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***Journal of Scientific and Engineering Research*, 2024, 11(12):10-16**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Different Irrigation Methods in Reduced Tillage Systems on Yield of Sunflower

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Abstract: 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 study focuses at the complex links between irrigation practices and crop results in order to improve farming sustainability. The approaches include a full field experiment combining a variety of irrigation technologies such as drip irrigation and sprinkler systems. This study looked into the effectiveness of drip irrigation and sprinkler irrigation in decreasing soil cultivation for a second crop of sunflowers after oat harvest. Statistical analysis and experimental design were used to determine the best drip and sprinkler systems. The ANOVA and Duncan's Multiple Range Test were used to compare the results. Average sunflower production between techniques was significant, with sprinkler irrigation producing maximum production (347.77 Kg da^{-1}), drip irrigation producing average production (346.90 Kg da^{-1}), and without irrigation producing the lowest (291.63 Kg da^{-1}).

Keywords: Yield, Tillage, Sunflower, İrrigation, Germination

1. Introduction

The projected global population in 2050 ranges from 9.5 to 10.0 billion. It will be necessary to boost plant production by 60–70% by the end of the century in order to keep up with the demand for food from the world's expanding population. It will be opened to agriculture in our country just as it has been around the world. Despite the fact that some regions have become virtually barren, agricultural output is actually declining. Therefore, in order to maximize output in already-cultivated regions, intensive agricultural activities are carried out. Most of our country's farms use a single-crop application system. Agriculture relies on chemical fertilizer and chemical pesticides, as well as on excessive and unneeded irrigation, tillage, and stubble burning. Soil quality declines as a result of these practices of intensive agriculture; also, excessive chemical inputs further contribute to this trend. Consequently, biodiversity declines as soil and environment become increasingly contaminated. Since agricultural activities are not profitable, they are not sustainable. As energy inputs rise, food quality falls. In order to lessen the detrimental consequences of these agricultural operations in our country, we need to implement modern agricultural management that makes the most of ecosystem functions. Systems can't help but exist. What is it in the globe that people are interested in right now that has not been researched in our country? Reduced, improving the efficiency of ecosystems that have recently started using direct sowing or a new crop rotation management technique. Important agro-ecosystem services will be developed with the help of cover crops in the 21st century. It's a method commonly referred to as "3C." (Crop rotation, Cover crop and Conservation tillage) [1]. In addition, it is claimed that gases that are the source of 14% greenhouse gases and

are emitted into the environment owing to inefficient agricultural soil management form the basis of so-called crop rotation, cover crops, and protective tillage. as documented in a study [2].

This research contrasted conventional soil tillage and planting practices in the Thrace Region with a reduced tillage technique, with the latter being used for the second crop of sunflower. Since global warming has led to an increase in drought, it is necessary to find irrigation technology that reduces the amount of water plants require throughout the growth season. The conventional sprinkler system will be compared to a drip irrigation system in terms of its impact on crop productivity. The study's objective is to discover how effective a drip irrigation system may be at minimizing water use by plants during the growth season.

2. Materials and Method

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.

Sunflower

Pioner sunflower seeds (P64LP130, Rm 45 Middle earl) were used. Hybrid with excellent grain and oil yields that matures around the middle of the harvest window, developed using Clearfield Plus technology. The hybrid matures at a medium age and produces a lot of grain and oil. There is 46% oil in the grain. It holds up well in dry conditions.

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 varies. 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 (Figure 1).

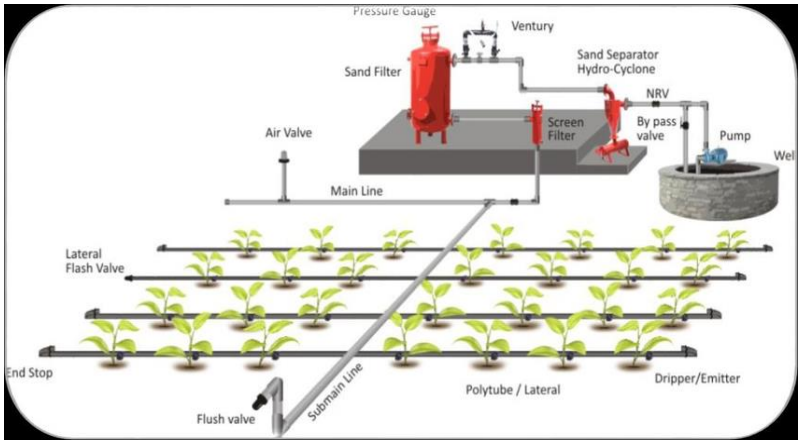

Figure 1: General view of the drip irrigation systems

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 (Figure 2).

