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The determination of grain yield, yield components, and macro nutrient content of corn (*Zea Mays* L.) by different agricultural practices

Melis Çerçioğlu *

Department of Forest Engineering, Faculty of Forestry, Izmir Katip Celebi University, İzmir, Türkiye

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Author(s)

M.Çerçioğlu *

* Corresponding author

Abstract

A field experiment was conducted to determine the impacts of some treatments on grain yield, yield components (cob length, cob diameter, grain weight), and macro nutrient content of corn (*Zea mays* L.). During the study, tobacco waste compost (50 t ha^{-1}), poultry manure (4 t ha^{-1}), bio-humus (10 t ha^{-1}) and NPK (0.3 t ha^{-1}) were applied. The experiment was established with a randomized complete block design with four replications in Izmir, Türkiye. According to the two years average values; cob length varied from 18.84 to 22.35 cm, cob diameter from 4.38 to 5.05 cm, grain weight from 1704 to 2529 g, grain yield from 14.48 to 19.88 t ha^{-1} by the treatments. The greatest average yield values were obtained under tobacco waste compost (19.88 t ha^{-1}) and poultry manure (19.64 t ha^{-1}) plots over the control. All yield components were significantly affected the treatments. Macro nutrient contents of corn grain were found statistically significant by the treatments as compared with control. Total N, P, K, Ca, and Mg content of grain varied between 1.25-1.64%, 0.044-0.087%, 2103-3559 ppm, 25.83-571.88 ppm, 127.57-469.93 ppm, respectively. As a conclusion, all treatments increased the yield components and macro nutrient content of corn with similar effects; on the other hand, poultry manure and tobacco waste compost were the most effective materials on all parameters. Moreover, the positive and significant correlations were found among first and second year parameters.

Keywords: Bio-humus, corn, NPK, poultry manure, tobacco waste compost, yield.

Introduction

Corn (*Zea mays* L.) is one of the most important cereals that provides staple food for human population in the world. However, it is a tropical crop, at present its cultivation in subtropical and temperate regions is also done intensively on World wide bases and it can successfully be cultivated twice in a year. Approximetly 61% of world corn production is used as animal feed, 19% as ethanol and other industrial products, 15% as direct human food, 4% as storage losses and 1% as seeds (Garcia-Lara and Sena-Saldivar, 2019). Corn is a major source of income for many farmers in developing countries (Tagne et al., 2008). In Türkiye, corn ranks third after wheat and barley in terms of cultivation and production and first among all cereals in terms of yield (Ozaslan and Kusaksiz, 2021). Total planting area, production of corn and yield were about 758 237 ha, 6 750 000 t, and 89 kg ha^{-1} in 2021, respectively in Türkiye (TUIK, 2022). Production of corn crop is carried out mostly in Marmara in North Western, Aegean in Western and Mediterranean in Southern regions of Turkey (Tonk et al., 2011).

Corn varieties vary according to their growth properties, yield and components, and hence suggested that breeders should choose most promising combiners in their breeding program (Odeleye and Odeleye, 2001). Manures and mineral fertilizers contributes approximetly 50 to 60% increase in productivity of food grains in many parts of the world, exclusive of soil and agro-ecological zone (Shakoor et al., 2015).

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The adequate amounts of manure needed to be apply to the soils in a proper way to meet the nutrient need of the crop and maintenance of soil quality. The organic wastes will increase the effciency use of nutrients added by mineral fertilizers by decreasing losses and improving availability of nutrients to the crop (Tolessa et al., 2001). It is reported that mineral fertilizer is known to affect the quantity and yield of corn (Ayodele, 1993).

Poultry manure alone and in combination with mineral fertilizer can be used for nutrient supplementation (Rasheed et al., 2003). Organic manure promotes seed germination and root growth by improving soil water holding capacity and maintain better aeration. Corn production can be improved significantly with the addition of farmyard manure alone and with conventional fertilizer (Sharma and Gupta, 1998). Stefan (2003) reported that fresh poultry manure contains 70% water, 1.4% N, 1.1% P_2O_5 and 0.5% K_2O while dried poultry manure contains 13% water, 3.6% N, 3.5% P_2O_5 and 1.6% K_2O.

