each plot was 6×5 m^2. For the experiment, the distance between rows to rows was 60 cm with six rows per treatment.

3.2. Farm Management

Base fertilizers were added to the soil based on soil tests and the recommendations of the Iranian Soil and Water Research Institute at the planting stage. The light-disk harrow was used to mix the soil and the fertilizer after soil fertilization. The furrower was used to make furrows at a distance of 50 cm. The zinc and manganese Nano-chelate were used in the furrows (with 4cm depth) before planting. The furrows were covered with soil. The seeds were planted 2 cm above the fertilizer. Physical and chemical properties of the soil are mentioned in table 1.

Table 1. Physical and chemical properties of studied field

Depth of soil (cm)	Nutrition K (ppm)	P (ppm)	N (ppm)	Clay (%)	Silt (%)	Sand (%)	Soil texture	pH	EC ($ds.m^{-1}$)
0-30	145	4	6.02	41.5	47	11.5	Silty Clay	7.90	2.60

3.3. Measured Traits

In order to determine the yield two planting lines from each plot harvested and after the removal of marginal effect were carried to the laboratory and were placed in the oven at 75°C for 48 hours and after ensuring that the samples were completely dry, they were weighed and finally the total yield was measured. By measuring three factors including leaf area, leaf dry weight and total dry weight, the physiological parameters of growth including LAI, NAR and CGR were obtained using the following equations. To determine the leaf area of the linear relationship S= K. L.W was used in which S, L and W were the leaf area, L and W respectively, the maximum length and width of each leaf and K= 0.75 correction coefficient. The leaf area index was calculated from leaf area ratio to ground level. Crop growth rate, net assimilation rate and relative growth rate were measured according fallowing formula (Buttery, 1970; Enyi, 1962):

Equ.1. CGR ($g.m^{-2}.day^{-1}$) =

TDM_2- TDM_1/T_2-T_1

TDM_1= Primary dry weight (g),

TDM_2= Secondary dry weight (g)

T_1= initial sampling time,

T_2= Secondary sampling time

Equ.2. NAR ($g.m^{-2}.day^{-1}$) =

CGR × $LnLA_2$-$LnLA_1/LA_2$-LA_1

CGR = Growth rate in grams per day per square meter

LA_1 = Initial leaf area,

LA_2 = Secondary leaf area

3.4. Statistical Analysis

Analysis of variance and mean comparisons were done by MSTATC software and Duncan multiple range test at 5% probability level.

4. RESULT AND DISCUSSION

4.1. Leaf area index (LAI)

According result of analysis of variance effect of vermicompost and cow manure and interaction effect of treatments on leaf area index was not significant (Table 2). Compare different level of vermicompost indicated that maximum leaf area index was noted for 4 $t.ha^{-1}$ and minimum of that belonged to control treatment (Fig.1). It seems consumption of vermicompost due to high levels of nutrients stimulated plant growth, which led to high plant growth and increased LAI. Beyk Khurmizi *et al*. (2011) reported that consuming a volume ratio of 25% vermicompost and 75% soil increases the leaf area of red beans. With respect to different level of cow manure maximum and minimum amount of leaf area index belonged to 15 $t.ha^{-1}$ and control (Fig.2). It seems animal manure has an effect on the infiltration of water into the soil and improves soil structure, which leads to soil fertility and help the plant to grow more, and thus increase the LAI.

