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Using of innovative shaping soil machines after tillage and evaluating efficiency of water consumption in linear tape and furrow irrigation systems on corn yield in north of Khuzestan, Iran

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ABSTRACT

Making run off and wasting water is one of the problems of sprinkler irrigation systems, especially in the areas where soil is heavy or has excessive compaction. Runoff is started usually after the third irrigation and in the first and second irrigation, it is made lesser, because of tillage is done recently and soil might be less fractured. Runoff is causing of wasting water, soil erosion and declining farm yield on the part of farm where the water is accumulated. In many countries now, for saving water consumption in row crops is used of diker machine which will be cause of irrigation in blocking grooves. According to the type of irrigation systems in Iran, soil shaping machine (Imprinter) was made with some changes in comparison to groove diker machine. By using this machine has been created small holes between the rows which are used for storing water. The soil shaping machine (Imprinter) has different applications in protecting water and soil which was adapted to dry land production systems in the past and it is adapted to the irrigation system now. This Study is conducted in order to provide appropriate tillage methods with soil conditioner and a more accurate estimation of water per hectare. In the end, presentation methods of water consumption efficiency with two types of soil conditioner (diker and Imprinter) while a split factorial experiment in randomized complete block design with three replications which was conducted in the Shoushtar city (Khuzestan Province, Iran). Main Treatment was consisted of tillage methods (Cyclotiller one time, Rototiller one time) and Subsidiary treatment was consisted of two types of soil conditioner machine (diker and Imprinter) and two irrigation methods (furrow, tape line). The results showed the tillage treatments with cyclotiller and using of the diker machine and furrow irrigation had the highest performance in comparison to other treatments by 8800 kg / ha.

Key words: Tillage, Corn, Imprinter Machine, Diker Machine, Cyclotiller, Rototiller

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INTRODUCTION

Not only the water resources of Iran are limited, but also the ground water resources are dwindling. The optimized consumption of water is necessary and inevitable for facing with these facts. One of the ways to increase the efficiency of irrigation water is economizing in water consumption. This can be achieved by using new irrigation methods. Trickle irrigation method can save water as much as 50 to 70 percent. Thus, the optimal using of available water resources for planting crops in agriculture part can be determine one of the most appropriate choice of solution to create a sustainable agriculture. Deficit irrigation is a strategy for bringing products to operate under conditions of water shortage which is associated with the reduction product. Reduce water consumption of saving water in the unit area and increasing crop cultivation will ultimately increase profits. Tape irrigation is one of the methods that is used the new method of row-crops irrigation. In different and low water countries use of tape irrigation crop began in1975. According to the research on low irrigation corn showed that low irrigation is caused of reducing yield. Also comparing water consumption efficiency in tape, rain and groove methods for corn production in America by Clarke (1997) is Showed Respectively 12, 11.5, 11.9 tons per hectare yield. Tape irrigation increases water consumption

efficiency from 1.9 to 2.10 kg per mm in ha because of having shorter period irrigation than surface and furrow irrigation methods [9].

Increasing development using of linear tape irrigation systems in row crops and vegetables such as sugar beet, corn, potatoes, tomatoes, cotton etc necessitate doing Extensive research about these methods from various aspects. Using of These methods have already been developed in some areas of the country (Iran) among leading farmer and while there is no a lot of knowledge on how to use these methods among farmers and sometimes agricultural researchers. Therefore the most important ways of saving water is changing irrigation methods. Nowadays using of modern irrigation methods have become necessary that somewhat could be helping water losses reduction. As mentioned, the key factor of crop yield is land preparation. Not only is it effective in intensification of soil chemical substances decomposition but also is it effective directly in the balance of alkalis and organic materials. The problem of water crisis is inevitable in Iran. Continuity of drought and its adverse effects will seek necessity of achieving an effective and sustainable strategy for producing agricultural and horticultural products in different climates of Iran. By analyzing of long-term rainfall Statistical in Iran is deduced that the coefficient of variation of annual and seasonal rainfall is high in most parts of the country (Iran). Therefore it shows the fluctuation of rainfall from year to year.

