Uluslararası Tarım Araştırmalarında Yenilikçi Yaklaşımlar Dergisi
International Journal of Innovative Approaches in Agricultural Research 2020, Vol. 4 (1), 48-55
https://doi.org/10.29329/ijiaar.2020.238.6

Original article

Impact of Vermicompost to Dent Corn (*Zea mays* L. *indentata*)

Ayşe Gülgün Öktem [a, *] & Abdullah Öktem [a]

[a] Department of Field Crops, Faculty of Agriculture, University of Harran, Sanliurfa, Turkey

Abstract

Corn is the most cultivated cereal plant in the world after wheat and rice. Grain yield of corn depends on genetic factors but the application of various nutrients to the soil is also effective for increasing yield. Vermicompost is used for increasing grain yield at the some plants recently. Worm fertilizer which is known as vermicompost is an organic fertilizer which is digested by worms and converted into fertilizer. Vermicompost includes all enzymes, soil antibiotics, vitamins, growth hormones and humic substances for plant growth. In this study, it was aimed to determine the effects of various levels of vermicompost on the yield and some characteristics of corn plant. The study was conducted in 2017 second crop growing season in Harran Plain conditions. In the study, DKC-6120 corn variety was used as plant material. Different levels of vermicompost were applied as a supplementary to standard inorganic fertilizer. Vermicompost dosages were 0, 50, 100, 150, 200 kg/da. The research was conducted according to the randomized complete block design with three replicates. Row spaces were 70 cm and intra row space was 20 cm. Seeds sown in 2-4 cm depth. Each parcel was built from 14 m2. In the study, hectoliter weight, ear weight, ear diameter, ear length, grain numbers of ear and grain yield values were determined. The highest hectoliter weight (80.37 g), ear weight (302.67 g), ear length (23.33 cm), grain number of ear (802.47 number) and grain yield (976.67 kg/da) values were obtained from 200 kg/da vermicompost applications while the lowest values were seen at control parcels (77.87 g, 260 g, 21.79 cm, 710.27 number, and 895.24 kg/da, respectively). Variance analysis was made with obtained data and the differences between the averages were compared according to the LSD test.

Keywords: Vermicompost, Dent Corn, Grain Yield, Sanliurfa.

Received: 21 November 2019 * **Accepted:** 10 December 2019 * **DOI:** https://doi.org/10.29329/ijiaar.2020.238.6

* **Corresponding author:**

Ayşe Gülgün Öktem, Department of Field Crops, Faculty of Agriculture, University of Harran, Sanliurfa, Turkey.
Email: gulgunoktem@harran.edu.tr

INTRODUCTION

Corn is the most cultivated cereal plant in the world after wheat and rice. It is one of the basic nutrients used in human and animal nutrition. Corn starch, oil and fructose syrup are industrial material. It is an indispensable component of feed ingredients. Corn production area is 5 919 003 ha and production amount is 5.7 million tones in Turkey (Anonymous, 2018).

Grain yield of corn depends on genetic factors but the application of various nutrients to the soil is also effective for increasing yield. One of these nutrients also is vermicompost. Worm fertilizer which is known as vermicompost is an organic fertilizer which is digested by worms and converted into fertilizer. Vermicomposting is a process of using worms to transform organic waste into a nutrient-rich fertilizer. It is a healthy and reliable method to eliminate wastes going into landfills, which improves the environment. Vermicomposting is cheap, and approximately takes two to three months to produce results. Vermicomposting is a popular sustainable low-cost treatment for organic solid wastes (kitchen wastes, plant wastes, market wastes, livestock wastes, etc.). Vermicompost includes all enzymes, soil antibiotics, vitamins, growth hormones and humic substances for plant growth. Compared to ordinary soils, the earthworm castings (the material produced from the digestive tracts of worms) contain much more nitrogen (N), phosphorus (P) and potassium (K). They are rich in terms of humic acids and improve the structure of the soil if used as a soil conditioner. Barlas et al. (2018) reported that vermicompost has a role as a source of nutrients for plant growth. However, yield and quality of produced vermicompost are also differed, because the nutrient content of vermicompost highly depends on the input material (Dominguez, 2004; Joshi et al., 2015).