Table 2. Result analysis of variance of measured traits

S.O.V	df	First sampling (40 days after plant)				Second sampling (55 days after plant)			
		LAI	TDW	CGR	NAR	LAI	TDW	CGR	NAR
Replication	2	0.1^{ns}	176.34*	0.25^{ns}	0.1^{ns}	0.03^{ns}	79.6*	0.19^{ns}	0.01^{ns}
Vermicompost (V)	2	0.21^{ns}	224.76*	2.26^{ns}	0.004^{ns}	0.18^{ns}	8.53*	8.54*	0.001^{ns}
Cow Manure (M)	2	0.17^{ns}	104.7*	1.33^{ns}	0.004^{ns}	0.16^{ns}	1.09^{ns}	1.27^{ns}	0.001^{ns}
V × M	4	0.1^{ns}	6*	0.1^{ns}	0.1^{ns}	0.1^{ns}	6.52*	0.1^{ns}	0.01^{ns}
Error	16	5.17	2.38	10.19	12.08	8.12	1.4	21.11	7.12^{ns}
CV (%)	-	3.57	4.04	3.21	6.07	5.21	5.57	4.41	7.21

$^{ns, *}$ and **: no significant, significant at 5% and 1% of probability level, respectively.

Continue Table 2.

S.O.V	df	Third sampling (70 days after plant)				Forth sampling (85 days after plant)	
		LAI	TDW	CGR	NAR	LAI	TDW
Replication	2	0.07^{ns}	13.1*	0.05^{ns}	0.003^{ns}	9.09^{ns}	0.9^{ns}
Vermicompost (V)	2	0.13^{ns}	65.05*	2.42^{ns}	0.026^{ns}	0.16^{ns}	476*
Cow Manure (M)	2	0.2^{ns}	88.04*	1.57^{ns}	0.1^{ns}	0.09^{ns}	409.23*
V × M	4	0^{ns}	4.31*	0.05^{ns}	0.0031^{ns}	0.01^{ns}	7.47*
Error	16	0.01^{ns}	6.22*	0.06^{ns}	0.33^{ns}	0.02^{ns}	0.5^{ns}
CV (%)	-	4.30	7.81	6.46	8.21	5.57	7.46

$^{ns, *}$ and **: no significant, significant at 5% and 1% of probability level, respectively.

Pouryousef *et al*. (2010) reported use of 20 $t.ha^{-1}$ of animal manure had the greatest effect on the leaf area index and shoot development of Asparagus plant, which was due to the finer and richer nature and microbial population of animal manure than chemical fertilizer.

4.2. Total dry weight (TDW)

Result of analysis of variance revealed effect of vermicompost and cow manure on total dry weight was significant at 5% probability level, but interaction effect of treatments was not significant (Table 2). The maximum of total dry weight was obtained for 4 $t.ha^{-1}$ vermicompost and minimum of that was for control treatment (Fig.3). It seems improve vermicompost soil content led to increase in soil porosity, soil water holding capacity and soil structure improvement, which led to an increase in nutrients and ultimately an increase in dry matter in the plant. Compare different level of cow manure showed the maximum total dry weight was noted for 15 $t.ha^{-1}$ and minimum of that belonged to control treatment (Fig.4).

Roknil (2013) concluded that the rapid increase in amount of dry matter begins with an increase in leaf area and peaks when the plant reaches a maximum leaf area. Aram *et al*. (2009) stated that increasing animal manure by 60 tons per hectare increases the dry matter weight of corn.

4.3. Crop growth rate (CGR)

Result of analysis of variance revealed effect of vermicompost, cow manure and interaction effect of the treatments on crop growth rate was not significant (Table 2). Compare different level of vermicompost revealed the maximum crop growth rate was noted for the 4 $t.ha^{-1}$ and minimum of that belonged to control treatment (Fig.5). It seems upward trend of CGR diagrams of vermicompost treatments can be attributed to the direct relationship between CGR and LAI and the amount of solar radiation received. Tilpo *et al*. (2011) reported the highest crop growth rate in corn was observed in two treatments of 45 and 60 tons of vermicompost per hectare and the lowest one belonged to control (nonuse of the vermicompost). Compare different level of cow manure showed that the maximum and the minimum amount of crop growth rate (CGR) belonged to the 15 $t.ha^{-1}$ and control treatments (Fig.6). It seems increase the amount of animal manure matter led to increase the leaf area index (LAI) and the more LAI will be increase the crop growth rate (CGR). Mirhashemi *et al*. (2009) concluded that the treatment of 20 tons per hectare of cow manure had the highest crop growth rate (CGR) in the Plantain.

