EFFECTS OF TILLAGE METHODS ON WEEDS DENSITY IN CORN (ZEA MAYS L.) PRODUCTION

A. Konuralp Eliçin[1], F. Göksel Pekitkan[1], Yılmaz Bayhan[2], Abdullah Sessiz[1]
Dicle University, Faculty of Agriculture, Department of Agricultural Machinery and Technologies Engineering, Diyarbakır, TURKEY [1]
Namık Kemal University, Faculty of Agriculture, Department of Biosystems Engineering, Tekirdağ, TURKEY [2]

akelicin@dicle.edu.tr

Abstract: *The objective of this work was to measure the effects of different tillage methods on weeds population in second crop corn. The field experiment was conducted at the research area of Dicle University in 2014, Diyarbakır province, southeastern part of Turkey. The treatment was lay out at the randomized complete blocks design with three times replication. In this study, different six tillage method were applied (one conventional tillage (CT) – four conservation tillage (RT) and no-till (NT)). According to results, there were found significant difference among treatments. The lowest values of weeds were recorded in the CT, while the highest values of weeds were noted in RT1and NT tillage methods. There was found more density the speices of Xanthium strumarium subsp., Solanum nigrum L., Euphorbia helioscopia L., Convolvulus arvensis L. and Sorghum halepense (L.) Pers. than other weed species .As a result, we can consider reduce tillage methods for mechanical weed control for corn production.*

Keywords: TILLAGE, CORN, WEED, CONVENTIONAL TILLAGE

1. Introduction

Maize (Zea mays, L.) is an important cereal crop in the worldwide. it contains about 72% starch, 10% protein, 4.8% oil, 8.5% fiber, 3% sugar and 17% ash. Due to higher yield potential, short growing period, high value for food, forage and feed for livestock, poultry and a cheaper source of raw material for agro-based industry, it is increasingly gaining an important position in the cropping system (Saif et al. 2003).

The choices relating to tillage methods are strongly affected by the other components of the cropping system. Thus, the selection of tillage method is very important for cultivation (Sornpoon and Jayasuriya, 2013). It is carried out mainly to loosen the upper layer of soil, to mix the soil with fertilizer and organic residues, to control weeds, and to create a suitable seedbed for germination and plant growth (Rasmussen, 1999). Good soil management program protects the soil from water and wind erosion, provides a good, weed-free seedbed for planting, destroys hardpans or compacted layers that may limit root development, and allows maintenance or even an increase of organic matter (Wright et al., 2008).

To increase production and reduce production cost in soil tillage operations, reduced tillage and direct seeding system is of great importance. Appropriate tillage and sowing technique can reduce factors that impede seedling emergence reduce energy and labor cost, and control weeds. Especially reduce tillage system are used for weed control. However, tillage systems are location specific; their success depends on soil, climate and local practices (Ozpinar and Cay, 2006).

Modern weed control method has played a major role in the productivity of cropping System. Herbicides are important tools for weed control and have improved production efficiency and facilitated reduced tillage production systems. Because of their effectiveness, herbicides and tillage are the dominant practices in many production systems. While the efficacy of these practices is evident, they may also lead to environmental contamination, human health problems, and soil erosion.

Conversely, proper tillage can lead to better spatial distribution of roots, improving the nutrient and water uptakes, hence improved productivity and there are evidences of weed control positively affecting the yield (Singh and Malhi, 2006; Nakamoto et al., 2006). Conventional tillage was obtained significantly different compared with no-tillage in yield of soybean (Öztürk and Söğüt 2016). Similar results were observed by Sessiz at al. (2010) for corn.

In recent years in Turkey, especially due to introduction of agricultural irrigation in Southeastern Anatolian region has lead to a dramatic increase in irrigating farming and thus second crop farming have gained importance. Especially, second crop corn production is increasing in this region. For this reduced tillage system gained an import for weed control in corn production.

The aim of the study was to compare the effect of six different tillage methods for weed density on the maize for weed density in southeastern part of Turkey.

2. Materials and Methods

The field experiment was conducted during the summer of 2014 at the experimental area of Agricultural Faculty at Dicle University, Diyarbakir Province (latitude 37°53´N and longitude 40°16´E, 680 m altitude), Turkey. In this study, Corn seeds, hybrid Agro May, Bora was used as second crop. The analysis of soil in experimental area were determined as 71.1% (clayey), 1.25% (organic matter), 1.63 kg da-1 (phosphorus), 13.02% (calcareous), saltless and mid-alcali (pH 7.73) in laboratory of GAPUTAEM (GAP International Agricultural Research and Training Center, Diyarbakır). The average weather conditions such as annual temperatures, relative humidity, and rainfall are summarized in Table 1.

