Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2023, 10(12):27-33**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

The Effect of Different Irrigation Systems for Reduced Tillage on Characteristics of Sunflower

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Abstract This research will examine the potential yield impact of utilizing drip irrigation systems on sloped fields as a means of exploring an alternate irrigation strategy. Experiments in the field were first conducted in 2022 at the village of Cene, Hayrabolu District, Tekirdag Province. Two irrigation systems were used in the research and ane is drip irrigation (flat drip pipes) and the other is a sprinkler system (Automatic drum irrıgation machine). In the research, percentage of emerged seedlings, stem diameter and plant height were determined. The sprinkler irrigation system had the highest occurrence rate at 89.05%, followed by the drip irrigation system at 88.05%. The drip irrigation system ranked second in terms of germination rate compared to the traditional method, due to the seeds absorbing moisture. No-tillage and low tillage had higher water content and higher emergence rates. Statistically significant differences were found between the approaches with respect to plant height, stem diameter, head diameter, and productivity.

Keywords Sunflower, İrrigation, Cover crops, No till, Minimum tillage

1. Introduction

Throughout the entire agricultural production process chain, tillage is the step that consumes the most energy. However, the current energy shortage has prompted researchers to look for strategies to maximize efficiency across all industries, including agriculture. It is evident that the implementation of the methods that produce energy savings will make a major contribution to the economy, given the size of the fields farmed with plows, the size of the tractor park, and the methods of tillage now in use in our nation. The most efficient and cost-effective methods of tillage and planting are selected for this purpose. Biotechnology, improved seed stock, improved irrigation and fertilization methods, enhanced harvesting machinery, and other mechanized processes all contribute to higher output. These additions will allow for a greater yield per unit area. Buying many products from the same place in areas where ecological circumstances are favorable is another option for raising production. Obtaining more than one harvest each year, or "second crop farming," is contingent on a number of factors, the first and foremost being the existence of favorable ecological circumstances. On fertile soils, a second crop can be harvested if proper conditions are maintained throughout the growing season [1]. The rise in plant products is crucial, not just for human nutrition but also for animal nutrition. A rise in plant products offers hope for addressing the crucial issue of feed demand in the context of animal rearing. Growing a second crop not only helps with the quality feed problem in animal nutrition, but it also guarantees an increase in the product needed for human nutrition. Beginning in early July and continuing until early November, the summer growing season for the Thrace Region's second crop, after wheat, takes place on irrigated agricultural grounds.

Cover crops have a wide range of potential benefits for soil health and subsequent crops, and they also aid in the preservation of cleaner surface and groundwater. They lessen the likelihood of soil erosion, boost the quality of the soil's physical and biological components, ensure the availability of water and nutrients for the next planting, suppress weeds, and interrupt pest life cycles. Some cover crops have the ability to pierce through compacted soil layers, allowing the roots of the subsequent crop to spread out more freely. What you get out of a cover crop depends on the type of plant you use, how well it performs, and how long you let it mature before planting your next crop [2].

Corn silage growing in irrigable places has become inevitable as a second product in the summer with the rise of animal husbandry. Due to its shorter growth time compared to grain maize, silage maize is increasingly being utilized by farmers in areas where wheat harvests are completed by the end of June. It is clear that there are significant issues with the uniform distribution of water by rain systems on sloping lands when looking at the overall structure of the lands in the Thrace Region. This research will examine the potential yield impact of utilizing drip irrigation systems on sloped fields as a means of exploring an alternate irrigation strategy.

2. Materials and method

2.1. Materials

Experiments in the field were first conducted in 2022 at an elevation of 60 metres in the village of Cene, Hayrabolu District, Tekirdag Province (41°18'N latitude, 27°20'E longitude) and a satellite Tekirdag has a Mediterranean climate, with moderate, rainy winters and hot, dry summers near the shore, but a continental climate inland. The average annual temperature, relative humidity, and annual precipitation for the 64-year period (1939–2022) are 13.88 degrees Celsius, 75%, and 580.8 mm, respectively. Temperature, relative humidity, and precipitation figures for the months of July through September, 2022.

The soil consists of 35,22% clay, 34,03% silt, and 30,75% sand. The soil in the testing field was clay-loam. The soil was well-drained, and it could hold about 0.18 m of water within 1.20 m of the soil profile [3]. The tests showed that the soil in the trial area has a clay-loam structure.