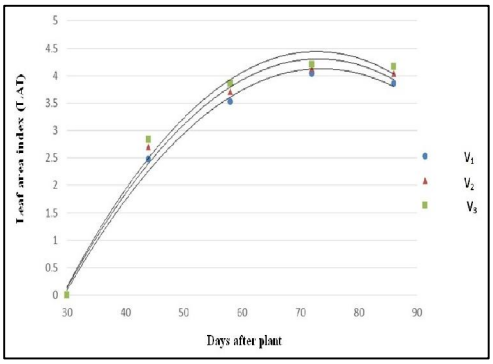

Fig. 1. Compare leaf area index affected different level of vermicompost.

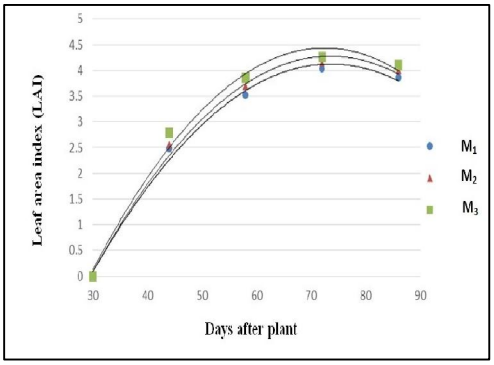

Fig. 2. Compare leaf area index affected different level of cow manure.

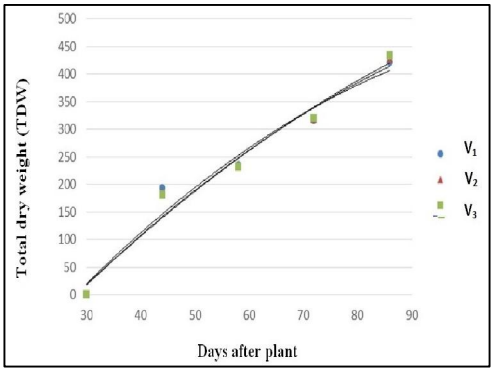

Fig. 3. Compare total dry weight affected different level of vermicompost.

4.4. Net assimilation rate (NAR)

According result of ANOVA effect of vermicompost and cow manure and interaction effect of treatments on net assimilation rate was not significant (Table 2).

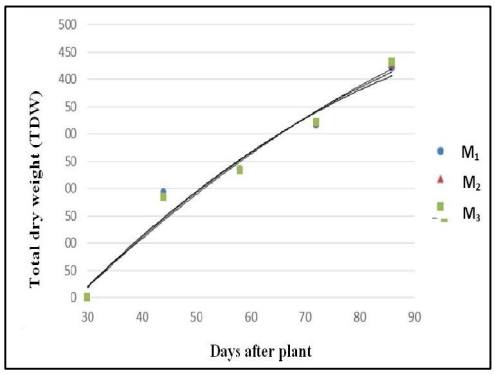

Fig. 4. Compare total dry weight affected different level of cow manure.

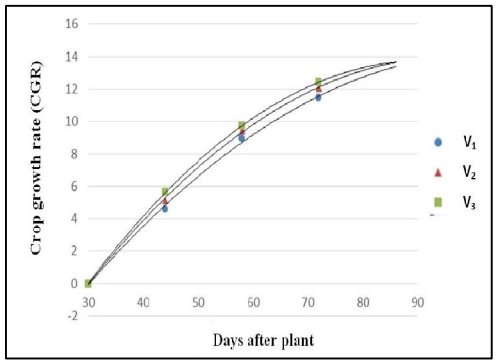

Fig. 5. Compare crop growth rate affected different level of vermicompost.

