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Effects of Tillage Methods on Grain Yield of Maize

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ABSTRACT

This study was conducted to investigate some effect of different tillage methods on grain yield and some characters of maize.Days to flowering, plant height, first cop length, grain cop ratio, grain humidity and grain yield was observed. It was determined that traditional tillage method had higher values with regard to grain yield than other methods. These effects may be due to weed competitionand soil oxygen capacity becauseweed intensity in zero tillage was higher than others. It was considering that only herbicide application for weed management was not sufficient for high yielding maize culture.

KEYWORDS | Maize, grain yield, tillage, bed planting

Introduction

Maize should definitely be placed within crop rotation as the second crop over the irrigated lands of. Maize has a high yield capacity and is suitable as the second crop after cereals and lentil. Weed problem is one of the most important factors for high yielding maize culture. Soil tillage is an important method for weed control in maize culture with herbicide application.

Tillage influences soil natural phenomena and ecological processes leading to a remarkable change in soil properties (Ketemaand Yimer, 2014).Studies, carried out primarily in the USA and Australia, showed that the conservation tillage system increases the benefits of the plant itself and reduces the production costs while fully respecting the environment and soil fertility (Annunziata et al., 2013). Most of the patterns of vertical distribution show that, under no-till, more roots accumulate in the upper soil layers, and root length density is higher due to greater availability of water and nutrients in that soillayer (Qin et al., 2006). Tillage systems affect soil physical, chemical and biological properties, as well as root growth and distribution, and crop yield(Basso et al., 2011).

Maize yields are lower for conservation tillage than conventional tillage when the climate is cool-humid or the soil is poorly drained, but can be greater than conventional tillage when the climate is warm-dry or the soil is well drained (Liu et al., 2013). Maize yields for minimum tillage better than under zero tillage (Ishayaa et al.,2008).Tillage in maize produce higher yields than notillage (Tueche and Hauser, 2011). Javeedand Zamir (2013) haveshowndeeptillagepracticesignificantlyincreasedthegrainyieldandyieldrelatedtraits as comparedtoconventional, minimum andzerotillagepractices.Guan et al. (2014) reported thatshort-term plowing tillage and rotary tillage could increase root biomass, improve root spatial and temporal distribution, and enhance nutrients uptake, which resulted in higher biomass and grain yield of summer maize compared to notillage.

Tillage is a great input of maize culture and important practice for agricultural ecosystem. The aim of this study was to determine the effects of diminished tillageon grain yield and some characters of maize (Zea mays L. var. indentata).

Materlal and Methods

P.3394 used as the plant material in the study is a commercial single hybrid dent maize variety that grown 100-105 days.

Field trial was carried out in Harran Plain of Turkey in 2008 and 2009 years. The research area has alluvial, deep, almost smooth Harran serial soils. Typical reddish profiles have clay texture. Entire profile contains lime, Plant height varies between 7.3-7.8 and organic material content is low. Annual total precipitation is 365.2 mm, average annual temperature is 17.2 °C 24-years meteorological data. Average temperatures during the in the first year of experiment (July, August, September, October) were 30.0, 29.5, 23.1, 18.0 °C (Karipcin, 2009). Meteorological data in second year of experiment was similar (32.4, 30.3, 25.4 and 22.3°C) to first year.

Conventional tillage included disking stalks after harvest, followed by moldboard plough to a depth of 20 cm and disking. Then plowed to a depth of 25 cm, rototiller was used to prepare the seedbed.

Bed planting included disking stalks after harvest, followed by moldboard plough to a depth of 20 cm and disking. Then plowed to a depth of 25 cm and bed planting planter with a bed maker was used to prepare seedbed.

Zero tillage included a zero tillage planter with a double-disk opener assembly behind a ripple coulter was used.

Diminished tillage included disking stalks after harvest. Then rototiller was used to prepare the seedbed.

Randomized block design with three replications was used for field experiments. Plot sizes were arranged as 5 m × 0.7 m × 4 rows = 14 m^2 (on-row spacing is 20 cm and inter-row spacing is 70 cm) during plantation and as 5 m × 0.7 m × 2 rows = 7 m^2 during harvest season. Seeds were planted on 7th July 2008 and 9th July 2009. Fertilization was carried out a day before and entire phosphorous and partial nitrogen (based on 10 kg da^{-1} pure nitrogen and 10 kg da^{-1}pure phosphorous) were applied as composed fertilizer form (20 % pure N + 20 % P_2O_5) by over spraying and mixed into the soil with proper machinery. Rest of nitrogen (15 kg da^{-1} pure nitrogen) was applied in NH_4NO_3 form (33 % pure N) before neck filling. Border strip irrigation was applied eight times based on plant water requirements. Chemicals (Foramsulfuron 22.5 g l^{-1} and Carbofuran 5%) were applied for weeds and insects. Harvests were performed on 17th November 2008 and 20th November 2009 for grain yield.

Combined analysis of variance to data and comparison of the means with the "student's t test" were performed by using JMP 5 0 1 statistical software (JMP, 2002).

Results and DIscusslon

Mean values and results of "Student's t test" for two years (2008-2009) of investigated characters are given in the Table 1. Results of variance analysis for all investigated characters were observed statistically significant (P<0.05) between tillage

methods.

Maize plants in the conventional tillage and diminished tillagemethods were early flowered than in the zero tillage and bed planting methods. The lowest days to flowering value was obtained in the diminished tillage method. Plant height in the zero tillage method was lower than others. First cop length in the zero tillage method was lower than others. The lowest first cop length value was obtained in the zero tillage method. Grain cop ratio in the zero tillage method was higher than others. The lowest grain cop ratio value was obtained in the diminished tillage method. Grain humidity in the zero tillage method was higher than others. The lowest grain humidity value was obtained in the conventional tillage method. Grain yield in the conventional tillage method was higher than others. The lowest grain yieldvalue was obtained in the zero tillage method.

These results are compatible with results of different researchers (Ishayaa et al., 2008; Cociu et al., 2010; Tueche and Hauser, 2011; Idikutand Kara, 2011;Javeedand Zamir 2013; Guan et al. 2014).These effects may be due to weed competition and soil oxygen capacity because weed intensity in zero tillage was generally higher than other tillage methods. And also in zero tillage maturation was later than others. This situation may be cause by higher soil moisture across to others. Grain humidity in the zero tillage was higher than others. This aspect may affect to grain cop ratio directly. Because grain cop ratio was calculated by grain weight in the cop divide to total cop weight. In the zero tillage and bed planting methods plant root area was no till with top fertilizer. In this case plant root area may be including more moisture than others and then flowering may be late.

It was considering that only herbicide application for weed management was not sufficient for high yielding maize culture. Our results suggest that optimal soil tillage method for dent maize could be conventionaltillage in Harran plain and similar conditions.

Table 1. Results of "Student's t test" and mean values for two years (2008-2009) of investigated characters

Tillage method	Days to Flowering (days)	Plant Height (cm)	First Cop Length (cm)	Grain Cop Ratio (%)	Grain Humidity (%)	Grain Yield (kg da^{-1})
Zero Tillage	58.75 a*	241.59 c	92.78 d	84.5 a	25.64 a	903.07 d
Diminished Tillage	57.38 b	254.57 a	113.83 a	81.25 c	23.38 b	949.53 c
Bed Planting	58.50 a	254.16 ab	111.78 b	81.88 bc	21.91 c	1032.25 b
Conventional Tillage	57.63 b	248.70 b	107.88 c	82.88 bc	21.85 d	1081.51 a
LSD value	0.55	5.78	1.74	1.38	1.05	28.14

*: Statistically significant at 0.05 probability level

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