2.1.1. Drip irrigation

Extruded from low-density polyethylene, flat drip pipes are used in pressurised irrigation systems, with drippers spaced out inside the pipe according to the type of crop being watered. Since it is intended for use at greater distances, the flat drip irrigation pipe has a thinner wall than its round counterpart; its drippers are also flatter; and the space between drippers ıt varies.

2.1.2. Sprinkler irrigation (Automatic drum irrıgation machine)

Drum irrigation machine produced by İrtem Tarım Makinaları Sanayi was used in the research. The outer diameter of the hard PE pipes on the machine is 110 mm and the pipe lengths are 400 m, and a single sprinkler irrigation head is used on the drum irrigation machine. Drum irrigation machine consists of mechanical groups that regulate working in combination. These mechanical groups consist of the cylindrical reel on which the plastic pipes are wound, the water turbine, the transmission group, the gear group that provides self-winding with the force of water during irrigation, and the chain gear system that ensures that the plastic pipes are wound properly without overlapping each other while being wound on the cylindrical reel. A single sprinkler head is placed at the end of the system.

2.1.3. Sowing and tillage systems

The purpose of this study was to examine the effectiveness of drip irrigation and sprinkler irrigation in reducing soil cultivation for a second crop of sunflowers following the oat harvest. Pneumatic sowing machine was used for sowing on May 20, 2022, and pneumatic sowing machine has a six rows and spaced rows at 70 cm and inter row 25 cm apart for the experiment. Weed spraying was done before and after planting in all plots at the same time and all trial plots were harvested on the same day

2.2. Methods

2.2.1. Percentage of emerged seedlings

Number of emerged seedlings were measured in the rows and percentage of emerged seedlings (PE) were calculated using formula (Bilbro and Wanjura, 1982):

$$PE = \frac{\textbf{Total emerged seedling per meter}}{\textit{Number of seeds planted per meter}} x100$$

2.2.2. Measurements of characteristics of plant

Plant height: In a study conducted by [5], a total of sixty plants located in the central region of the research plots were harvested when they reached maturity. The measurement was taken from the base of the sunflower head to the bottom of the plant, and the height of each plant was recorded.

Stem diameter: The measurement of stem diameter in these harvested plants was conducted by employing a calliper to measure the diameter of one-third of the ground, as described by [5].

Head diameter: The measurement of the sunflower head was conducted by [5] using two axes, and the resulting values were averaged.

2.2.3. İrrgation system design

Water was stored in the stream by cutting off the water, and a motor pump was installed on the edge of the trial plots to pump the water into the system. The control unit has been added to the system to clean the water after the motor pump. The water coming out of the control unit was transmitted to the 110 diameter main pipeline for the drip irrigation system and the sprinkler system. Water was delivered from the main pipeline to the 22 diameter drip irrigation pipelines. For the sprinkler system, water was supplied to the automatic irrigation system machine with pipelines with a diameter of 110.

Drip irrigation: Flat pipe with an hourly capacity of 1,6 L/h is utilised; the main pipe has a 110 mm diameter and is resistant to 10 ATU; the drip pipes have a 22 mm diameter; the dripper spacing is 30 cm; and the drippers are spaced 30 centimetres apart.

Sprinkler irrigation: Automatic drum irrıgation machine produced by İrtem Tarım Makinaları Sanayi was used in the research. The outer diameter of the hard PE pipes on the machine is 110 mm and the pipe lengths are 400 m, and a single sprinkler irrigation head is used on the drum irrigation machine.

3. Results and Discussion

3.1. Percentage of Emerged Seedlings

We used an analysis of variance to find out which irrigation systems worked best for field sprout emergence in second-crop sunflower farming at a 1% significance level (Table 1). The sprinkler irrigation system has the highest emergence percentage with 89.05%, and the drip irrigation system is ranked second with 88.05% (Figure 1). In the Dunkun test, the drip irrigation system was in group AB, the sprinkler method was in group A, and the traditional method was in group C (Table 2). Irrigation with a sprinkler system and drip irrigation system has a higher emergence rate compared to the traditional method due to the moisture absorption of the seed. Similar results are found in [6; 7; 8; 9; 10], also pointed out that no tillage and reduced tillage had higher water content and obtained higher emergence rates.