Table 1. *Monthly means of temperature, humidity and rainfall*

	Months											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Avrg. Humidity (%)	82.1	53.6	68.3	63.0	53.7	29.6	22.4	21.5	35.5	60.9	70.2	87.9
Max. Temp. (^{0}C)	9.2	16.8	22.0	19.6	26.3	31.6	42.0	42.1	31.3	30.0	19.7	16.0
Min. Temp. (^{0}C)	-1.0	4.9	6.9	6.4	16.3	18.0	26.4	25.8	16.5	10.5	4.7	-3.6
Avrg. Temp. (^{0}C)	3.4	5.4	10.8	14.7	19.7	26.5	31.5	31.1	24.8	17.5	8.5	6.6
Tot. Rainfal. (mm)	43.0	17.0	60.6	39.9	48.8	21.4	0.6	0.0	27.4	34.2	97.6	73.4

The average temperature in June-December period was conducted 26.28^{0}C, average moisture was 33.98% and average rainfall 16.72 mm. Tillage treatments in 2014 consisted of six tillage methods that are described in Table 2. The specification of the tools used in experiments are given in Table 3.

Table 2. *Soil tillage methods utilized in experiments*

Tillage Methods	Tools
Conventional Tillage (CT)	Plough + Disk harrow + Float + Direct seeding machine
Reduced Tillage (RT1)	Disc harrow + Float + Direct seeding machine
Reduced Tillage (RT2)	Stripe tiller by rotary + Float + Direct seeding machıne
Reduced Tillage (RT3)	Cultivator + Float + Ridge tillage + Direct seeding machine
Reduced Tillage (RT4)	Cultivator + Float + Direct seeding machine
No-Till (NT)	Seeding by direct drill

Table 3. *The specification of the tools used in experiment.*

Tools	Type	Working depth (cm)	Working width (m)	Working sped (m/s)
Moaldbord plough	Four bottom	30-35	1.42	0.50
Heavy disk harrow	24 Disk-tandem	15	2.5	0.45
Cultivator	11 Sweeps	15	3.10	0.45
Rotary tillage	Four row	12	2.8	0.45
Ridge tool	-	-	0.7	0.40
Float	-	-	2.9	0.60
Direct planter	Four row	4-6	2.8	0.40

Experimental field were design after lentil harvesting as 18 plots with each measuring 12 m x 6 m (Figure 1).. Before sowing, the experiment area was irrigated eight hours with sprinkler irrigation system. After irrigation, soil tillage operations were made and after soil tillage applications, seed planting was performed by pneumatic planter with an inter row spacing of 0.7 m distance on 23 June 2014. Massey Ferguson tractor was used in the experiments. During the soil tillage treatments, tractor travel speed was changed depend on used tools.

Fig. 1. *The view of experimental area during the growing.*

After emergence of plants, the weeds were counted two times; the first weed count was made 30 days after sowing. Just the first count of weeds, all of the weeds in plots was manually removed by worker. The second count of plants was made after 30 days of the first count. Plants count each plot of 3 replicates 1 m^2 frame randomly discarded and the according to plants species have been counted in the remaining frame. No herbicide was applied to the field both before and after tillage. The treatment was lay out at the randomized complete blocks design with three times replication. Data was subjected to an analysis of variance (ANOVA) using a statistical software package (JMP version 5.0.1a). Least significant difference (Tukey's HSD test) was used to compare treatment means at $P<0.05$.

3. Results and Discussion

The average values of weeds are given in Table 4. According to analysis of Variance and Duncan's test results, there were found more density the species of *Xanthium strumarium subsp*., *Solanum nigrum L.*, *Euphorbia helioscopia L.*, *Convolvulus arvensis L.* and *Sorghum halepense (L.)* Pers. than other weeds species.

Table 4. *Analysis of variance (mean square) for weeds population*

VK	DF	First Count	Second Count
		F Ration	F Ration
Applications tillage methods	5	14.02*	8.28*
Replication	2	2.79	1.81
CV		14.10	16.80

*P< 0.05

As it can be seen from Table 4 and Figure 2, both the first and second count, significant differences were found among the tillage methods on weeds population the lowest weed were observed in CT. The other hand the maximum values were observed in RT1 and NT systems. Weed density was found between 35.3-80 (plant m^{-2}) at the first count. While the highest values of weed density was found in NT methods as 80 (plant m^{-2}), the lowest value was determined in CT methods as 35.3 (plant m^{-2}) at first count (Table 4). The other hand, the highest values of weed density was found in NT methods 110 (plants m^{-2}) at the second count. The lowest values of weed density was obtained in CT methods 44.6 (plants m^{-2}).