Compost can alter soil physical and biological properties in ways that can influence crop performance. Soil moisture (Serra-Wittling et al., 1996) and thermal properties (Jacobowitz and Steenhuis, 1984) can be improved by compost applications. Besides, it can improve soil microbial activity and biomass (Fraser et al., 1988), by decreasing the incidence and severity of crop diseases through stimulation of antagonists (Craft and Nelson, 1996) and decreasing in substrate availability (Mandelbaum and Hadar, 1990). Tobacco wastes are generated at various stages of post-harvest processing of tobacco and during the manufacture of tobacco products (Adediran et al., 2004). These wastes (*Nicotiana tabacum*) are phytotoxic due to their high content of alkaloids which if not well-managed can cause environmental damage (Adediran et al., 2003; Mumba and Phiri, 2008). Composting of these wastes can reduce the alkaloid content and convert them into useful materials (Adediran et al., 2004; Okur et al., 2008; Cercioglu et al., 2012; Nguyen et al., 2022). Organic wastes such as manures, composts and plant residuals are frequently used in crop production systems as an alternative to mineral fertilizers, to restore degraded soils and ameliorate physicochemical constraint (Celestina et al., 2019). The addition of plant residuals into the soil is considered a good management practice since it stimulates soil microbial growth and activity, with the subsequent mineralization of plant nutrients and improves soil fertility and quality (Doran et al., 1988; Eriksen, 2005; Randhawa et al., 2005; Cercioglu, 2017).

The purpose of this study was to examine the impacts of some agricultural practices (bio-humus, poultry manure, tobacco waste compost and NPK fertilizer) on grain yield, yield components and macro nutritional composition of corn.

Material and Methods

Study Site and Treatments

The study site was located at the Menemen Research and Practice Farm of Ege University in Izmir, Turkey (38°58′ N, 27°03′ E). Long-term average annual precipitation and temperature in Izmir is 713.8 mm and 17.9℃ respectively (Meteroloji Genel Müdürlüğü, 2022). Some climatic data for Menemen was given in Table 1. The soil was classified as sandy loam (*Typic Xerofluevent)* (Soil Survey Staff, 2006) and some initial soil properties were shown in Table 2. A 2-year field experiment was conducted in a randomized complete block design with four replicates per treatment. The four types of amendments used were: poultry manure, tobacco waste, bio-humus and NPK fertilizer. Some properties of these amendments were given in Table 3. Tobacco wastes were gathered from cigarette industry and composting process was performed outdoor under a roof. The moisture content of the compost was determined approximetly 55% by weighing the material regularly and adding water when necessary. Aeration was made by manual turning during the composting period. After 3 months, when the temperature of the compost decreased to the ambient level, composting was completed. Both of bio-humus (composted plant residues) and poultry manure were obtained from organic manure industry for this study. All organic materials were added into the soil one day before planting and their doses were determined by researching recent studies, recommendations from producers of materials and plant nutrient removal by corn from soil. Application doses were as follows: poultry manure: 4 t ha^{-1}, bio-humus: 10 t ha^{-1}, NPK: 0.3 t ha^{-1}, tobacco waste compost: 50 t ha^{-1}. Bio-humus and poultry manure were both added to the soil with NPK. Triple superphosphate (43-44% P_2O_5), ammonium nitrate (33% N), and ammonium sulphate (21% N) were applied as NPK fertilizers with the doses of 19 kg da^{-1} N, 9 kg da^{-1} P_2O_5 and 21 kg da^{-1} K_2O.

The total amount of water required by corn was supplied in each year was 600 mm (600 m^3 da^{-1}) through drip irrigation considering rainfall events. Some quality parameters of irrigation water used in the experiment was shown in Table 4. Kermess variety of corn (*Zea mays* L.) was used as a test crop in the experiment. The corn seeds were planted in April with 0.70 × 0.18 m spacing and harvested in October for both years. Grain yield, yield components (cob length, cob diameter, grain weight) and macro nutritional composition (N, P, K, Ca, Mg) of corn were examined.

Table 1. Some meteorological data of study site (MEVBİS, 2022).