It has been reported by various researchers that the application of vermicompost to soil increases yield and quality in many plants. Ozel (2019) reported that the highest corn yield was obtained from 750 kg/da application of vermicompost in Harran Plain condition. Jat and Ahlawat (2006) specified that 300 kg/da of vermicompost application to sugar corn increased protein ratio, dry weight and also usable nitrogen and phosphorus content of soil. Oktem et al. (2018) found that grain yield increased with vermicompost applications to corn. Jahan et al. (2014), explained that vermicompost application with chemical fertilizer is betters than conventional composting in cauliflower. Kanturer et al. (2013) stressed that vermicompost application is more advantageous on yield and quality more than compost, chemical fertilizer and barnyard manure for pepper.

In this study, it was aimed to determine the effects of various levels of vermicompost on the yield and some yield characteristics of corn plant.

Material and Methods

This study was conducted Sanliurfa Turkey, during in 2017. The experimental field is located in Harran Plain (altitude: 465 m; 378080 N and 388460 E). The weather of Harran Plain is usually warm during winter months and rainfall is rare. The climate varies from arid to semi-arid. Rainfall was not observed from June to September at the treatment year. Same climatic data are presented in Table 1.

Table 1. Monthly climatic datas during the corn growth period in 2017 at Sanliurfa

Meteorological observations	**Months***					
	June	**July**	**August**	**September**	**October**	**November**
Ave. Temperature (^{0}C)	22.9	34.2	32.2	29.6	20.5	13.4
Max Temperature (°C)	41.8	43.5	44.8	42.1	30.9	24.5
Min Temperature (°C)	17.8	22.4	21.4	18.3	11.3	2.5
Aver. Humidity (%)	22.4	26.7	24.9	22.6	15.1	9.2
Rainfall (mm)	-	-	-	-	17.1	17.4

* Data collected from the Sanliurfa Meteorological Station (Anonymous, 2017).

Soil samples representing the 0-20 cm layer were taken a day before planting; air dried, passed through a 2.00 mm sieve and analyzed (Jones, 1984). The soil of the research field was clay, slightly alkaline, high lime and very low salt contents. Some physical and chemical properties of soil are presented at Table 2.

Table 2. Some physical and chemical properties of research soil

Deep (cm)	**Organic Material (%)**	**Total Salt (%)**	**pH**	**Lime (%)**	**P_2O_5 (kg /da)**	**K_2O (kg da^{-1})**	**Fe (ppm)**	**Zn (ppm)**
0-20	1.37	0.098	7.5	22.3	2.8	93.4	1.23	0.67

Research area was ploughed and cultivated after prepared for planting with a single pass of a disc-harrow. The experiment was laid out in a randomized blocks design with three replications. Corn seeds were planted at depth of 2-4 cm with row spacing of 70 cm, intra row distance of 20 cm and 25 seeds for each parcel. Each parcel was built from 14 m^2. At sowing, 8 kg/da of pure N, P and K, as a 15-15-15 composed fertilizer, was applied to each plot; this was followed by 12 kg/da of N as urea when the plants reached 30-40 cm in height. Irrigation water was first applied to all the plots using a sprinkler irrigation system, for emergence of plants, after post emergence plant, plots were irrigated equally by the furrow irrigation system.

In the study, DKC-6120 corn variety was used as plant material and different levels of vermicompost were applied as a supplementary to standard inorganic fertilizer. vermicompost applications were; control (inorganic fertilizer only), 50 kg/da vermicompost + inorganic fertilizer, 100 kg/da vermicompost + inorganic fertilizer, 150 kg/da vermicompost + inorganic fertilizer, 200 kg/da vermicompost + inorganic fertilizer. The amount of vermicompost was calculated to be per unit area and mixed to the soil before sowing. Analysis values of vermicompost used in research were given Table 3.

Table 3. Some Analysis values of vermicompost which is used in the study

Analysis Parameters	**pH**	**EC (dS/ m)**	**Humidity (%)**	**Total Nitrogen (%)**	**Total Phosphorus Pentoxide P_2O_5 (%)**	**Organic Carbon (%)**	**Water Soluble Potassium oxide K_2O (%)**	**Organic Mater (%)**	**Total Humic+Pulvik Acid (%)**
Results	7.27	5.104	47.91	3.24	3.28	31.25	1.24	70.00	41.46

When the plants reached harvesting maturity were harvested by manually. An analysis-of-variance (ANOVA) was performed to evaluate statistically differences between results. Means of the data obtained from research were compared using least significant difference test (LSD) at $P \leq 0.05$.

