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Research Article

EFFECT OF CONSERVATION TILLAGE ON SEEDING ACCURACY AND SOIL MOISTURE CONTENT IN CORN CULTIVATION

[*]Jamshidi A.R.[1], Tayari E.[2], Jasem Nejad M.[1] and Neisy A.[1]
[1]Department of Agricultural Mechanization, Collage of Agriculture, Shoushtar Branch, Islamic Azad University, Shoushtar, Iran
[2]Sama Technical and Vocational traiNINg College, Islamic Azad University, Shoushtar Branch, Shoushtar, Iran
**Author for Correspondence*

ABSTRACT
In order to evaluate the effects of conservation tillage on seeding accuracy and soil moisture content, an experiment was done in a fully randomized block design with three replications in a farm located in the north of Shoushtar in loam-clay soil. The treatments consisted of: 1) conventional tillage: using moldboard + disk (MT) 2) using the disk plow + disk (DT) 3) using combined plow (conservation tillage) (CT). After treatments, the changes in soil bulk density and soil moisture at depths of 5, 10, 15 and 20 cm were measured in the interval between two irrigation. Finally, yield and yield components were measured. The results showed that the difference between the crop yields in different treatments was not significant at the statistic level of 5% and conservation tillage practices will not cause the yield to reduce. The conservation tillage practices also reduce soil bulk density ($P<0.05$). Reduction in moisture content at the measured depths is less in conservation tillage methods and moisture content is higher in conservation tillage methods. Furthermore, the seeding accuracy in the conservation tillage method will not decrease compared to conventional method.

***Keywords*:** *Conservation Tillage, Crop Residue, Seeding Accuracy*

INTRODUCTION
Before the introduction and development of herbicides, one of the main objectives of tillage was to combat weeds, so that with successive plowing, sprouting or grown weeds would be destroyed. After the introduction of herbicides, the role of tillage in relation to this matter was faded and gradually, approach based on minimization practices on soil was developed. Almost since three decades ago and the early 1980s, marked tendency toward conservation tillage has formed. In conservation tillage systems, the conditions for the maximum resistance to wind and water erosion must be created. Creating this condition by leaving crop residue on the soil surface is possible.

Miller *et al.*, (1976) investigated the effect of different land preparation methods on corn yield and moisture content. The results showed no significant effect of tillage on yield. However, conservation tillage has had a significant effect on soil moisture in different depths of soil. Gichero (1994) evaluated three methods of conservation (mulch), ridge and conventional tillage on soil moisture in terms of effectiveness. An experiment on a loam-clay soil in semi-arid region of Kenya was performed. 2-year test results showed that the moisture content in the soil profile during the 2 years of conservation tillage methods are higher than the other two methods. This researcher concluded that the best management of moisture content is done by leaving mulch on the surface. Osunbitan and Oyedele (2004) examined the effects of different tillage methods on bulk density and soil hydraulic properties of sandy loam soils in southeast Nigeria. Test treatments include local and traditional preparation methods (using a moldboard plow) as well as no-tillage methods. The researchers found that the amount of soil bulk density decreases with soil disturbance increases so that in no-tillage treatment and in moldboard plow method, they were 1.28 and 1.09g/cm3, respectively. Kováč *et al.*, (1993-1995) studied the effects of conservation tillage and no tillage on moisture content in Priest any region located in east Europe. Soil type was clay loam and crop rotation was barley - corn. According to these researches, the increase of moisture content in the soil

profile in conservation tillage method was significant compared to conventional ones (Asoodar and Sabzezar 2009).

Based on the results of Anastasias, differences in corn yield in different land preparation methods including low tillage, no tillage and conventional tillage were not significant. However, the use of conservation tillage saves labor and fuel required to produce corn. These experiments were conducted after wheat harvest. The no-till and low-till methods based on the results of this research also resulted to 39.5 and 5.5% savings during planting and 36 and 7.2% savings in fuel consumption, respectively (Anastasias *et al.,* 2007).

MATERIALS AND METHODS

For this experiment, a field located in Mianab in Shoushtar with area of about 1 ha and atmospheric and stack irrigation was selected. Previous year's crop was forage corn. The type also was clay loam. Regarding the 3 treatments and 3 replicates that were supposed to be tested, the land was divided into nine sections. The approximate dimensions of 70 x 16 m for each plot were considered.

The treatments were:

(1) Conventional tillage: using moldboard (MT)

(2) Using the disk plow + disk (DT)

(3)Using combined plow, model Kevernland(CT)

To compare treatments, a fully randomized block design with three replications was used. The treatments were conducted in 2012.

Plowing depth of about 20-25 cm for all treatments and in equal manner was considered. Before the treatments, soil bulk density was measured. At the early June, planting operations were performed. Tarashkadeh's pneumatic seeding machine was used for cultivation whose specifications are listed in the table below.

Using a special cylinder with dimensions of 80 × 78 mm, bulk density of from 5 to 20 cm depth of plowing was measured. Soil samples taken after removal of the cylinder were placed inside the oven at 105 ° C for 24 hours and then the bulk density was measured by the following equation.

$$B.D = \frac{Wd}{V}$$

B.D=soil bulk density (g/cm3)

Wd= weight of dried soil (g)

V = cylinder volume (cm3)

Soil bulk density once before the operation and then for all treatments was measured. Three days after the third irrigation, soil samples from depths of 5, 10, 15 and 20 cm in soil samples were taken. The sampling interval was every other day until the next irrigation. The final sampling was performed 1 day before the fourth irrigation.