	Total rainfall (mm)	
Months	1st year	2nd year
January	154.4	97.2
February	114.0	211.0
March	131.8	21.6
April	46.6	51.0
May	9.6	23.4
June	7.6	16.6
July	0.0	7.0
August	0.0	0.0
September	34.8	28.0
October	17.0	287.6
November	70.0	19.6
December	165.8	144.8
Total	751.6	907.8
	Mean temperature (°C)	
Months	1st year	2nd year
January	9.0	9.5
February	9.3	11.7
March	10.5	11.7
April	15.1	15.7
May	20.4	20.5
June	25.2	24.1
July	27.9	27.6
August	27.0	28.6
September	22.4	22.9
October	19.6	17.3
November	13.3	16.8
December	11.7	11.9
Mean	17.7	18.2

Table 2. Some soil properties of the study site

Parameters	
Sand,%	55.28
Silt, %	36.00
Clay, %	8.72
pH	7.78
OM, %	1.11
EC, µS cm^{-1}	72.00
$CaCO_3$, %	4.70
Total N, %	0.07

Table 3. Some properties of the amendments

	Poultry manure	Tobacco waste compost	Bio-humus
pH	8.60	9.18	7.88
EC, dS m^{-1}	54.50	49.50	9.20
OM, %	44.90	33.60	46.50
$CaCO_3$,%	12.00	7.06	26.00
N, %	1.01	0.87	0.92
P, %	0.34	0.27	0.20
K, %	2.19	1.94	0.69
Ca, %	9.44	7.44	11.76
Mg, %	1.20	0.63	0.92

Table 4. Quality properties of irrigation water

Parameters	
pH	7.22
EC (μS cm^{-1})	1000
Cations (me L^{-1})	
Na	3.37
K	0.03
Ca+Mg	6.60
Anions (me L^{-1})	
Cl	2.92
CO_3	-
HCO_3	6.40
SO_4	0.64
SAR	1.85
Quality Class	C3S1

Soil Sampling and Laboratory Analyses

Soil samples were removed from 0-30 cm depth of the center of each plot. These samples were air-dried and passed through a 2 mm sieve prior to analysis. Soil texture was determined by the Bouyoucos hydrometer method (Bouyoucos, 1962). Organic matter concentration was analyzed according to Nelson and Sommer (1982). Calcium carbonate content was analyzed according to the Scheibler method (Tüzüner, 1990). Soil pH (Jackson, 1967), electrical conductivity (Rhoades et al., 1999), total N (Bremner, 1965) were determined. The pH and EC measurements for organic wastes were performed in aqueous extract by using pH and EC meter. The samples were obtained by mechanically shaking with distilled water for 1 hour at a 1/10 solid/water ratio (dry weight/volume) (Kacar, 1994).

Corn grains were ground and wet digested by a HNO_3 + $HClO_4$ mixture. Total N content was measured by Kjeldahl method (Tan, 2005). Total P values were analyzed by vanadomolybdophoshoric method (Lott et al., 1956). Total K, Ca, and Mg contents were determined by atomic absorption spectrofotometry (Hanlon, 1998). Yield values were determined by collecting 10 crops from each plot and calculated by measuring total weight, cob weight, and grain weight in t ha^{-1}.

Statistical Analysis

An analysis of variance (ANOVA) was conducted using the GLM procedure with SPSS 25.0 to examine the impacts of agriculture practices over years on cob components and nutritional composition of crop. Statistical differences were evaluated with Tukey's test of means at an alpha level of 0.05 using SPSS 25.0 (SPSS, 2021). Moreover, correlation tests were performed between first and second year parameters.

Results and Discussion

Grain yield and yield components of corn

The effects of poultry manure, bio-humus, NPK and tobacco waste compost on yield and yield components of corn were shown in Table 5. Grain weight values were significantly affected by the treatments for both years as compared to control. Grain weight values varied among 1094 g and 3051 g and the greater average results were determined under tobacco waste compost and poultry manure treatments. Grain yield values significantly varied among 11.79 and 24.01 t ha^{-1} by the treatments. All materials significantly increased grain yield values as compared to control. The greater yield values were analyzed in the first year as 24.01 t ha^{-1} and 23.85 t ha^{-1} by the treatments of poultry manure and tobacco waste compost, respectively. Yield results decreased in second vegetation period as the extremely dryness of the second year (see Table 1). Although there is sufficient moisture in the soil, the decrease in temperature restricts plant growth. The restriction of plant growth with summer drought and the storage of moisture in the winter period and providing suitable humidity during plant development indicate the Xeric humidity regime (Basayigit and Dinc, 2005). Ayoola and Makinde (2009) were found higher grain yield of corn under poultry manure plots and lower in NPK fertilizer and control plots. Mix application of poultry manure and NPK fertilizers can improve the efficiency of nutrient uptake and availability to the crop (Warren et al., 2006).