Results and Discussions

Hectoliter Weight (g) and Ear Weight (g)

Hectoliter weight and ear weight values were given at Table 4. As can be seen from table 4. The hectoliter weight and ear weight values were significant at 0.05 level according to variance analyses. The highest hectoliter weight value was obtained from 200 kg/da vermicompost applications (80.37 g) while the lowest value was seen at control parcels (77.87 g).

The highest ear weight was seen 200 kg/da vermicompost applications (302.67 g) whereas the lowest ear weight was control parcels (260 g). The yield components such as hectoliter weight and ear weight increased with vermicompost applications.

Ayrancı and Sade (2004) reported that hectoliter weight ranged from 67.97g to 79.71 g. The same way Kusvuran and Nazlı (2014) found that ear weight values were between 233 g- 348 g on corn. Our findings show similar values to the researchers' findings.

Table 4. Hectoliter weight and ear weight values and LSD groups

Applications	**Hectoliter Weight (g) ***	**Ear Weight (g)***
Control	77.87 b[†]	260.0 b
50 kg/da	79.93 a	294.80 ab
100 kg/da	79.80 a	301.00 a
150 kg/da	79.62 ab	283.33 ab
200 kg/da	80.37 a	302.67 a
LSD	1.61	31.56

*: indicates statistical significances at 0.05.

[†] There is no statistical difference among values annotated with the same letter at *P*<0.05 according to the LSD test.

Ear Length (cm) and Grain Number of Ear (number)

Vermicompost applications were significant at ear length and grain number of ear (P<0.05). As can be seen from Table 5, the highest ear length was determined at 200 g/da vermicompost applications (23.33 cm) while the lowest value was seen at control parcel (21.79 cm).

Table 5. Ear length and grain number of ear values and LSD groups

Applications	Ear Length (cm)*	Grain Number of Ear (number)*
Control	21.79 b[†]	710.27 b
50 kg/da	22.37 b	791.21 ab
100 kg/da	22.62 ab	794.35 a
150 kg/da	22.76 ab	779.52 a
200 kg/da	23.33 a	802.47 a
LSD	0.52	55.53

* : indicates statistical significances at 0.05.

[†] There is no statistical difference among values annotated with the same letter at *P*<0.05 according to the LSD test.

Vermicompost applications effected positively on ear length. Bruns and Abbas (2002) reported that ear length values is directly effect on grain yield. Oktem at al. (2018) emphasized that ear length increased with vermicompost application. Our findings were supported researchers.

Grain number of ear ranged from 710.27 number to 802.47 number. Grain number of ear increased with vermicompost applications. Oktem et al. (2018) reported that as the length of the ear increases, the number of grains in the ear increases at the result the grain yield increases. Prasanna et al. (2007) reported that the highest grain number of ear value was obtained from vermicompost fertilization on sorghum.

Ear Diameter (mm) and Grain Yield (kg/da)

Ear diameter and grain yield values and LSD groups were presented at Table 6. Vermicompost applications at ear diameter was insignificant as statistically. Ear diameter values ranged from 51.50 mm to 51.98 mm. Demiray (2013) reported that ear diameter ranged from 48.9 mm to 58.3 mm, Vartanlı (2006) specified that it was seen 53 mm-57.9 mm. Our findings are similar to the findings of the researchers.

Vermicompost applications were significant as statistically on grain yield (P<0.05). The highest grain yield values were obtained from 200 kg da^{-1} vermicompost applications (976.67 kg/da) while the lowest value was seen at control parcels (895.24 kg/da).

Table 6. Ear diameter and grain yield and LSD groups

Applications	Ear Diameter (mm)	Grain Yield (kg/da)*
Control	51.50†	895.24 b
50 kg/da	51.63	906.19 ab
100 kg/da	51.50	970.00 ab
150 kg/da	51.87	965.59 ab
200 kg/da	51.98	976.67 a
LSD		79.91

*: indicates statistical significances at 0.05.

† There is no statistical difference among values annotated with the same letter at P<0.05 according to the LSD test.

