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# Effects of tillage systems on second crop sesame *(sesamum indicum L.)* yield and weed density

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**Abstract**

The aim of this research was to define conventional (CT) and conservation tillage systems in sesame (Sesamum indicum L.) farming as a second crop after harvesting lentil in southeastern region in Turkey. Toward this aim, four different soil tillage methods namely, moldboard plough + disc harrow + float +seeding (CT), disc harrow plus+ float + seeding (RT1), cultivator +float+ seeding (RT2) and no-tillage (NT) (seeding by direct drill) were examined on yield of sesame and some of plan properties at southeastern part of Turkey.The experiment was carried out in research area of faculty of agriculture, Diyarbakir, Turkey in 2014 crop season. The study was designed in accordance with the randomized block design and carried out in three replications. The Results showed that seed yield and weeds density were positively affected by the tillage methods. The increase in the seed yield observed at Conservation tillage while decrease in the weeds population. The highest yield value was found from CT methods (1623.3 kg ha$^{-1}$). The tillage methods were not found statistically effect on protein and oil rate.

**Keywords:** Second crop, Sesame, Tillage, Yield, Emergence rate, Weed density

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## Introduction

Sesame (Sesamum indicum L.) is among so major arable the second crop in conventional farming in Southeastern region of Turkey. It is very resistant to drought crop and is therefore mainly grown as dry land crop in Turkey. The average production amounts of sesame are 18410 tons and seed yield 656.8 kg ha$^{-1}$ in Turkey (FAO, 2017). However, in our country, Entry of farm irrigation after GAP has led to increase in irrigation farming and therefore second crop sesame so important for grower. However, the most important problems in sesame is planting operations. The sesame seeds are minor and sowing must be made as close to the ground surface for seed emergence. Seed cannot be deep that the germination does not occur. Conventional tillage method is intensive in this region. Tillage is power-required work of agricultural manufacture. Because, the extreme cost of energy that is why the farmers need to economical tillage methods. The application of energy-saving systems can perform efficient supports to economical (Bayhan et al., 2006; Sessiz et al., 2009). Agriculture is considered as an energy conversion (Baran and Gokdogan, 2017). Farmers prefer conservation tillage in sesame farming. Conservation tillage methods offer considerable advantages compared to the conventional tillage. Therefore, reduce or no-tillage systems are becoming widespread. Other advantages of no-tillage include reducing soil moisture loss, reduced soil erosion, increased water protection and soil accumulation increasing soil organic matter; reduce time, and reducing greenhouse gas emission (Cakır et al., 2006; Sessiz et al., 2008) as compared to CT. NT has not been widely adopted in Turkey, especially in southeastern region. 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. How ewer, the success of tillage methods is depending soil, climate and local practices (Bayhan et al., 2006; Ozpinar and Cay, 2006; Sessiz et al., 2009; Sessiz et al., 2010). Especially weed control in agricultural cultural practices is so expensive among applications.

Weeds have an adverse effect on crop yields because of competition with cultivated plants (Sessiz et al., 2009; Öztürk et al., 2018). Mostly hand and cultivator do the weed control in sesame farming. Because the manual weed struggle is a tedious, time consuming and expensive process. Therefore, mechanicals struggle is so importance in weed control processes. The mechanically weed struggle does not only destroy weeds but also increases the aeration of the soil. The germination of weed seeds or the application of the vegetative propagation organs varies depending on the soil temperature, light, light soil handling patterns and processing depth. As the chemical struggle leads to environmental pollution that is why the mechanical struggle is important as alternative method of struggle.

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Agricultural irrigation has occurred an increase in the southeastern Anatolian region after project of The GAP. Therefore, the second product sesame cultivation has gained importance.

The soil structure deterioration, soil erosion occurred due to the conventional tillage method of the farmers in the region. Because of the farmers in the region, using of conventional tillage methods were occurred physical deterioration of soil and increased soil erosion etc. (Sessiz et al., 2009; Öztürk et al., 2018; Elicin et al., 2018).

The goal of this research was to determine the effects of soil tillage systems on yield and weed density in second crop sesame in Southeastern part of Turkey.

## Materials and Methods

This research was established in experimental area of the University of Dicle, Faculty of Agriculture, in Diyarbakir conditions, during the summer season in 2014 after lentil harvesting. The mean annual average precipitation is change between 476-600 mm for along years during summer growing season, and the mean annual air temperature is change between 31.5-17.5 °C. 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 midalcali (pH 7.73) in laboratory of GAPUTAEM (GAP International Agricultural Research and Training Center, Diyarbakır).

### Soil Tillage Systems

Tillage systems (four systems), conventional, reduced (two reduced tillage system), and direct sowing (no tillage) were administered after lentil harvesting in June 2014. The specifications of the used devices in research are given table 1. The tillage systems are given in Table 2. The same tolls and machines were used for this experiment.