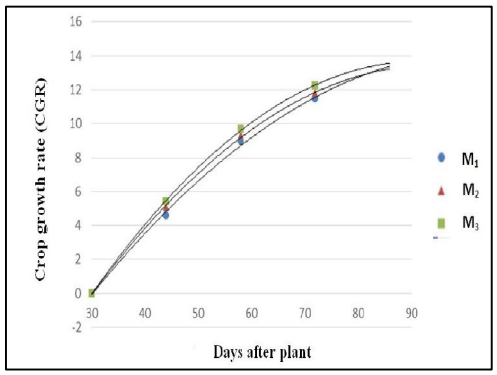

Fig. 6. Compare crop growth rate affected different level of cow manure.

The maximum of NAR was obtained for 4 t.ha^{-1} vermicompost and minimum was for control (Fig.7). Compare different level of manure revealed maximum NAR was noted for 15 t.ha^{-1} and minimum belonged to control (Fig.8).

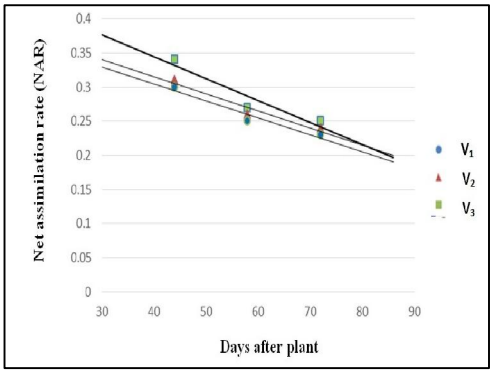

Fig. 7. Compare net assimilation rate affected different level of vermicompost.

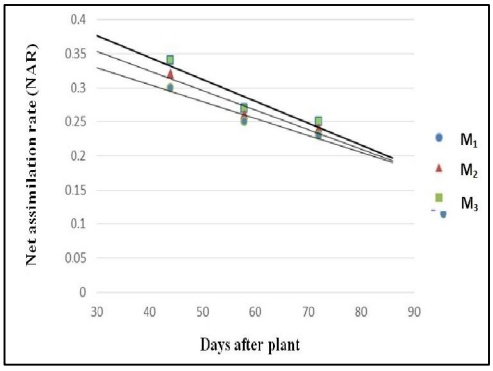

Fig. 8. Compare net assimilation rate affected different level of cow manure.

Further consumption of vermicompost and animal manure increased leaf area index, so due to the inverse relationship between LAI and NAR, increasing LAI leads to decreasing NAR. The reason can be considered as increasing the age and size of the plant and increasing competition for food. Khorramdel *et al.* (2010) by evaluate effect of different levels of vermicompost concluded that in Fennel flower the highest amount of NAR was in the treatment of nonuse of vermicompost.

5. CONCLUSION

Vermicompost and animal manure with benefits such as sustainability of soil resources, maintaining long-term crop production capacity, preventing environmental pollution and finally providing a healthy and quality product to the market as an alternative to non-renewable inputs in sustainable agriculture. Based on the results of current research, treatments of 4 $t.ha^{-1}$ of vermicompost mixed with 15 $t.ha^{-1}$ of animal manure had the highest amount of physiological indicators and can recommended for studied area.

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FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

CONFLICT OF INTEREST: Authors declared no conflict of interest.

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REFRENCES

Abbas, G., J. Z. K. Khattak, A. Mir, M. Ishaque, M. Hussain, H. M. Wahedi, M. S. Ahmed. and A. Ullah. 2012. Effect of organic manures with recommended of NPK on the performance of wheat (*Triticum aestivum* L.). J. Animal Plant Sci. 22(3): 683-687.

Alipon, C. 2016. Study crop growth parameters affected nutrition management. 1st Cong. Developed method to increase crop production. pp: 41-46.