The point is about poultry manure has very high salinity content. Because of this problem, using poultry manure in the studies may cause some problems. Hence, it is needed to be measure of salinity content before applying to the soil. Moreover, the addition of tobacco wastes on soil were improved yield in various crops by many researchers (Özgüven and Kaya, 1984; Durak and Brohi, 1986; Brohi, 1987; Brohi and Durak, 1988;

Sayın and Aydın, 1989; Özgüven et al., 1999). The present study results were found similar with these literatures about corn yield.

Cob length is related to number of grains per cob and the factors reducing number of grains per cob also reduced cob length. Cob length is an important yield factor that is positively related to grain yield and has high heritability (Ruiz de Galarreta and Alvarez, 2001; Lucchin et al., 2003). Additionally, cob length is also affected by genetic structure, environmental factors, cultivation techniques such as planting time, plant density and nitrogen dose. Cob length results were significantly affected by the treatments when compared with control ($p<0.05$). Average values for cob length varied among 18.84 cm and 22.35 cm. All the treatments were showed same significance levels as compared to control. Oktem and Kahramanoglu (2021) were conducted an experiment to obtain grain yield and quality parameters of some popcorn genotypes. They found that cob length values were ranged from 17.68 to 22.95 cm. Ozturk and Buyukgoz (2021) were carried out a study to evaluate agronomic performance of some corn landraces in Trabzon. They used 18 corn landraces and two certified corn varieties. According to their findings; cob length values varied between 10.85 and 21.95 cm.

Cob diameter affects the grain yield by changing the number of grain rows and the number of grains in the cob; it is known to vary according to genotype, environmental conditions and cultural practices. Cob diamater values varied among 4.07 cm and 5.73 cm. The greater values were found as 5.73 cm by poultry manure treatment in the first year. On the other hand, the higher cob diameter values were determined as 4.84 under tobacco waste compost plots in the second year. In Trabzon, a study was performed to determine agronomic performance of some corn landraces. 18 corn landraces and two certified corn varieties were used and cob diameter values varied from 3.34 cm to 4.71 cm (Ozturk and Buyukgoz, 2021). Oktem and Kahramanoglu (2021) were conducted a research on some popcorn genotypes and measured yield and quality parameters. According to their findings, cob diameter of corns was varied among 2.99 cm and 3.76 cm. Özkaynak and Samancı (2003) reported the cob diameter values of corn varied among 2.40 cm and 2.90 cm in lines, 2.60 cm and 3 cm in hybrids. Similar results were also found by other researchers (3.30-4.40 cm, Tekkanat and Soylu, 2005; 2.97-3.39 cm, Özkan, 2007; 2.83-3.06 cm, İdikut et al., 2012; 2.67-3.01 cm, Cihangir, 2013).

Macro nutrient concentration of corn grain

Macro nutrient contents of corn grain were significantly affected by the treatments as shown in Table 6 and Table 7. Total N concentration of grain ranged from 1.25 to 1.64% by the treatments. The highest total N content was found in the first harvest under poultry manure treatment by the increasing rate of 22.4% as compared to control. Bio-humus and tobacco waste compost treatments showed same significance level on N content of grain. In the second year of the experiment, total N content was determined significantly greater under poultry manure, bio-humus and tobacco waste compost by same significance level when compared to control. According to the average N values of first and second harvest; significantly greater values were found by poultry manure treatment. P contents of corn grain varied among 0.044 and 0.087% by the treatments with significant differences. The greatest P values were analyzed in the first year under NPK treatment by the increasing rate of (approximetly) 32% as compared with control. In the second year, P values were found significantly higher under poultry manure, NPK, and tobacco waste compost plots by same significance level. The average higher P values of first and second harvest crops were observed by NPK treatment as compared to control. K contents of corn grain were significantly affected by the treatments and it varied from 2103 ppm to 3559 ppm. The greater K values were determined under tobacco waste compost as compared to control in the first and second year experiment. Tobacco waste compost was showed significantly 57% greater K values than control in the first year. Ca content of corn grain significantly varied among 25.83 and 571.88 ppm by the treatments. The highest Ca values were determined by tobacco waste compost in the first harvest as compared to control. After second harvest, the greatest Ca values were found under bio-humus treatment. According to the average values, the higher Ca results were analyzed by the application of tobacco waste compost. Mg content of corn grain significantly varied among 127.57 and 469.93 ppm by all the treatments. The greatest Mg values (469.93 ppm) was found under poultry manure plot in the first year of the experiment. Dogan et al. (2019) observed that the lowest Mg from the plots without fertilizer, and the highest Mg value was obtained from the plots with poultry manure, farmyard manure and mineral fertilizers. Jackson (1999) determined that poultry manure increases the water soluble and exchangeable K and Mg which enhances crop yield. Ojeniyi and Adeniyan (1999) reported that poultry manure can effectively increase soil fertility, yield, and nutritional composition of crops.