Drought phenomenon has seen in past years in our country (Iran) and has shown its effects and unpleasant outcomes. Commercial conditions and limited on the water resources and the climate condition state obviously that must be considered more about drought phenomenon. In addition should be considered necessity of increasing water consumption efficiency in agriculture, modifying consumption patterns, Irrigation management and attention to the water productivity. According to water resources of country are declining, therefore, Optimal of water consumption terrain is inevitable. [1] Enhancing irrigation efficiency is one of the ways to save water consumption. This can be achieved by applying new methods of irrigation. Low irrigation is a strategy for product processing under conditions of water shortage that is come with reducing yield. It is also a way that determines maximum allowable reduction of water consumption and yield eventually profits will be increased by reducing water consumption per unit area and increasing the area under cultivation. So, it is inevitable developing of irrigation systems as suitable solutions for water consumption in row crop and vegetables such as sugar beet, corn, potatoes, tomatoes, cotton, etc. In some fields, there is a runoff problem especially farms which are irrigated with Center Point and furrow irrigation methods. This is more difficult especially in heavy and dense soils and also steep field. Many problems are created by flowing water that is followed through wheel effect of sprinkler irrigation systems and tractor traffic on the ground. Water of rain or irrigation maybe cause of creating hard layer on the furrow in the farm especially in loamy soils which are plowing recently or sandy soils without organic matter [4].Water of Irrigation and rain are flowing in the furrows therefore will not be available for plants. Small obstacles create into some furrows which are created by diker machine that are called blocked furrow. The only disadvantage of diker machine is in plant maintenance because farmer cannot use field cultivator and rotary weeding between furrows. Thus plant maintenance stage will not be mechanical exercise and only farmers have to use spraying in this stage.

Figure 1 - Diker machine and how to creating blocked furrow in the bottom of the furrow

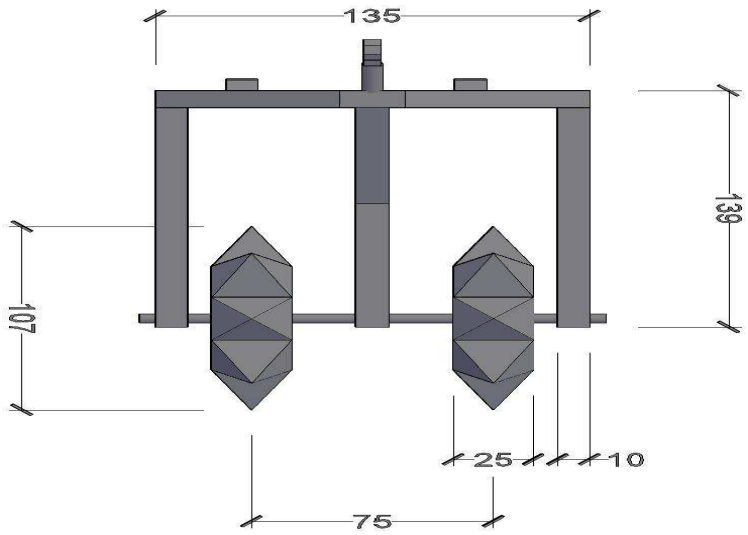

Figure 2- Imprinter soil machines

According to choose the most appropriate tillage methods and necessity of proper management of water resources by using soil shaping machines in order to enhance yield and to reduce the economic costs of production, Therefore Necessary of implementing project like this could be felt in the north of Khuzestan province (Iran).

MATERIALS AND METHODS

To evaluate the effects of tillage and irrigation methods on water consumption and yield of maize this project was conducted in three repetitions by completely randomized block design in split factorial. is tillage is as the main factor in two levels of using soil shaping ((Diker and Imprinter) irrigation methods in two levels as second subsidiary factor are conducted. In order to Knowing the bulk density of the soil sampling is done in depths of 0 to 15 and 15 to 30 cm in growth stage and the time of pollination from top of the ridge and bottom of the furrow. Percent of soil moisture was sampling from 0-150 and 15-30 cm depth before each irrigation. Samples were immediately transported to the laboratory in a sealed container after weighing will be dried in the oven. Percent of the soil moisture was calculated by the following formula:

Formula (1). % moisture = (wet soil weight - dry soil weight) / dry soil weight × 100

A composite sample of soil in depth of 0-30, 30-60 and 60-90 cm are prepared in order to determine soil texture, acidity, and electrical conductivity and finally analysis in the Soil and Water Research Laboratory. [7] For determining soil organic matter will sample from 0-15 and 15-30 cm depth before planting and after harvesting. One water of irrigation sample prepared for testing.