Alizadeh Dehkordi, P. 2010. Effect of livestock and urea fertilizers on net soil mineralization, growth and yield of maize under cut irrigation at flowering. M.Sc. Thesis. Faculty of Agriculture and Natural Resources. Shahrekord University. 101 pages. (Abstract in English)

Aram, Sh., A. Faramarzi, M. Farbodi. and M. B. Khorshidibenam. 2009. Effect of manure levels and planting date on yield and yield components of sweet corn in the middle region. J. Agri. Sci. 3(12): 1-11. (Abstract in English)

Beyk Khurmizi, A., P. Abrishamchi, A. Ganjeali, M. Parsa. 2011. The Effect of vermicompost on salt tolerance of bean seedlings (*Phaseolus vulgaris* L.). J. Agroecology. 2(3): 474-485. (Abstract in English)

Bohme, L. and F. Bohme. 2006. Soil microbiological and biochemical properties affected by plant growth and different long-term fertilization. Europe. J. Soil Biol. 42: 1-12.

Buttery, B. R. 1970. Effect of variation in leaf area index on the growth of maize and soybean. Crop Sci. 10: 9-13.

Claudio, P. J., B. Raphael, F. Alves, L. R. Kamiila, S. N. Brunade. and M. Priscila. 2009. Zn (II) adsorption from synthetic solution and kaolin wastewater on vermicompost. Sci. Total Environ. 162: 804-811.

Dastmozd, Gh. R., H. R. Ebrahimi. and B. Jafari Haghighi. 2015. Combined application of vermicompost and NPK fertilizers on Wheat production in Marvdasht. Res. J. Fish. Hydrobiol. 10(10): 153-156.

Enyi, B. A. C. 1962. Comparative growth rates of upland and swamp rice varieties. Ann. Bot. 26: 467-487.

Hossian, S. M. A., A. M. A. Kamal, M. R. Islam. and M. A. Mannan. 2002. Effect of different levels of chemical and organic fertilizers on growth, yield and protein content of wheat. J. Biol. Sci. 2(5): 304-306.

Jat, R. S. and I. P. S. Ahlawat. 2008. Direct and residual effect of vermicompost, biofertilizers and phosphorus on soil nutrient dynamics and productivity of chickpea-fodder maize sequence. J. Sust. Agri. 28(1): 41-54.

Khoramdel, S., A. Kochaki, M. Nasirimahalati. and R. Ghorbani. 2010. Effect of biofertilizers on yield and yield components of medicinal plant nigella sativa (Nigella sativa L.). Iranian J. Agri. Res. 8(5): 768-776. (Abstract in English)

Manivannan, S., M. Balamurugan, K. Parthasarathi, G. Gunasekaran. and L. S. Ranganathan. 2009. Effect of vermicompost on soil fertility and crop productivity-beans (*Phaseolus vulgaris*). J. Environ. Biol. 30(2): 275-281.

Mirhashemi, S. M., A. R. Kouchaki, M. Parsa. and M. Nasiri Mahallati. 2009. Investigating the advantage of mixed cultivation of Plantain and fenugreek in different levels of manure and planting pattern. Iranian J. Field Crop Res. 7(1): 269-279. (Abstract in English)

Pouryousef, M., D. mazaheri, M. R. Chaiechi, A. Rahimi. and A. Tavakoli. 2010. Effect of different soil fertilizing treatments on some of agro morphological traits and mucilage of Isabgol (*Plantago ovata* Forsk). Electronic J. Plant Prod. 3(2): 193-213.

Roknil, A. 2013. Evaluation effect of different level of cow manure on corn production. Second Symp. Assessment role of vermicompost to achieve Sustainable Agriculture. pp: 19-24.

Suhane, R. K., R. K. Sinha. and P. K. Singh. 2008. Vermicompost, cattle-dung compost and chemical fertilizers: Impacts on yield of wheat crops. Commun. Rajendra Agri. Univ. Pusa. Bihar. India.

Tlipo, Z .2012. Effect of different level of vermicompost on growth curves of corn crop. The Second Symp. Application of vermicompost in sustainable crop production. pp: 19-24.