

Technical Indicators and Assessment of Energy Expenditure Indifferent Tillage Methods and Planting Wheat

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Abstract: The objective of this work was to study the effects of tillage and planting methods on technical indicators, energy and other properties. In this research, which was carried out in khatam area in 2014-2015, different tillage and planting methods included conventional tillage, conservation tillage by chisel plow, conservation tillage by combined plow and no tillage based on randomized complete block design with three replication? Factors that were used as a measure of comparison, include the average number of plants per square meter, uniform planting depth (vertical distribution uniformity of seeds), a uniform distribution of seeds (uniform distribution of seed surface), the percentage of green seeds, the measurement of time the actual capacity and practical calculation tools, power tools and fuel energy consumption in any way. The results of this research, no tillage with fuel consumption of 15 liters per hectare, the lowest fuel consumption and therefore less fuel energy of 671 MJ, most stored soil moisture 30.4 percent, the lowest since the 33/67 minutes per hectare and thus the maximum capacity of the machine's actual position was higher than the other treatments. Conventional tillage with the highest fuel consumption of 47 liters per hectare fuel consumption rate, the lowest percentage of soil moisture 61/20% and a maximum operating time of 33/295 minutes per hectare respectively.

Keywords: *Tillage methods, Energy, Wheat, Fuel.*

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 [1] 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 [2] 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 is 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 [3] 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. 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 [4].

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 [5].

Materials and Methods

For this experiment, a field located in khatam in yazd 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:

- Conventional tillage: using moldboard (MT)
- Conservation tillage: chisel plow
- (3)Using combined plow (CT)

To compare treatments, a fully randomized complete block design with three replication was used. The treatments were conducted in 2014.

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 content were measured for all treatments and also for 4depths.

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

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.

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

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:

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

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.

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

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 shows Analysis 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 reasonable point 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 stem in 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

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	1.562	2	0.781	1.303 ^{ns}	0.339	5.143
Columns	149.922	3	49.974	83.325 ^{**}	0.000	4.757
Error	3.598	6	0.600			
Total	155.0826	11				

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

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	76.167	2	38.083	4.466 ^{ns}	0.065	5.143
Columns	23459.583	3	7819.861	916.987 ^{**}	0.000	4.757
Error	51.167	6	8.528			
Total	23586.917	11				

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 moisture is significant in 4 measured depths, except in 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

ANOVA					
Source of Variation	SS	df	MS	F	F crit
Rows	27.167	2	13.583	2.249 ^{ns}	5.143
Columns	292.433	3	97.478	0.313 ^{ns}	4.757
Error	260.387	6	43.398		
Total	579.987	11			

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 penetration zone, irrigation may be delayed. Also, according to the above tables, keeping moisture using a disk plow is higher in moldboard.

Disk plow is intermediate 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. The conservation tillage practices also reduce soil bulk density ($P < 0.05$).

Analysis of variance of the effect of tillage on the accuracy of sowing and soil bulk density showed that the measurement traits including deviation from sowing depth, deviation from straight line of sowing, deviation from the average plant spacing on the stack, seed spacing on the 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 4 also shows the 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 [6-8].

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