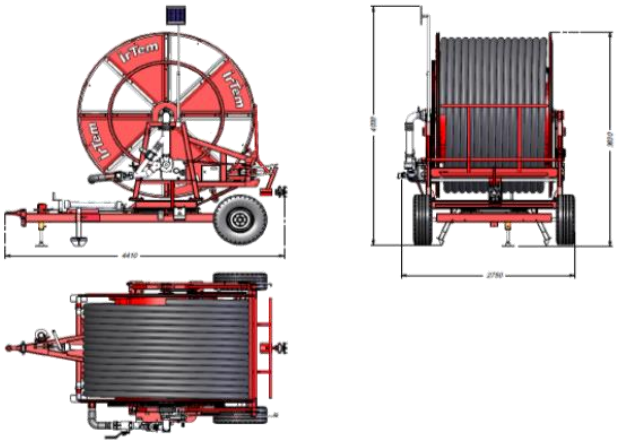

Figure 2: General view and dimensioning of the drum irrigation machine

Sowing and tillage machine

Subsoiller: This subsoiler can be equipped with 7 tines. The tines have a thickness of 30 mm and a height of 76 cm, qualities that allow pinocchio to work in any condition. Pinocchio puts a two-spike roller on his back. This roller makes sure that the soil that was just dug up is broken up into a fine tilth and that crop waste in the top 15-20 cm of soil is mixed in. If the dirt is loose, it can be ready to plant in just one pass.

Power harrows: The Drago DC is a power harrow made for small and medium-sized farms. Its heavy-duty build, relatively light weight, wide range of accessories, and ability to be used with Gaspardo seed drills make it the perfect piece of equipment for tractors with mid-range power. Drago DC lets you change the speed of the rotor by changing the gear pair inside the gearbox, making it easy to fine-tune to your needs.

Penumatic sowing machine: Pneumatic sowing machine has six rows and spaced rows at 700 mm and inter row 250 mm apart for the experiment. It is a pneumatic planting machine that can be connected to the machine with a three-point attachment. It is a planting machine that can plant seeds such as sunflower, corn, melon, watermelon, pumpkin, soybean, peanut, beet, cotton, cucumber, sesame, tomato, onion, carrot and pea.

Methods

Percentage of emerged seedlings

Number of emerged seedlings were measured in the rows and percentage of emerged seedlings (PE) were calculated using formula [4].

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

Yield

According to [5], there is a common assumption that yields obtained from the central area of a plot are more representative of real-world outcomes compared to yields obtained from the border area. Consequently, measurements of plant height, stem diameter, head diameter, and yield values were solely conducted inside the central area of the plot, which encompassed around 28 square meters.

Irrigation 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 centimeters apart.

Sprinkler irrigation: Automatic 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.

Statistical analysis and experimental design

The optimal drip and sprinkler systems for the subsequent cultivation of sunflowers were identified through a comprehensive evaluation. In this experiment, a randomised complete block design (RCBD) consisting of three blocks was employed. Each treatment block consisted of three plots, with each plot being replicated three times (Figure 3). The researchers conducted one-way analyses of variance (ANOVA) using SPSS software (Version 12:00; Chicago, IL, USA). The researchers utilised Duncan's Multiple Range Test with a significance level of $p<0.05$ to conduct a comparison of the means of the acquired results in this study [6].