Seed for planting was SC 704 and planting distance was 17 × 75 square cm. After implementation project map tillage treatments on the floor and the seeds were cultivated by the most popular row crop planter in area (Tarashkadeh). Then the installation of irrigation facilities was acting (the main water supply pipes, volumetric meter, Sub-branches and tape tape) in the considered treatments. [11] The amount of fertilizer needed was applied based on the soil test and recommendations of the Soil and water Institute. All agricultural operations were done based on the recommendations of Seed and Plant Research Center which are including irrigation, thinning, and weed, fighting weeds and pests and diseases. Consumption fertilizer was done during the eight-leaf stage two weeks before the planting. To calculate the soil penetration resistance use of the soil cone index in the green and pollination stages [6].

Irrigation

In the tape line irrigation method the exhaust pipe of the main well pump is divided into two parts. On one of the tubes installed a magnetic filter and then determined water flow and Water velocity based on filter user table. Then we provide two types of irrigation pipe for irrigation. Firstly, before planting provided several samples of different depths of land from 0 to 30 cm. finally EC are measured and recorded. To measure water rate inputs in each plot is used the volumetric water meter. Irrigation was done for conventional treatment base on the conventional method of area with 7 days period and tape irrigation with three days period. Volumes of water requirement are calculated by Meteorological data in both methods. In these study irrigation intervals is done for the tape irrigation three times a week for instance on certain days Saturday, Monday and Wednesday. To estimate crop water requirements is applied Penman-Monteith formula that has been modified by FAO and the crop coefficient for corn. Water consumption in treatments is calculated by the following equation.

Formula (2)

$$ET = P + I - Rf - Dp \pm \Delta s$$

Where :

ET: crop water consumption (mm), P: precipitation (mm), I: irrigation water (mm), Rf: runoff (mm), Dp: deep percolation (mm), Δs: changes in volume of soil water in depth of root (mm).

Measurements

To determine the moisture content in planting period and humidity difference between top of the ridge and within the furrow sampling is done during the 5-stage in the planting period at the depth of 0 to 100 mm in each plot. The samples were placed in Otoklav for 48 h at 105 ° C and finally were dried. Weight moisture content rate is calculated by using formula (3).

Formula (3).

$$\Theta = (Ww - Wod / Wod) \times 100$$

Where:

Θ = Soil moisture content (%), Ww = weight of wet soil (kg), Wod = weight of dry soil (kg)

For determining soil salinity in different planting which were irrigated by normal water and magnetic water, sampling was done in three stages during the growth period in depth of 0 - 100 mm and amount of 200 grams in each plot. Finally, samples sent to the soil and water laboratory and then soil salinity was determined by ml muse per square cm.

Coefficient velocity of emergence (cv)

Coefficient velocity of emergence (cv) is calculated by daily counting of plant directly in each treatment. Emergence Rate Indexes (ERI) and Mean Emergence Times (MET) and Percentage of Emergence (PE) are calculated by following formulas.

1) Emergence Rate Indexes (ERI)

$$ERI = \frac{S_{te}}{MET}$$

Where:
ERI= Emergence Rate Indexes (number / day), MET= Mean Emergence Times (day), STE= seed total emergence (number/day)

2) Mean Emergence Times (MET)

$$MET = \frac{N_1T_1 + N_2T_2 + ... + N_nT_n}{N_1 + N_2 + ... + N_n}$$

Where:
MET = Mean Emergence Times, N = Number of emerged seed, T = period of time after planting

3) Percentage of Emergence (PE)

$$PE = \frac{n}{N} \times 100$$

Where:
PE = Percentage of Emergence, n = number of emerged seed, N = the total number of seeds that have been planted nominally.

Statistical analysis will be done on the results by the SPSS, MSTATC and Excel software.

