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IMPACT OF TILLAGE SYSTEMS ON SOIL CHARACTERISTICS AND PRODUCTIVITY OF SUNFLOWER UNDER THE CONDITION OF AL-HASA IN SAUDI ARABIA

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ABSTRACT

The present study aimed to compare the influence of four different tillage systems on soil characteristics, root system, vegetative growth and seed yield of sunflower. A field experiment was carried out on a clay soil during two consecutive seasons (1999 and 2000) at the Farm of the Agricultural and Water Research Center, Al-Hasa, Saudi Arabia. The suggested land preparation and tillage systems were disc plowing followed by spike tooth harrowing (DPTH), moldboard plowing followed by spike tooth harrowing (MPTH), disc plowing followed by disc harrowing (DPDH), chisel plowing followed by disc harrowing (CPDH) and no tillage (CONT). The result indicated that there were significant differences between the evaluated systems in soil density at 10 and 20 cm soil depth. DPDH system was superior in producing the lowest values of soil density at both depths and the less soil penetration resistance through the layer of the plowing. All tillage systems increased the initial and basic infiltration rates, compared to the non tillage. Chisel plowing gave the highest initial and basic infiltration rate, while DPDH system gave slightly lower values, compared to chisel plowing but higher than the others. The tillage systems were found to have a significant effect on the root characteristics and plant vegetative growth. Better root length, root distribution area, fresh and dry weight of the root were achieved by DPDH system. There was no significant difference between MPTH and DPTH systems on the root system, except root fresh weight. However, there was a significant difference between DPTH treatment and the others on the root characteristics, except root length. Also, DPDH system resulted in the highest values of the vegetative growth, providing an increase of 28%, 55%, 51% and 70% in plant height, number of leaves per plant, plant fresh weight and average leaf area per plant, respectively compared with the CONT. No significant differences were existed neither between MPTH and DPTH nor between DPTH and CPDH on the four vegetative parameters. Seed yield and its components of sunflower exposed a significant effect between the various tillage systems. The greatest effect was observed by DPDH system which produced the best seed disc components, giving an increase of 31% in the seed disc diameter and an 36% in the seed yield. It is possibly to suggest that using the system of disc plowing followed by disc harrowing could be the useful land preparation for enhancing the yield of sunflower under the condition of the area of study.

INTRODUCTION

Tillage is described as the practice of modifying the state of the soil in order to provide conditions favorable to cop growth. It represents the most costly single item in the budget of arable farmer. It is apart of the business of farming which remains entirely an art (Culpin, 1981). Several experiments have been conducted at different parts of the world during the last decade to

compare the effect of various tillage systems on crop yield. Different tillage operations have different effects on the plant growth and yield and this may be attributed to soil changes in the physical and engineering properties brought about by tillage operations. It has been found that soil tillage has a major influence on water intake, storage, evaporation of water from the soil by plant root and microbial activity which influences soil aeration, moisture and temperature. These factors in turn contribute to the quantity and the quality of the crop grown.

Sunflower (*Helianthus annus* L.) is one of the most important oil crop in the world due to its strategic nature. It requires good soil cultivation and adoption of soil before sowing in order to produce the desired amount and quality of yield. Soil can be treated and manipulated by using appropriate agricultural implements to provide a suitable environment for seedling and plant growth. The favorable method of soil tillage may be assessed in several ways in which different soil properties, plant development and crop yield are measured. Previous investigations showed that different applications of tillage systems affected positively soil properties, plant growth characteristics, yield and yield components of plants.

Infiltration rate and soil density influence by tillage treatments (Radcliffe *et al*. 1988; FAO, 1990; Hill and Meza-Montalvo, 1990 and Lowery and Stoltenberg, 1998). Abu-Hamdeh and Al-Widyan (2000) examined the effect of tillage treatment, tire inflation pressure and vehicle axle load on soil physical properties and crop yield. They showed that infiltration rate was strongly affected by tillage treatments from 0 to 20 cm. Dry bulk density and air porosity were affected from 0 to 20 cm tillage treatments and from 20 to 40 cm by tire inflation pressure and axle load.

Al-Hashem *et al*. (2001) evaluated four tillage systems on some soil physical properties and faba been yield. Treatments were disc plowing followed by disc harrowing; disc plowing followed by cross strips of disc plowing; disc plowing followed by kamara and chisel plowing followed by disc harrowing. They concluded that all tillage treatments increased the initial infiltration rate. Chisel plowing and disc plowing followed by kamara harrowing gave an increase in the basic infiltration rate. They also added that there was a significant difference in the values of soil density at 20cm soil layer. Chisel plowing resulted in the highest soil density at this depth as compared to disc plowing.