Table 1: Variance analysis table of emergence

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	19.03	2	9.513	16.54	0.07*
Within Groups	14.11	6	2.351		
Total	33.13	8			

Significant at P<0.05

Table 2. Statistical data

Method	Average Emergence (%)
Drip Irrigation	88.56±1.17 **AB**
Sprinkler Irrigation	89.05±1.71 **A**
Conventional	85.75±1.66 **C**

Tests were done by Duncan

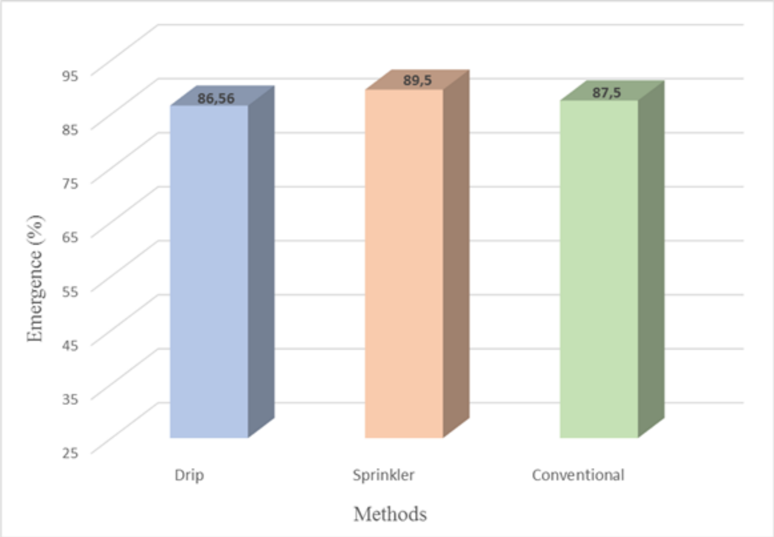

Figure 1: Values of percentage emergence seedlings as affected irrigation treatment

3.2. Plant height

Statistically significant variations were found between the approaches with respect to plant height when the study's data were analysed. See Table 3. According to Table 4 and Figure 2, the rainwater irrigation system achieves the highest plant height while the dropless irrigation method achieves the lowest.

Table 3: Variance analysis table of plant height

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between groups	4198.70	2	2099.35	40.32	0.000**
Within groups	10466.55	207	52.07		
Total	24453.28	209			

Significant at P<0.01

Table 4. Statistical data

Method	Average Length (cm)
Drip Irrigation	163.6±10.3 **c**
Sprinkler Irrigation	173.2±8.2 **a**
Conventional	167.5±12.8 **b**

Tests were done by Duncan

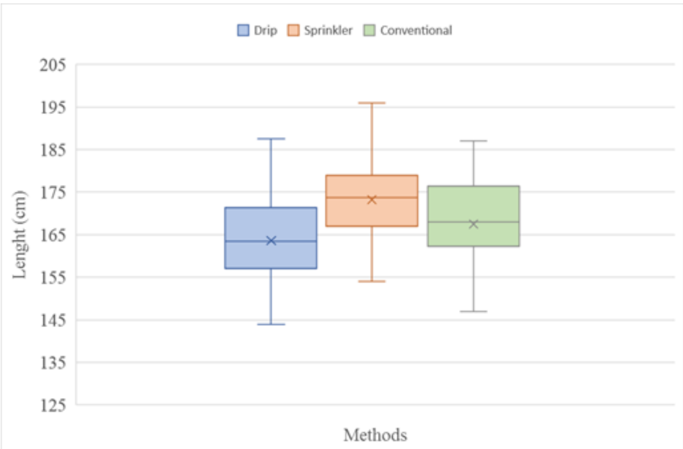

Figure 2: Values of plant height as affected irrigation treatment

3.3. Stem diameter

The statistically significant difference in stem diameter between the two approaches was found in the experimental data (Table 5). Table 6 and Figure 3 show that the steam diameter is greatest for drip irrigation at 22.73 mm and smallest for spray irrigation at 20,88 mm.