Vermicompost, which is added to standard inorganic fertilizer effected positively grain yield and some yield components (Figure 1). The reason for this, it photosynthesis and enzymes activation may be affected positively. In the end of this process, grain yield of corn may be increased. Goksu and Kuzucu (2017) explained that vermicompost application with chemical fertilizer increased ion exchange capacity in soil, so the physical and biological activity of the soil has been enriched. As the result, plant has shown a faster and better nutrition.

Prasanna et al. (2007) stated that grain yield on corn increased with vermicompost applications. Oktem et al. (2018) and Ashoka et al. (2009) stated that they get the highest grain yield from corn plant with worm + chemical fertilizer application. Ozel (2019), Jat and Ahlawat (2006) stated that vermicompost applications effected positively grain yield of corn. It has been reported that vermicompost fertilization has positive effects on different plants (Jahan et al. 2014; Kanturer et al. 2013; Wang et al. 2010; Atiyeh et al. 2000; Ozkan and Muftuoglu, 2015; Barlas et al. 2018).

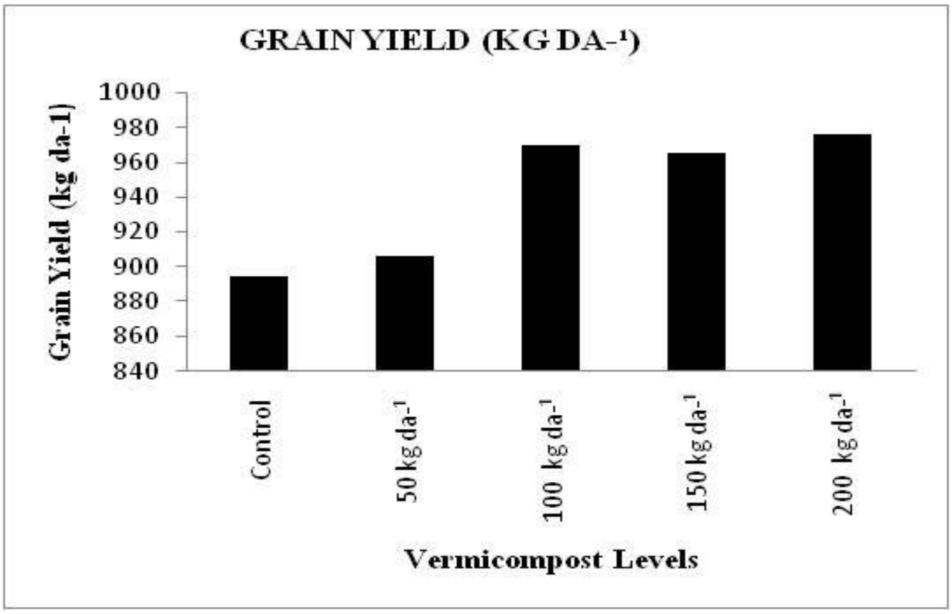

Figure 1. Effect of vermicompost application on grain yield.

Conclusions

According to this research results, the highest hectoliter weight (80.37 g), ear weight (302.67 g), ear length (23.33 cm), grain number of ear (802.47 number) and grain yield (976.67 kg/da) values were obtained from 200 kg/da vermicompost applications while the lowest values were seen at control parcels (77.87 g, 260 g, 21.79 cm, 710.27 number, and 895.24 kg/da, respectively). Vermicompost applications had positive effects on yield and some yield components of corn plant. However, more detailed studies are needed on this subject.

REFERENCES

Anonymous, (2017). Sanliurfa Meteorological Station, Sanlıurfa/Turkey.

Anonymous, (2018). Year Book of Statistical Institute. www.tuik.gov.tr

Ashoka, P., S. R. Anand, P. Mudalagiriyappa and R. Smitha (2009). Effect of macro and micronutrients with organics on growth, quality, yield and economics of baby corn (Zea mays L.) in tungabhadra command area. Crop Research (Hisar), 37(1-3), 15-18.

Atiyeh, R.M., J. Dominguez, S.Sobler and C. A. Edwards (2000). Changes in biochemical properties of cow manure during processing by earthworms (*Eisenia andrei*) and the effects on seedling growth. Pedobiologia, 44, 709-724.

Ayrancı, R. and B. Sade (2004). Konya ekolojik şartlarında yetiştirilebilecek atdişi melez mısır (Zea mays L.indentata sturt.) çeşitlerinin belirlenmesi. Bitkisel Araştırma Dergisi, 2, 6–14.