Soil strength is one of the mechanical soil properties which can be reduced by tillage operation due to soil loosening and breaking up the compacted soil layers. Kruger (1996) studied four tillage systems on sunflower (no till, shallow tillage, chisel plowing and moldboard plowing). He found that tillage treatments did not affect the bulk density of soils, however, cone resistance profiles had greater values for no tillage in the 0-7.5cm layer and for surface tillage vs. moldboard plowing in 12.5cm layer. El-Banna, (1990) compared the effect of different tillage systems on clay soil and found that the moldboard plow resulted in the lowest cone index value down to the depth of plowing. However, readings for the chisel plow were higher and the highest penetration resistance values were recorded from the no tillage

treatment. Siemens (1989) obtained similar results for various tillage systems applied on corn and soybean in USA.

Bonciarelli *et al.* (1991) found that sunflower seed yields ranged from 2.36 t/ha when using localized minimum tillage to 2.84 t/ha when using disking plus plowing. Also, they found that seed yields were 2.87 t/ha with plowing at 50cm depth treatment, 2.95 t/ha with disking plus plowing, and 3.14 t/ha with harrowing at 25cm depth treatment. Aleixo *et al.* (1993) examined the effect of three tillage systems on crop productivity of sunflower and soil physical properties. The three soil treatments involved working the 0.05m and 0.15m topsoil layer with an offset disc harrow, and working the 0.25m topsoil layer with a moldboard plow. It was found that the 0.25m topsoil moldboard plowing treatments led to higher yields. The 0.05m and 0.15m treatments induced higher topsoil layer compaction than the plowing treatment.

Angelini *et al.* (1995) grew sunflower under minimum (10-15cm deep disk harrowing) or conventional (plowing to a depth of 50cm) tillage. They found that aboveground biomass, leaf area index and net photosynthesis were lower with minimum tillage than the conventional tillage.

The influence of tillage, weed control methods and fertilizer on sunflower productivity and soil properties was studied by Gomaa and Al-Naggar (1995). They found that moldboard plowing operating at depth of 30cm and chisel plowing operating at depth of 20cm reduced soil density and salinity and increased soil porosity. The highest seed yield/ha of sunflower was obtained with moldboard plowing, application of 3.6 kg Topogard/ha and P application. Pratibha *et al.* (1995) applied different methods of land preparation for sunflower production. Sunflower were given zero tillage, plowed twice (a country plow or moldboard plow) plus disc harrow, plowed once (with moldboard plow) plus disc harrow, plowed twice with rotary cultivator or plowed with moldboard plow once followed by cultivator twice. Yield was 22.6% higher in treatment of moldboard plowing once followed by cultivator twice than with zero tillage. The yield attributes were significantly superior in the treatment of moldboard plowing once followed by disc harrowing and in treatment of moldboard plowing once followed by cultivator twice compared with all other tillage treatments. Field studies were carried out by Gajri *et al*. (1997) for three years on deep loamy sand and sandy soils to show the interaction effects of three irrigation regimes on sunflower yield in relation to tillage and mulching. They found that the both deep tillage and mulching significantly increased crop yield of sunflower. Deep tillage and/or mulching helped the crop in efficient utilization of water by increasing leaf area index and the depth and density of rooting.

A study was conducted by Moreno *et al*. (1997) to determine the effect of traditional (TT) and conservation (CT) tillage on soil physical properties, water depletion and crop development and yield on a sandy clay loam soil. They reported that soil density in the 20 cm layer was significantly higher (10-24%) in the CT than in the TT treatments, mainly after tillage operations. The resistance to penetration at any time was higher in the CT than in the TT treatment. Infiltration rates were 35% higher in the TT than in the CT treatments. They reported also that plant height, leaf area index and root

length density of the first sunflower crop were significantly higher in the TT than in the CT treatment. The seed yield was slightly higher in the CT than in the TT.