Table 5: Variance analysis table of stem diameters

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between groups	160.41	2	80.20	4.802	0.009**
Within groups	3356.97	201	16.7		
Total	3973.53	209			

Significant at P<0.01

Table 6: Statistical data

Method	Average Diameter (mm)
Drip Irrigation	22.73±5.2 **b**
Sprinkler Irrigation	20.88±3.8 **ab**
Conventional	22.27±2.0 **a**

Tests were done by Duncan

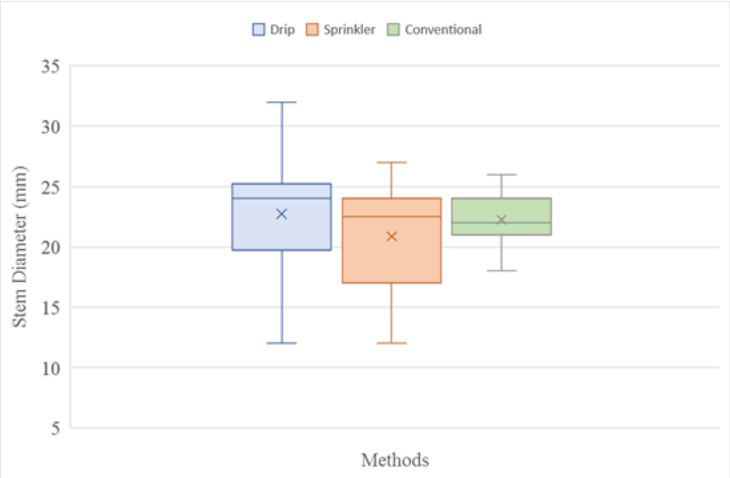

Figure 3. Values of stem diameter as affected irrigation treatment

3.4. Head diameter

A statistically significant difference was seen between treatments based on head diameter, as indicated in Table 7. The sprinkler irrigation treatment had the smallest head diameter, measuring 13.1 mm, while the conventional approach had the largest head diameter, measuring 18.9 mm (Tables 8 and Figure 4).

Table 7: Variance analysis table of head diameters

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between groups	772.64	2	386.32	80.88	0.000**
Within groups	960.07	201	4.78		
Total	1993.92	209			

Significant at P<0.01

Table 8: Statistical data

Method	Average Length (cm)
Drip Irrigation	14.9±2.7 **b**
Sprinkler Irrigation	13.1±2.1 **c**
Conventional	18.9±2.4 **a**

Tests were done by Duncan

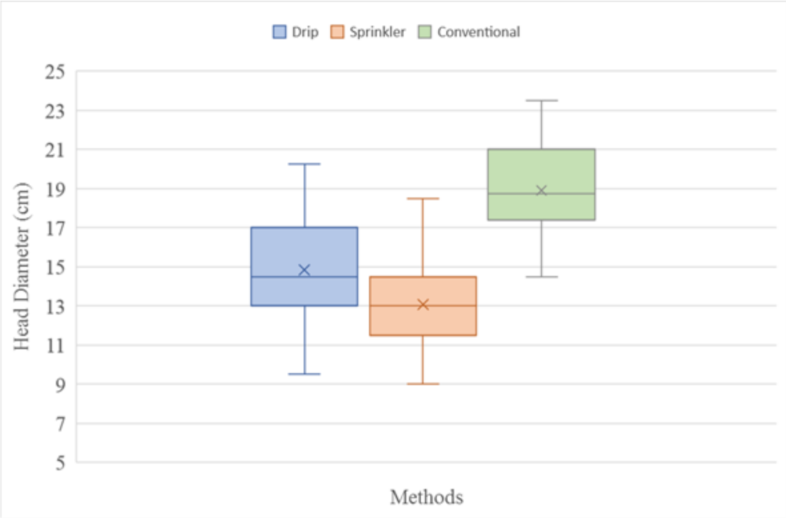

Figure 4: Values of head diameter as affected irrigation treatment

4. Conclusion

This study investigated the effectiveness of drip irrigation and sprinkler irrigation in reducing soil cultivation for a second crop of sunflowers after oat harvest. The research used various tools to plant seeds, including Pioner sunflower seeds. The study used a motor pump to pump water into the system, and a control unit to clean it. The optimal drip and sprinkler systems were identified through statistical analysis and experimental design. The results were compared using ANOVA and Duncan's Multiple Range Test. We also studied and analyzed the effectiveness of different irrigation systems for field bud emergence in second-crop sunflower cultivation. The sprinkler irrigation system had the highest occurrence rate at 89.05%, followed by the drip irrigation system at 88.05%. The drip irrigation system ranked second in terms of germination rate compared to the traditional method, due to the seeds absorbing moisture. No-tillage and low tillage had higher water content and higher emergence rates. Statistically significant differences were found between the approaches with respect to plant height, stem diameter, head diameter, and productivity. The rainwater irrigation system achieved the highest plant height, while the drip irrigation system achieved the lowest. The sprinkler irrigation treatment had the smallest head diameter, while the conventional approach had the largest diameter.

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