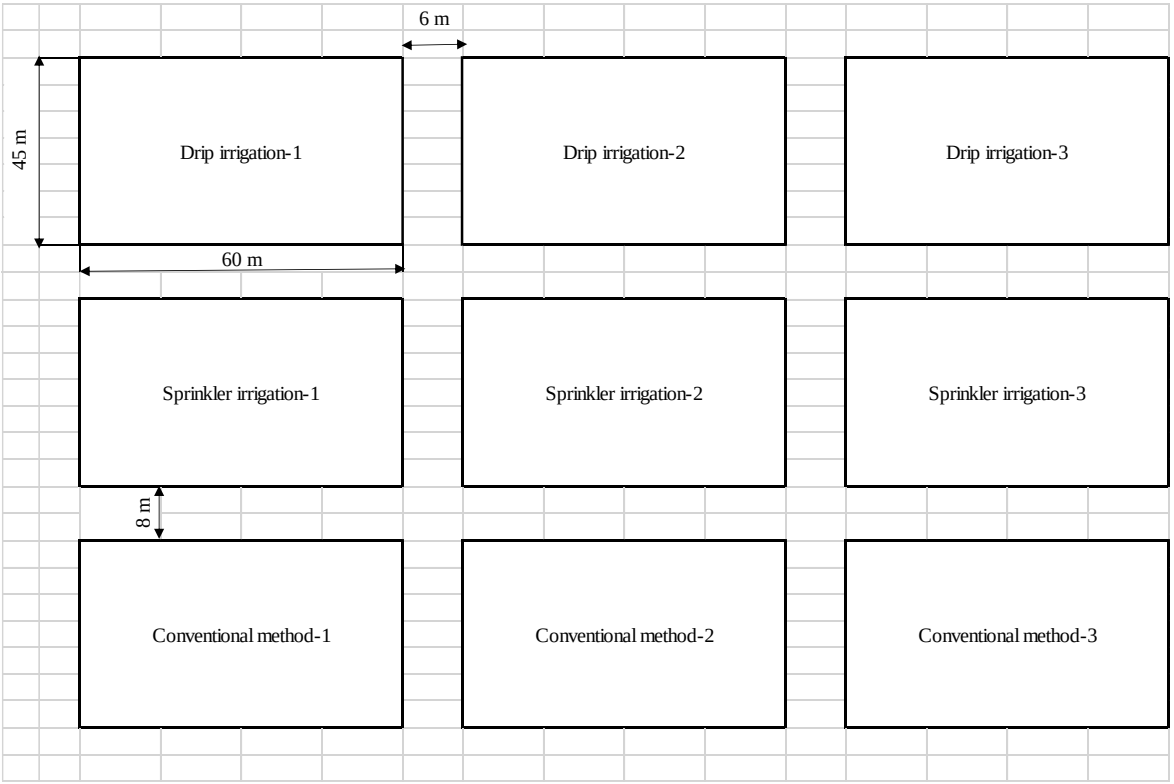

Figure 3: Experimental design

3. Results and Discussion

Percentage of emerged seedlings

Statistically significant variations were found between the approaches with respect to percentage of seedling when the study's data were analysed (Table 1). The lowest percentage of emerged seedlings was found in conventional methods with 85,75% and the highest percentage of emerged seedlings was found in sprinkler Irrigation with 89,05% (Table 2, Figure 4). 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 [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