Al-Hasa Oasis is one of the agricultural regions in Saudi Arabia, where their farmers accustomed to perform mechanization in some farm operations. AL-Hashem (2001) conducted a field study to estimate the agricultural mechanization in this region. He found that most common tillage practiced in the oasis consists of disc plowing flowed by spike tooth harrowing plus leveling. However, sometimes farmers practice different cultivation processes without assessment being done. Therefore, the objective of this work is aimed to investigate the most suitable mechanical tillage system and the best adaptation of soil cultivation for the improvement of some soil properties and productivity of sunflower crop under the condition of AL-Hasa Oasis.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive seasons of 1999 and 2000 at the Farm of the Agricultural Research and Water Center, Al-Hasa, Saudi Arabia. The experiments were done in an open field characterized by its clay soil texture (23% sand, 30% silt and 47% clay), low salinity ($EC_{1:2:5}$=1.6dsm^{-1}), slightly alkaline ($pH_{1:2:5}$=7.8) and relatively low $CaCo_3$ content 7%. The soil also contained low total nitrogen and available phosphorous content (0.002% $\pm$ 0.0005 and 5 mg1^{-1}, respectively). These parameters and other soil analysis were determined following the methods outlined by Rowell (1994).

In the current experiment, four treatments were conducted plus the control which included: Disc plowing to a depth of 25 cm followed by spike teeth harrowing plus leveling (DPTH), moldboard plowing to a depth of 25 cm followed by spike teeth harrowing plus leveling (MPTH), Disc plowing to a depth of 25 cm followed by disc harrowing plus leveling (DPDH), Chisel plowing to a depth of 30 cm followed by disc harrowing plus leveling (CPDH) and no tillage (CONT). The experiment design was a randomized complete block design with three replications. Plots had dimension of 3×20 m occupying an area of 60 m^2.

Tillage equipment used in this study were as following:

- A massy Ferguson tractor, MF 190 model was used to perform the tillage processes.
- A three bottom, 60 cm diameter, fully mounted disc plow.
- A three bodies, fully mounted moldboard plow.
- A seven tine, fully mounted chisel plow.
- A tandem, fully mounted disc harrow with two rows. Two gangs per row and six discs per gang.
- A spike tooth harrow with three rows of tines.
- A general purpose leveling blade.

Land preparation and planting :

Tillage systems were carried out on each block according to the experimental design. Firstly, the primary tillage operation i.e. disc plowing, moldboard plowing, chisel plowing were performed. Then, they were followed by the secondary tillage operation i.e. spike teeth harrowing, disc harrowing plus leveling in the different assigned blocks. Seeding was made manually at a spacing of 40 cm in lines which were 50 cm apart. Irrigation was applied regularly through the experiment duration and chemical fertilizers (super phosphate plus urea) were given according to the recommendation of the Ministry of Agriculture and Water.

Soil measurements:

Three soil properties were measured to assess the effect of the tillage system under investigation. They are: The soil bulk density, infiltration rate and cone penetration resistance. Soil bulk density was determined by following the core sample standard method (Campbell Henshell, 1991). Soil samples were collected by driving an iron cylinder with open ends into the soil. Three samples were taken at depths of 10 and 20 cm , then weighed and dried to the constant mass to calculate soil density.

Water infiltration rate was estimated by using double ring infiltrometer as described in (Parr and Bertrand,1960). The rings were inserted into the soil and filled with water. The water interning the soil in the rings was recorded at each 10 minutes by measuring the water level in the inner ring from the top end. Rings were refilled with water from time to time manually.

Soil penetration resistance was measured with an advanced computerized cone penetrometer following the procedure in the standard S313.2 (ASAE, 1992). The cone was pushed vertically into the ground at a low uniform rate. The penetration resistance was recorded automatically by the equipment at every 2 cm vertical intervals to a depth of 30 cm from the soil surface. Five replicates of 15 separate measurements was determined for each treatment.

Plant measurement and harvesting:

Measurements were completed on a representative sample of 12 plants randomly selected from each treatment. The plant measurements included: (a) the vegetative growth (plant height, number of leaves per plant, plant fresh weight, average leaf area per plant, diameter and thickness of the disc), (b) the root system (root length and root distribution area, fresh and dry weight of the root) and (c) the disc seed weight. The number of leaves per plant was done two weeks before harvesting. Harvesting was formed when maturity sign appeared on the flower disc. The selected plant was removed completely from the ground by digging around the plant using a metal shovel and extracting the root system carefully from its zone. Then, the measurement of the vegetative part were carried out. Next, the root system was separated at the lowest point of the plant. Then, it was cleaned carefully from soil by washing thoroughly with water and weighed. The root length and root distribution area were determined by placing the complete root system on a square plate divided into squares (1cm $\times$1cm) which made and used for this purpose. The root dry weight was found by drying the root at 75° for three

days. Plant flowers were left to dry, then manually threshed. The crop seeds of each sample were weighed and the total yield was calculated on the basis of kg per hectare.