Table 5. Mean comparison of different treatments on grain yield and yield parameters

	Grain weight (g)			Grain yield (t ha^{-1})			Cob length (cm)			Cob diameter (cm)		
Treatments	1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean
Control	2314 c	1094 d	1704 d	17.18 c	11.79 c	14.48 c	20.25 b	17.42 d	18.84 c	4.69 c	4.07 c	4.38 d
Poultry manure+NPK	3051 a	1959 b	2505 a	24.01 a	15.28 ab	19.64 a	22.77 a	20.05 b	21.41 b	5.73 a	4.38 b	5.05 a
Bio-humus+NPK	2676 b	1760 c	2218 b	21.43 b	13.03 bc	17.23 b	23.80 a	19.11 c	21.46 b	4.91 b	4.42 b	4.67 c
NPK	2520 c	1684 c	2102 c	20.83 b	12.99 bc	16.91 b	23.24 a	19.05 c	21.15 b	4.89 b	4.35 b	4.62 c
Tobacco waste compost	3012 a	2046 a	2529 a	23.85 a	15.91 a	19.88 a	23.73 a	20.97 a	22.35 a	4.83 bc	4.84 a	4.83 b
Mean	2715	1709	2212	21.46	13.80	17.63	22.76	19.32	21.04	5.01	4.41	4.71
CV (%)	11.67	21.85	15.27	12.96	12.51	12.59	6.42	6.84	6.23	8.21	6.26	5.29
F value												
Year			72.964*			317.567*			121.096*			96.378*
Treatment	159.46*	192.34*	1.561	39.98*	4.08*	21.326*	10.18*	23.90*	1.744	60.09*	15.14*	2.200
Year*Treatment			0.915			1.883			1.907			2.201

The table presents significance levels between treatments for the measured parameters. Within columns, values followed by same letter for the treatments are not significantly different at $p<0.05$ probability level (Poultry manure: 4 t ha^{-1}, Bio-humus: 10 t ha^{-1}, NPK: 0.3 t ha^{-1}, Tobacco waste compost: 50 t ha^{-1}). *=Significant at $p < 0.05$.

Table 6. Mean comparison of different treatments on N, P, K content of grain

	N (%)			P (%)			K (ppm)		
Treatments	1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean
Control	1.34 d	1.25 d	1.29 d	0.066 c	0.044 c	0.055 d	2262 d	2103 d	2182 d
Poultry manure+NPK	1.64 a	1.50 a	1.57 a	0.078 b	0.067 a	0.072 bc	2928 b	2625 b	2777 b
Bio-humus+NPK	1.55 b	1.49 a	1.52 b	0.079 b	0.063 b	0.071 c	2585 c	2473 c	2529 c
NPK	1.43 c	1.34 b	1.38 c	0.087 a	0.068 a	0.077 a	2819 b	2646 b	2733 b
Tobacco waste compost	1.56 b	1.52 a	1.54 ab	0.080 b	0.068 a	0.074 b	3559 a	3110 a	3335 a
Mean	1.50	1.42	1.46	0.078	0.062	0.0698	2830.6	2591.4	2711.2
CV (%)	7.88	8.38	8.20	9.72	16.57	12.30	16.98	13.99	15.51
F value									
Year			43.64*			359.56*			49.35*
Treatment	53.40*	30.81*	76.15*	36.81*	56.55*	88.90*	60.08*	67.56*	121.93*
Year*Treatment			1.88			6.30*			3.26

The table presents significance levels between treatments for the measured parameters. Within columns, values followed by same letter for the treatments are not significantly different at $p<0.05$ probability level. (Poultry manure: 4 t ha^{-1}, Bio-humus: 10 t ha^{-1}, NPK: 0.3 t ha^{-1}, Tobacco waste compost: 50 t ha^{-1}). *=Significant at $p < 0.05$.