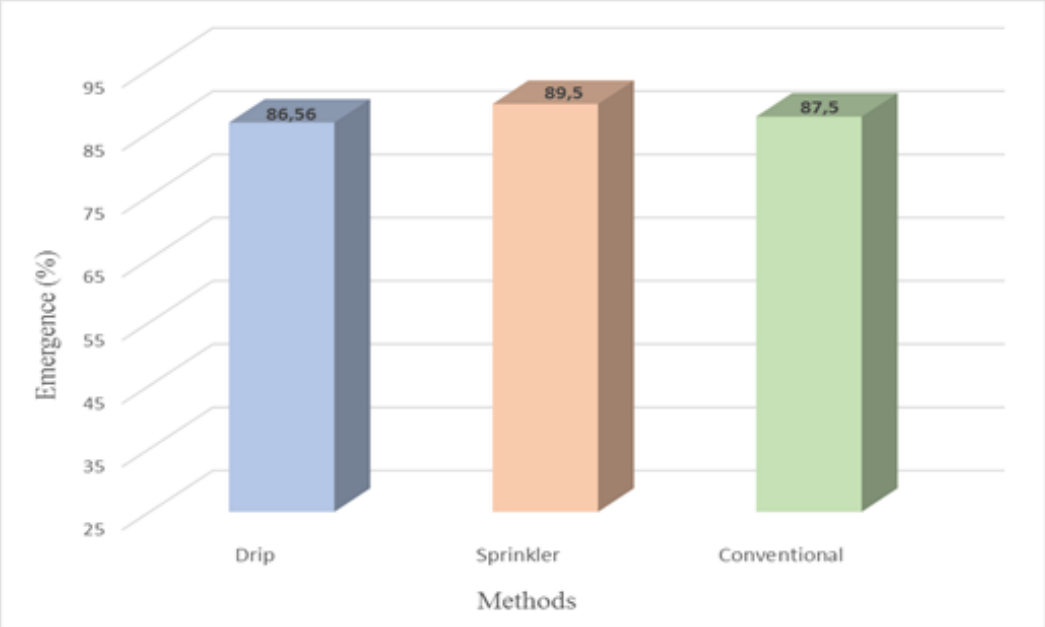

Figure 4: Values of percentage emergence seedlings as affected irrigation treatment

Plant yield

The variations in average sunflower yield between techniques were found to be substantial (Table 3). Sprinkler irrigation produced the maximum production (347,77 Kg da-1), while drip irrigation produced the lowest yield (291,63 Kg da-1) (Table 4 and Figure 5). Salbas & Erdem (2020) discovered that sunflower output rose when five different irrigation fluids were used. The proportion of emergence had a significant effect on green bean yield, according to the findings. [11; 12; 10; 13; 14; 15] discovered similar results.

Table 3: Variance analysis table of head diameters

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6205,74	2	3102,87	53,83	0.000*
Within Groups	345,86	6	57,64		
Total	6551,60	8			

** Significant at P<0,01

Table 4: Statistical data

Method	Average Yield (Kg da $^{-1}$)
Drip Irrigation	346,90±8,3 a
Sprinkler Irrigation	347,77±8,8 a
Conventional	291,63±5,2 b

Tests were done by Duncan

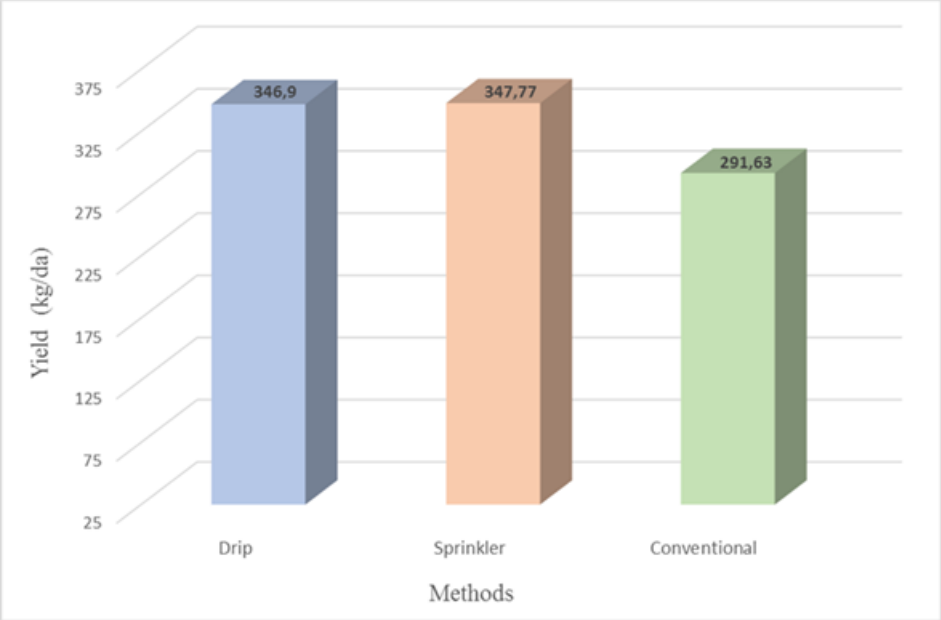

Figure 5: Values of yield as affected irrigation treatment

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 results were compared using ANOVA and Duncan's Multiple Range Test. 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 yiled. Average sunflower production between techniques was significant, with sprinkler irrigation producing maximum production (347.77 Kg da-1), drip irrigation producing average production (346.90 Kg da-1), and without irrigation (conventional) producing the lowest (291.63 Kg da-1). The emergence rate had a significant effect on sunflower yield.