Statistical analysis:

Collected data were subjected to the proper statistical analysis procedures as the technique of Analysis of Variance for the randomized complete block design as mentioned by Gomez and Gomez (1984). Treatments were compared using the least significant difference LSD at 5% level of probability. Computations were done using PC computer and the famous Statistical package "SAS" version 6.

RESULTS AND DISCUSSION

Table (1) represents the mean soil bulk density at two soil depths of 10 and 20 cm as affected by the different tillage systems. The statistical analysis showed that there were significant differences in soil density between the five tillage systems. Results show that there was no significant difference between the treatments of DPDH and MPTH at both depths, but there was a significant difference between the treatment of DPDH and others at the same two depths. In compare with no tillage treatment, the highest improvement in soil density was gained from the DPDH treatment in which the average soil density was decreased 41%. However, the lowest improvement was obtained from the CPDH treatment which resulted in 34% decrement in the average soil density. These results agrees with Moreno *et al*. (1997) and Al-Hashem *et al.* (2001). Disc and moldboard plows have the capability to pulverize the treated soil and invert large clods so the soil volume increase leading to a decrease in soil density. However, chisel plows penetrate the soil layer and break up aggregated soil clods without inversion.

Table 1: Effect of different tillage systems on soil density (gm/cm^3) (average of two seasons, 1999 and 2000)

Treatment	Soil depth	
	10 cm	20 cm
DPTH	1.46	1.47
MPTH	1.37	1.45
DPDH	1.30	1.39
CPDH	1.50	1.51
CONT	2.27	2.30
L.S.D. at 5%	0.11	0.08

Figure (1) showed the effect of the different tillage systems on cone penetration resistance through the 30cm soil layer. As can be seen, the four tested systems resulted in lower cone penetration resistance compared to the no tillage treatment, Kruger (1996) came to similar results. Of the five tillage

systems compared, the DPDH treatment resulted in the lowest cone index values down to the depth of plowing providing more loosening to the soil particularly at the layer of 10-25 cm. This layer probably represents the most root distribution zone for the plant under the current study. Readings for the chisel plow were higher through soil profile because it does not loosen the soil as uniformity as the disc or moldboard plows for the same reason explained before. The highest penetrometer readings were obtained from the no tillage treatment (El-Banna 1990). The reduction in soil resistance was due to that primary tillage operations normally reduce soil strength and rearrange soil aggregates, in addition, the following secondary tillage operations are intend to create refined soil conditions (Kepner *et al.,* 1978).

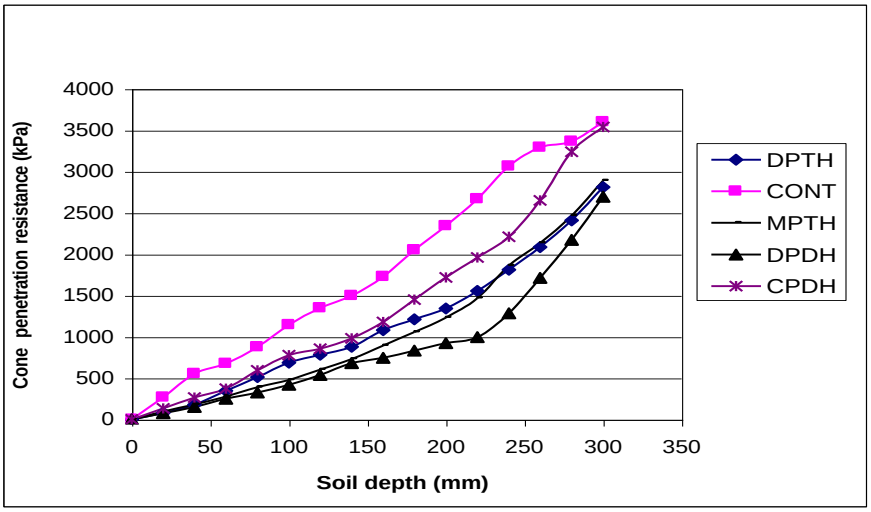

Fig. 1: Soil penetration resistance as affected by different tillage systems.