Table 5. *Tillage treatment and weeds population*

Practies	Weed Population	
	First Count	Second Count
CT	35.3 e	44.6 e
RT1	71.2 ab	89.3 b
RT2	41.6 de	62.6 d
RT3	50.6 cd	73.6 cd
RT4	63.0 bc	77.6 bc
NT	80.0 a	110.0 a
LSD	14.6	13.2

CT: Conventional Tillage RT: Reduce Tillage NT: No-Tillage

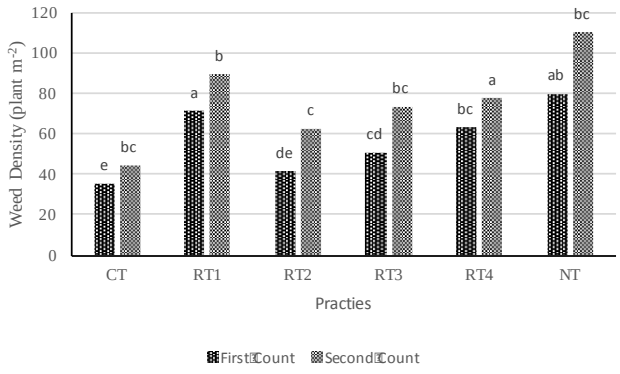

***Fig. 2**. Weed density (plant m^{-2})*

The weed populations were found more in second count than the first count. However, both the first count and the second count, the maximum values were observed in NT treatment. The lowest values were obtained in CT Tillage methods in second count (Figure 1). According to second count of weed density was obtained highest values in no-tillage and reduced tillage than conventional tillage methods. *Xanthium strumarium L.* is one of the most prevalent and competitive weeds in the field area (Snipes et al. 1982) and it is listed among the most common troublesome weeds in plant grown in the region (Dowler 1995; Royal et al. 1997). Çelik and Altıkat (2006) reported that weed population is higher about 30-40% in conventional tillage system than reduced tillage method. Gürsoy et al. (2014) also reported that No-till planting resulted in the highest weed biomass.

4. Conclusion

The weeds are so many problems for yield and yield component on corn production. In this study, significant differences were found between tillage systems. The lowest weed densities were observed in conventional tillage (CT), while the maximum weeds were obtained RT1 and NT. From these results, it can also be concluded that conventional tillage method was beneficial and useful in reducing of weeds population in second crop corn production. To reduce production cost and chemical application, we must consider alternative cultural practices. Especially mechanical tools may be useful for weed control.

5. References

Nakamoto, T., J. Yamagishi, and F. Miura. 2006. Effect of reduced tillage on weeds and soil organisms in winter wheat and summer maize cropping on Humic Andosols in Central Japan. Soil & Tillage Res., 85: 94-106.

Ozpinar S, Cay A 2006: Effect of different tillage systems on quality and crop productivity of a clay-loam soil in semi-arid north-western Turkey. Soil Tillage Res., 92, 69-78.

Öztürk, F., Söğüt, T. 2016. The Effect of Tillage and Plant Density on Yield and Yield Components of Soybean (Glycine max. L Merill.) Grown under main and Double-cropping Soybean. IV. İnternational Scientific Congress Agricultural Machinery 2016. Proceeding II, 26-30.

Rasmussen, K.J., 1999. Impact of ploughless soil tillage on yield and soil quality: A Scandinavian review, Soil and Tillage Research. 53(1): 3–14.

Saif, U., M. Maqsood, M. Farooq, S. Hussain and A. Habib, 2003. Effect of planting patterns and different irrigation levels on yield and yield components of maize (Zea mays L.). Int. J. Agric. Biol., 1: 64-66

Sessiz, A., A. Alp and S. Gürsoy, 2010. Conservation and conventional tillage methods on selected soil physical properties and corn (Zea Mays L.) yield and quality under cropping system in Turkey. Bulg. J. Agric. Sci., Volume: 16, Issue: 5 Pages: 597-608

Singh, B., and S. S. Malhi. 2006. Response of soil physical properties to tillage and residue management on two soils in a cool temperate environment. Soil & Tillage Res., 85 (): 143-153.

Wright, D., Marois, J., Rich, J. and Sprenkel, R., 2008. Field Corn Production Guide - SS-AGR-85.

Gürsoy, S., Özaslan, C., Urğun, M., Kolay, B., And Koç, M., 2014. The Effect of Sowing Time, Tillage System and Herbicides on Weed Species Density, Weed Biomass and Yield of Lentil Within a Lentil-Wheat Sequence. Agriculture & Forestry, Vol. 60 Issue 3: 73-85,

Snipes, C. E., G. A. Buchanan, J. E. Street, and J. A. McGuire. 1982. Competition of common cocklebur (Xanthium pensylvanicum) with cotton (Gossypium hirsutum). Weed Sci. 30:553-556.

Royal, S.S., Brecke, B.J. ve Colvin, D.L. 1997. Common cocklebur (Xanthium strumarium) interference with peanut (Arachis hypogaea). Weed Sci. 45, 38.43.

Dowler, C. C. 1995. Weed survey southern states broad leaf crops subsection. Pages 290–305

Sornpoon W., Jayasuriya H.P.W., 2013. Effect of different tillage and residue management practices on growth and yield of corn cultivation in Thailand. Agric Eng Int: CIGR Journal. Vol.15 no.3