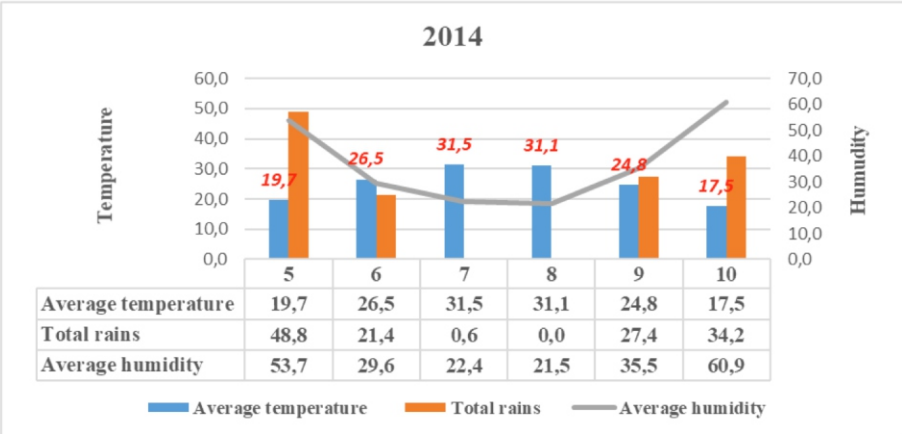


**Figure 1.** Monthly average air temperatures C, totally rains (mm) and humidity (percentage), Respectively during growing season.

**Table 1.** The specification of the devices used in research

| Tool | Type | Working depth (cm) | Working width (m) |
|---|---|---|---|
| Moldboard plough | 4 bottom | 25-30 | 1.42 |
| Heavy disk harrow | 24 disc | 15 | 2.5 |
| Cultivator | 11 sweeps | 15 | 3.10 |
| Float | Rectangle shape | shallow | 3.00 |
| Seed machine | 4 row | 4-6 | 2.8 |

**Table 2.** Tillage systems are used in research

| Conventional tillage methods (CT) | Moldboard plough+ disk harrow+ float + direct seeding machine |
|---|---|
| Reduced Tillage methods (RT1) | Disc harrow+ float + direct seeding machine |
| Reduced Tillage methods (RT2) | Cultivator + float + direct seeding machine |
| Direct sowing (NT) | Direct seeding machine |

**Figure 2.** Experimental area

(CT) was conducted with four bottom (1.42 m working with) moldboard plow to 25 cm depth. After plowing, the research area three times harrowed with disk (24 disk–tandem, working width, 2.5 m) at 20 cm depth, and leveled by float. RT consisted of two tillage methods (Table 2). RT1 is Disc harrow+ float + direct seeding machine, RT2 is Cultivator (11 sweeps, 3.10 m working with) + float + direct seeding machine. No-tillage (direct sowing treatment), sowing was made without tillage. The working with (four row) of direct seeding machine is 2.8 m. Working speed was constant as 1 m/s for all machines during the experiments. Massey Ferguson tractor was used in the experiments.

Experimental field were design after lentil harvesting as 12 plots with each measuring 12 m x 6 m. Before sowing, the experiment area was irrigated eight hours with sprinkler irrigation system. After seedbed preparation and irrigation, local variety sesame seed was sowing as second crop after harvest of lentil crop by pneumatic planting machine on June 23 in 2014. The planter has flat double discs + 8-wave colter (Table 1). Additionally extra weights were loaded on the top of seed drill for a better effect of colter into the soil (Sessiz et al., 2008; Sessiz et al.,2010). The sesame seeds were seeded nearly 1.0 cm deep at 0 kg ha$^{-1}$. No herbicide was applied to the field.

**Examined properties**

In this study, especially, weed density, seed yield and quality properties (protein and oil content) were examined. Harvesting area is (5 m x 0.7 m x 2 m) 7 m$^2$. Seame seeds were dried in oven at 65 ºC for 18 h. Protein rate was determined by means of the Kjeldahl method (AOAC, 2000). The oil content of the grain from each tillage system was determined using a Soxhlet extraction method.

**Weed Measurement**

The weeds were counted two times after emergence of sesame seeds; 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 replication 1 m$^2$ frame randomly discarded and the according to plants species have been counted in the remaining frame. Herbicide was not used before and after tillage.

**Statistical analaysis**

This experiment was arranged by randomized block with three replications.Data for each experiment were analysed by JMP 5.0 software program for comparison of Data was analyzed by JMP package program Mean tested by Tukey at the 1% level

**Results and Discussion**

The effect of tillage methods on sesame seed yield are shown in Table 3. Analysis of variance indicated that The applications were found significantly on yield while insignificant in protein content and oil content.