Barlas, N. T., B. Cönkeroğlu, G. Unal and K. Bellitürk (2018). The effect on different vermicompost doses on wheat (Tritucum vulgaris L.) nutrition. Tekirdağ Ziraat Fakültesi dergisi, 15, 1-4.

Bruns, H.A., H.K. Abbas, (2002). Effects of intra-row spacing on maize growth in the Mid-South. Agronomy Abstracts, 48, 21-27.

Demiray, Y.G. (2013). Bingöl ili ekolojik şartlarına uygun tane mısır çeşitlerinin belirlenmesi. Bingöl Üniv. Msc Thesis, Bingöl.

Dominguez J, (2004). State of the art and new perspectives on vermicomposting research, Earthworm Ecology, C. A. Edwards (Ed.), CRC Press LLC, 401–424. https://doi.org/10.1201/9781420039719.ch20.

Goksu, G.A. and C.O. Kuzucu (2017). Karpuzda (Citrullus lanatus (Thunb.) Matsum. & Nakai) Farklı dozlardaki vemikompost uygulamalarının verim ve bazı kalite parametrelerine etkisi. Çanakkale Onsekiz Mart Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 3(2); 48-58.

Jahan, F.N., A.T.M. Shahjalal, A.K. Paul, H. Mehraj and A.F.M. Jamaluddin (2014). Efficacy of vermicompost and conventional compost on growth and yield of cauliflower. Bangladesh Res. Publ. J., 10(1), 33-38.

Jat, R.S. and I.P.S. Ahlawat. (2006). Direct and Residual Effect of Vermicompost, Bio fertilizers Phosphorus on Soil Nutrient Dynamics and Productivity of Chickpea-Fodder Maize. J. Sustain. Agric., 28 (1), 41-54.

Jones, B. J. (1984). A laboratory guide of exercises conducting soil testes and plant analyses. Madison, Wis. Benton lab., Inc. USA.

Joshi T. N., D. B. Nepali, R. A. Sah and T. C. Bhattarai (2015). Survivability and multiplication of earthworm species (Eisenia fetida : Oligochaeta, Savigny) during poultry waste disposal. Int. Inv. J. Agric. Soil Sci., 3(3), 43–46.

Kanturer, D.M., F. Tepecik, F. Özden and H. Ilbi (2013). Çevreye dost üretimde vermikompost bir alternatif olablir mi? Vermikompost, Nisan, 2013.

Kusvuran, A. and R.I. Nazlı (2014). Yüzüncü Yıl Üniversitesi Tarım Bilimleri Dergisi, (YYU J AGR SCI), 24(3): 233- 240.

Wang, D., O. Shi, X.Wang, M. Wei, J. Hu, J. Liu and F. Yang (2010). Influence of cow manure vermicompost on the growth, metabolite contents and antioxidant activities of Chinese cabbage (Brassica compestris ssp. Chinesis). Biol. Fertil. Soil, 46, 689-696.

Oktem, A.G., A. Oktem and Z. B. Yahlizade (2018). Mısır Bitkisinde(Zea mays L. indentata) Vermicompost Uygulamaları. Ziraat Bilimlerinde Güncel Akademik Çalışmalar. ISBN 978-9940-540-48-7, p: 355-368. (http://www.ivpe.me/).

Ozel, M.R. (2019). Farklı düzeylerdeki organik solucan gübresinin at dişi mısırın (*Zea mays* L. İndentata) verim ve verim unsurlarına etkisi. Harran Üniversity Msc Thesis, Sanlıurfa.

Ozkan, N. and N. M. Müftüoğlu (2015). Farklı dozlardaki vermikompostun marul verimi ve bazı toprak özellikleri üzerine etkisi, Bahçe Özel Sayısı: VII. Ulusal bahçe bitkileri kongresi bildirileri- II: sebzecilik-bağcılık-süs bitkileri, s: 121-124.

Prasanna, K., A. S. Halepyati, B. K. Desai and B. T. Pujari (2007). Effect of İntegrated Nutrient Management on the Productivity and Nutrient Uptake by Maize (Zea mays L.). Karnataka J. Agric. Sci., 20 (4), 833-834.

Vartanlı, S. (2006). Ankara koşullarında hibrit mısır çeşitlerinin verim ve kalite özelliklerinin belirlenmesi. Ankara University Msc Thesis, Ankara.