Percentage and Coefficients of emergence for corn
Analysis of variance of seed emergence is shown in table -1. Effect of type of tillage, type of irrigation and type of water consumption are significant at 1% on mean emergence percentage. Table-2 is shown effect of type of tillage, type of irrigation and type of water consumption on the emergence percentage. In the tillage with Cyclotiller percent of emergence is increased significantly in compare to Rototiller. The lowest mean emergence with 60.1 was belonged to the conventional tillage and the most with 83.4 was belonged to the tillage with Cyclotiller.

Table 1 - Summary analysis of variance of emergence for corn under the Influence of different tillage methods

Sources of changes	Degrees of freedom	Percent of emergence	Velocity of emergence (coefficient)
Repetition	2	31.33	0.0001
Type of tillage (A)	1	193.29*	0.091**
Error			
Shaping soil machine (B)	1	0.362	2
Type of tillage in soil shaping machine (A×B)	1	63**	6
Type of water (C)	1	0.24	160
Type of tillage in type of irrigation (A×C)	1	** 109	0.16
Type of irrigation in soil shaping machine (B×C)	1	56**	35**
Type of tillage in type of irrigation in type of soil shaping (A×B×C)	1	0.11	0.07**
Error	2		
Coefficient of changes (%)	Degrees of freedom	12.3	0.79

**, ** Significant 0.05. 0.01 Respectively.*

Table -2. Effect of type of tillage on percent of mean emergence

Type of planting	Speed of emergence	Percent of emergence (%)
Diker Machine ،Furrow Irrigation ،Rotivator	6.6^{c}	60.43^{e}
Imprinter Machine ، Furrow Irrigation ،Rotivator	6.7^{c}	62.5^{d}
Diker Machine ،Tape Irrigation ،Rotivator	6.7^{c}	62.9^{d}
Imprinter Machine ، Tape Irrigation ،Rotivator	6.5^{d}	65.8^{c}
Diker Machine ،Furrow Irrigation ،Cyclotiller	7.3^{b}	87.9^{a}
Imprinter Machine ،Furrow Irrigation ،Cyclotiller	7.6^{a}	66.3^{c}
Diker Machine ،Tape Irrigation ،Cyclotiller	7.8^{a}	83.4^{a}
Imprinter Machine ،Tape Irrigation ،Cyclotiller	7.4^{b}	77.93^{b}
Conventional Cultivation	6^{e}	60.1^{e}
LSD	0.07	14.3^{7}

● *Different letters indicate a significant difference at the 1% level*

According to Table -1, effect of type of tillage, type of soil, type of irrigation and soil shaping machines have been significant at 1% on coefficient of emergence. According to Table-2, coefficient of emergence velocity of tillage with Cyclotiller machine is increased in compare to conventional cultivation (Plow tillage and two times disk). Thus, existences of softer soil and two times disk have been effective on velocity of emergence. Also emergence has been started at least two days earlier that is shown its advantages in compare to the other tillage treatments.

RESULTS AND DISCUSSION

One method for controlling runoff on the farm is increasing opportunities for soil water penetration.

A good way for doing this purpose is tillage and blocked furrow irrigation which is done by imprinter.

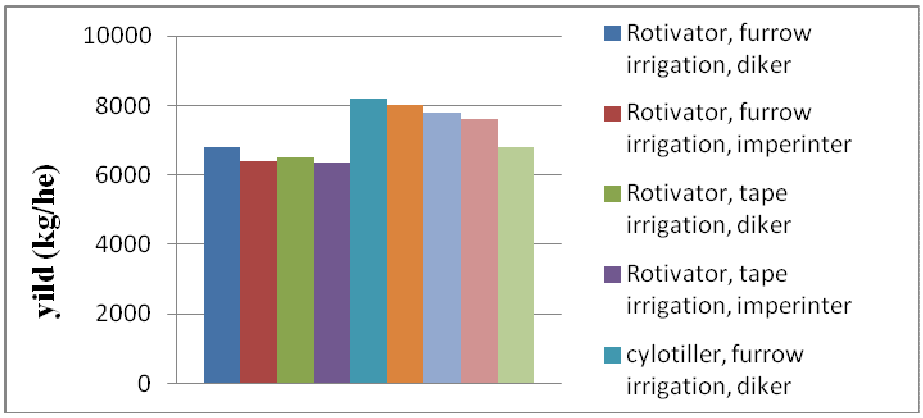

Diagram 1- Interaction among tillage machine, soil shaping machine and type of irrigation

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