It has the effect of irrigation on the yield. The experiment area was irrigated after sowing. The highest value of yield was achieved as 1623.3 kg ha$^{-1}$ by CT tillage method, while the lowest value was produced from RT2 and NT methods (respectively, 1320 and 1333.3 kg ha$^{-1}$). Several factors affect the seed yield and yield attributes in crop, including cultivar, seasonal variation, location, planting date, soil nutrient, moisture availability, growing conditions in different crops (Abdelaal et al., 2017; Barutçular et al., 2017; Gormus et al.,2017a, b). Seed yield is the most important target in sesame farming, but occurs as a result of the interaction of many components. The sowing time has an effect on yield and yield components. In the literature, it has been reported that the yield decreased as a result of late sowing (yield last planting date) Alamsarkar et al., (2007). Similarly our Seed yield results were found other researches (Yalcın and Cakır, (2006); Furat and Uzun, (2009); Silme and Çağırgan, (2009); Vita et al. (2007) studied no-tillage and conventional tillage effects on wheat seed yield. They were determineted high seed yield with no-tillage than conventional tillage.

In inirrigated condations, this values were found lower than irrigated condation by Polat et al. (2006) in southestern region in Turkey. Similar results were found by Sessiz and Söğüt, (2008) for sesame yield. The effect of soil tillage methods on content of sesame protein and oil are shown in Table 3. Protein and oil rate of sesame were found insignificantly ($p>0.05$) by tillage systems. There were not found siginificant differenes among the tillage systems. Parallel results were found in all tillage systems. The content values of protein were obtained as average % 51. However, oil content values were obtaines as average % 20. According to Vita et al. (2007), tillage methods was found insignificant on protein rate. Lopez et al. (1998) found high protein rate for conventional tillage than no-tillage. Same results were found by Sessiz and Söğüt (2008) for sesame protein content and oil content.

Weed density was found between 18.12-39.33 plant m$^{-2}$ at the first count. The highest values of weed density was observed in NT tillage methods as 39.33 plant m$^{-2}$ otherhand the lowest values was found in CT tillage methods as 18.12 plant m$^{-2}$ at first count (Table 6). Weed density of the second count was found highest values in NT Tillage methods (32.66 plant m$^{-2}$). Similar result were reported by Çoruh and Boydaş, (2007). Özaslan and Gürsoy, (2015) reported that the effects of the tillage methods on weed population differed between the weed types. Sorghum halepense had the highest density under the reduced tillage method, while the Sinapis arvensis density increased under the conventional tillage treatment. The lowest weed density values were found in second count than the first count in this study. However, both the first count and the second count, the highest values were observed in NT treatment. The lowest values were obtained CT tillage methods (Table 6). According to second count of weed density was obtained lowest values in conventional tillage methods (16.33 plant m$^{-2}$).

**Conclusions**

Finally, the current research work was aimed to evaluate the tillage methods for seedy yield and weeds densities on sesame production. The weeds population are so problems for seed yield and yield component on sesame production. According to our research, the lowest weed population were observed in conventional tillage methods (CT). The conventional tillage methods used are high yield and weeds control successfully in sesame in Southestern Anatolia of Turkey.

**Table 3.** Analysis of variance of some quality

| Source of variation | DF | Yield | Protein rate | Oil rate |
|---|---|---|---|---|
| Applications | 3 | * | ns | ns |
| Replies | 2 | | | |
| CV | | 8.41 | 2.32 | 1.01 |

ns: not significant *Significant at $P < 0.05$

**Table 4.** Sesame seed yield, oil and protein rate

| Applications | Seed yield (kg ha$^{-1}$) | Oil rate (%) | Protein rate (%) |
|---|---|---|---|
| CT | 1623.3 a | 51.13 | 19.60 |
| RT1 | 1476.6 ab | 51.46 | 20.30 |
| RT2 | 1320.0 b | 51.20 | 19.70 |
| NT | 1333.3 b | 51.40 | 20.07 |
| LSD | 243.0 | 1.04 | 0.92 |

In each column, means followed by the same letter within columns are not significantly different ($P < 0.01$) according to Tukey test.

**Table 5.** Analysis of variance (mean square) for weeds population

| Source of variation | DF | First Count | Second Count |
|---|---|---|---|
| Practies | 3 | * | * |
| Replication | 2 | | |
| CV | | 19.2 | 8.86 |

ns: not significant *Significant at $P < 0.05$

**Table 6.** Tillage treatment and weeds density

| Applications | Weed Density | |
|---|---|---|
| | First Count | Second Count |
| CT | 18.12 b | 16.33 b |
| RT1 | 29.33 a | 27.58 a |
| RT4 | 38.33 a | 32.00 a |
| NT | 39.33 a | 32.66 a |
| LSD | 11.12 | 5.21 |

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