References

[1]. Vinayak, S., Islam, R., 2017. Healthy soil, healthy environment building Ohio`s soil health. Ohio Farm Science Review, September 19-21, 2017. The Ohio State University. College of Food, Agricultural, and Environmental Sciences.

[2]. Yücel, C., G. Kamçi, D. Yücel, Y. Bayhan, 2021. Cover Plants in Direct Sowing System Using(Turkish). Doğal Kaynaklarimizin Geleceği: Sürdürülebilirlik Ve İnovasyon. Editör: EM. Oant. Iksadyayinevi, Ankara-Turkey, SBN: 978-625-7636-68-1, Page:36-50.

[3]. Klute, A., R. C. Dinauer, A. L. Page, R. H Miller and D. R. Keeney (eds.), 1986. Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods. American Society of Agronomy, Madison, Agronomy Monograph, 9, 1182 pp.

[4]. Bilbro, J.D. and D.F. Wanjura, 1982. Soil Crusts and cotton emergence relationships. ASAE, 25 (6):1484-1489.

[5]. Peterson, R., (1992). Statistics and experimental design working manual. Technical Manual No:11, International center For Agricultural research in the Dry Areas, 16-17, Icarda, Aleppo, Syria.

[6]. Düzgüneş, O., T. Kesici, ve F. Gürbüz, 1987. İstatistik Metodları-1. Yayın No:861, Ders Kitabı:229, Ankara Üniversitesi, Ziraat Fakültesi, Ankara.

[7]. Yalçın H., E. Çakır. 2006. Tillage effects and energy efficiencies of subsoiling and direct seeding in light soil on yield of second crop corn for silage in Western Turkey. Article in press, Soil & Tillage Research.

[8]. Siemens, M. C., D. E. Wilkins, 2006. Effect of residue management methods on no-till drill performance. Applied Engineering in Agriculture, 22 (1): 51-60.
[9]. Canakçı, M., D. Karayel, M. Topkacı, A. Koç, 2009. Performance of a no-till seeder under dry and soil conditions. Appl. Eng. Agric. 25 (4): 459–465.
[10]. Gemtos, T. A., Cavalaris, C., Demis, V. I., Pateras D., Tsidari, C., 2002. Effect of Changing Tillage Practices After Four Years of Continuous Reduced Tillage. ASAE Annual International Meeting/CIGR XVth World Congress, Chicago, Illinois, USA, Paper number 021135. pp. 1–11.
[11]. Yalcin, H. 1998. A Study on Investigation of The Suitable Tillage Methods in Second Crop Maize for Silage. PhD Thesis, University of Ege, Institute of Natural and Applied Science, Izmir, Turkey.
[12]. Prior, S. A., Reicosky, D. C., Reevesa, D. W., Runionc, G. B., & Raper, R. L. (2000). Residue and Tillage Effects on Planting Implement Induced Short-Term CO2 and Water Loss from a Loamy Sand Soil in Alabama. Soil and Tillage Research, 54, 197-199.
[13]. Çakır, E., Yalçın, H., Aykas, E., Gülsoylu, E., Okur, B., Delibacak, S., & Ongun A.R. (2006). Korucu toprak işleme ve doğrudan ekimin ikinci ürün mısır verimine etkileri. Tarımsal Mekanizasyon 23. Ulusal Kongresi Bildiri Kitabı 06-08 Eylül 2006 Çanakkale.
[14]. Bordovsky, I., W. Lyle, J. Keeling, 1994. Crop rotation and tillage effects on soil water and cotton yield. Agron. J. 86, 1–6.
[15]. Borin, M., L. Sartori, 1995. Barley, soybean and maize productionusing ridge tillage, no-tillage and conventional tillage in NorthEast Italy. J. Agric. Eng. Res. 62, 229–236.