After weighing, the samples were transferred into the oven. The oven temperature was set at 107 °C and kept for 24 hours on the machine. After 24 hours the samples were dried and weighed and soil moisture was obtained from the following equation.

$$Md = \frac{Ww - Wd}{Wd} \times 100$$

Ww= weight of wet soil (g)

Wd= weight of dried soil (g)

Md = moisture based on weight

In order to compare treatments in terms of moisture content, percent of moisture loss during a time interval between two irrigation was measured using the following equation. The percent of reduction in moisture contentwere measured for all treatments and also for 4depths.

$$\mathbf{R_M} = \frac{M_0 - M_1}{M_0}$$

RM = reduction in moisture content (%)
M0 = soil moisture in initial stage of measurement (%)
M1 = soil moisture in final stage of measurement (%)
Deviation from the mean depth: using the following equation, deviation from the mean depth was measured for placing the seeds in the soil. At least 10 observations were done at each plot.

$$d = \frac{\Sigma(x_i - \bar{x})}{n}$$

x_i = depth of placing seeds in the soil (cm)
= measured mean depth (cm)
n = number of observations (n > 10)
The mean distance of seeds onto the stack:
For each plot,3 lines with length of 3 m were randomly selected and using a ruler, the consecutive distance between two plants were measured.
Deviation from the mean distance between seeds:

$$d = \frac{\Sigma(d_i - \bar{d})}{n}$$

d_i = distance between two consecutive seeds (cm)
= mean distance between the seeds (cm)
n = number of observations and measurements (n > 10)
Deviation from a straight line of sowing:
For this purpose, three lines were selected in each plot and a rope of 2 m length was pulled between two rows. Deviation from a straight line of sowing was calculated by the following formula.

$$s = \frac{\Sigma(x_i - \bar{x})}{n}$$

x_i = distance format seed to middle base line (cm)
= distance from middle line to the line on the stack (cm)

RESULTS AND DISCUSSION

Table 1 showsAnalysis of variance (ANOVA) for effects of applied treatments on yield and yield components. As the table shows, the effect of treatments on traits was not significant at the 5% level. This result seems reasonable given the results of other researchers. Also,the important and reasonablepoint from the results of experiment is that conservation tillage has no impact on yield. Table 2 also presents the comparison of measured mean characteristics at the level of 5%. Although no statistically significant differences was observed in yield, but the yield in conservation tillage systems is slightly lower. One of the reasons for this case is less diameter of stemin conservation tillage method, which this minor reduction is somewhat compensated with more height of plant comparing to the conventional method.

Table 1: Analysis of variance of the effects of tillage on yield-related traits

s.v	df	Shoot diameter (mm)	Length cob (cm)	Height plant (m)	Yield (kg/ha)
Replication	2	13.25^{ns}	6.6	0.001^{ns}	1200456^{ns}
Treatment	2	59.4^{ns}	2.9	0.002^{ns}	2145698^{ns}
Error	4	28	2.7	0.004	10235689
cv		17	8	3	9

Table 2: Comparison of measured mean traits related to yieldcomponents in treatments

treatment	Shoot diameter (mm)	Length cob(cm)	Height plant (m)	Yield (kg/ha)
MT	24[a]	35[a]	2.3[a]	80569[a]
DT	21[a]	33[a]	2.3[a]	7958[a]
CT	19[a]	33[a]	2.3[a]	6875a

Table 3 indicates Analysis of variance of the effects of tillage on moisture reduction.As the table shows, the effect of treatments on percent of reduction in moistureis significant in 4 measured depths,exceptin depth of 20 cm.

Table 3: Analysis of variance of the effects of tillage methods on reduction in soil moisture at different depths of soil

s.v	df	5	10	15	20
Replication	2	1.6[ns]	8 [ns]	9 [ns]	5 [ns]
Treatment	2	294[*]	245[*]	285[*]	123[*]
Error	4	12	16	23	55
cv		9	11	10	20

Table 4: Comparison of mean moisture loss (in percent) according to Duncan's test at statistic level of 5%

treatment	5	10	15	20
MT	51[a]	27[b]	14[a]	14[b]
DT	46[b]	31[a]	16[a]	14[b]
CT	29[c]	19[c]	10[b]	8[a]

Comparison of mentioned traits in different treatments is found in Table 4. According to this table, the minimum loss of moisture at depths of 5, 10 and 15 relates to conservation tillage method. This is very important for optimal use of roots from soil moisture as well as irrigation frequency.Unfortunately, due to the impossibility of establishing different irrigation frequencies, it may not be possible to evaluate the effect of tillage on the loss of irrigation, but it is clear that in case of sufficient moisture in the root penetrationzone, irrigation may be delayed. Also, according to the above tables, keeping moisture using a disk plow is higher in moldboard. Disk plow isintermediate between the conventional and conservation tillage because it does not fully moldboard the soil and portion of the soil residue remains on the soil surface that unfortunately, the use of the conventional tillage is not common.

Analysis of variance of the effect of tillage on the accuracy of sowingand soil bulk density showed that the measurement traits including deviation fromsowing depth, deviation froma straight line of sowing, deviation from the average plant spacing on the stack, seed spacing onthe stack is not affected by tillage method that has the application of sowing accuracy and the differences not observed at the 5% statistical level were not significant. Table 5 also showsthe comparison of measured mean traits of treatments. Therefore, conservation tillage has no effect on reduction in sowing accuracy. This is quite reasonable due to the fact that there is no significant difference in yield, because the lack of precision in sowing will ultimately result in decreased yield. But the effect of tillage on soil bulk density is significant and has the lowest bulk density in conservation tillage treatment. This is due to the incorporation of plant residues in the plow layer that reduces the weight per unit volume of soil.

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