Table 7. Mean comparison of different treatments on Ca and Mg content of grain

	Ca (ppm)			Mg (ppm)		
Treatments	1st year	2nd year	Mean	1st year	2nd year	Mean
Control	376.25 c	25.83 d	201.04 d	155.28 d	127.57 d	141.43 e
Poultry manure+NPK	506.25 b	86.02 b	296.13 b	469.93 a	199.37 a	334.65 a
Bio-humus+NPK	470.94 b	109. 67 a	290. 30 b	377.84 b	174.10 b	275.97 b
NPK	468.75 b	51.83 c	260.30 c	283.50 c	157.31 c	220.40 d
Tobacco waste compost	571.88 a	83.36 b	327.60 a	370.62 b	156.06 c	263.34 c
Mean	478.81	71.34	275.07	331.43	162.88	247.16
CV (%)	14.80	45.86	17.37	35.76	16.19	29.06
F value						
Year			4274.8*			1889.6*
Treatment	29.12*	49.44*	47.05*	219.5*	62.28*	274.6*
Year*Treatment			15.72*			117.7*

The table presents significance levels between treatments for the measured parameters. Within columns, values followed by same letter for the treatments are not significantly different at $p< 0.05$. (Poultry manure: 4 t ha^{-1}, Bio-humus: 10 t ha^{-1}, NPK: 0.3 t ha^{-1}, Tobacco waste compost: 50 t ha^{-1}). *=Significant at $p < 0.05$.

Correlation of first and second year parameters

Correlation is a parameter that shows strenght or weakness relationships between variables. In the study, correlation among average yield parameters and macro nutrient content of corn was given in Table 8. The correlation between all parameters was positive and significant at 1% level. The greatest correlation coefficient (r=0.939**) was determined between grain weight and grain yield. Grain weight per cob is the main factor, which contributes substantially towards final yield per hectare (Cheema et al., 2010).

Table 8. Correlation among average (first and second year) yield parameters and macro nutrients of corn

	Grain weight (g)	Grain yield (t ha^{-1})	Cob length (cm)	Cob diamater (cm)	N (%)	P (%)	K (ppm)	Ca (ppm)	Mg (ppm)
Grain weight (g)	-	0.939**	0.883**	0.831**	0.723**	0.835**	0.645**	0.916**	0.869**
Grain yield (t ha^{-1})			0.875**	0.796**	0.655**	0.765**	0.600**	0.912**	0.884**
Cob length (cm)				0.723**	0.656**	0.856**	0.621**	0.844**	0.812**
Cob diameter (cm)					0.688**	0.657**	0.491**	0.709**	0.806**
N (%)						0.607**	0.635**	0.488**	0.735**
P (%)							0.631**	0.754**	0.693**
K (ppm)								0.469**	0.522**
Ca (ppm)									0.828**
Mg (ppm)									-

**=Significant at $p<0.01$

Conclusion

Results of present study indicated that all treatments had greatly affected grain yield, yield components and macro nutritional composition of corn for both years. The most significant impact was observed when tobacco waste compost and poultry manure was applied to soil. All yield component values were significantly affected by the treatments. The average cob diameter values were higher under poultry manure, cob length values were higher under tobacco waste compost, grain weight values were higher under poultry manure and tobacco waste compost treatments. The average grain yield results were obtained significantly greater under tobacco waste compost and poultry manure than control plot. Total average N, P, K, Ca, and Mg content of grain were significantly affected by tobacco waste and poultry manure treatments. Correlations between grain yield to, grain weight, cob length, and cob diameter were positive and significant.

It is concluded that tobacco waste compost application at the rate of 50 t ha^{-1}, and poultry manure application with 4 t ha^{-1} in combination with NPK improved yield and yield components and macro nutrient composition of corn. Moreover, because of the high sand content of study soil, the treatments do not lead to any soil pollution problem. However, they might lead to pollution of groundwater. Before applying of poultry manure to the soil, it is recommended to measure the salt concentration.

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