Figure (2) illustrates that all treatments showed an increase in the initial and basic infiltration rate. This result is in agreement with the finding obtained by Eljack (1990), FAO (1990) and Al-Hashem *et al.* (2001). The improvement in the infiltration rate may be attributed to two reasons. Firstly, soil tillage creates slots of large pores to the soil surface which increase porosity so the irrigation water enter soil easily and secondly, due to the disturbance and breaking of the soil layers by tillage implement which improve soil hydraulic conductivity. As figure (2) shows, CPDH treatment provided the highest initial and basic infiltration rate in comparison to the other treatments. This improvement may be referred to as chisel plow penetrates deep in the soil and breaks up soil layers by the rigid tines which results in deeper channels for down water movement into the ground. This observation is similar to that of Singh *et al.* (1978), Deer and Company (1984) and AL-Hashem *et al.* (2001). DPDH treatment gave slightly lower values of initial and basic infiltration rate compared to CPDH treatment but higher than the other three treatments. This indicates that the improvement in infiltration rate gained from

treatment of DPDH corresponds with that improvement in soil density and cone penetration resistance obtained by this testament as discussed previously.

The effect of the different tillage systems on the plant root characteristics was represented in Table (2). Statistical analysis showed a significant difference between the different tillage systems on the main root length, root distribution area, fresh and dry weight of the root. The table also shows that DPDH treatment was superior over the other treatments and had a highly significant effect on the four root characteristics. The better soil pulverization and improvement in soil physical properties provided by using disc plowing followed by disc harrowing gave the root system the opportunity to use water, oxygen and nutrients more efficiently which resulted in high and better root characteristics (i.e. an increase of 30% in root distribution area compared with no tillage). The results show no significant effect between MPTH and DPTH treatments on the root characteristics except fresh root weight, however there was a significant difference between DPTH treatment and the others on the root characteristics except root length. The present investigation indicated that using chisel plowing followed by disc harrowing on this type of soil did not show any significant effect between this treatment and no tillage. These two treatments observed the less values of root growth characteristics.

Table 2: Effect of different tillage systems on root characteristics (average of two seasons, 1999 and 2000)

Treatment	Root length (cm)	Root distribution area (cm^2)	Root fresh weight (kg)	Root dry weight (kg)
DPTH	26.33	768	1.23	0.74
MPTH	29.00	748	0.90	0.61
DPDH	34.00	920	1.66	0.94
CPDH	25.11	664	0.80	0.49
CONT	24.00	640	0.68	0.42
L.S.D. at 5%	2.74	81	0.29	0.16

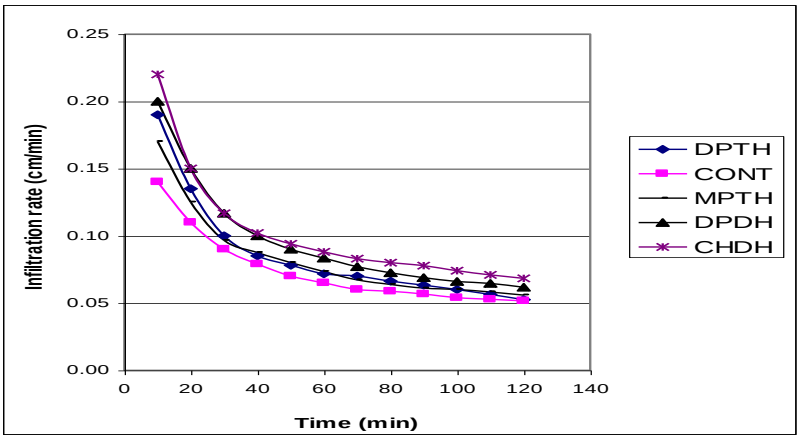

Fig. 2: Infiltration rate as affected by different tillage systems

Data in Table (3) summarizes the mean vegetative parameters of sunflower plants grown in the different soil cultivation systems. Analysis of variance showed that there was a highly significant difference among the DPDH and all the other treatments. These treatment provided the highest plant length, number of leaves, plant fresh weight and leaf area per plant. While the least values were obtained by no tillage. This results are in correspondence with the findings of other studies (Angelini *et al*., 1995; Gomaa and Al-Naggar, 1995 and Moreno *et al*., 1997). Results also showed a non significant difference existed neither between MPTH and DPTH nor between DPTH and CPDH on the four vegetative parameters. It is clear from the above results that the favorable plant vegetative could be gained by the application of DPDH system. Manipulating the soil by this type of cultivation produced better soil bed and optimum soil tilth which resulted in bigger root growth i.e. root size and root distribution area as seen previously (Table 2).

The advantage of this improvement was reflected on the vegetative growth in the current treatment which gave an increase of 28%, 55%, 51% and 70% in the plant height, number of leaves, plant fresh weight and leaf area per plant respectively, compared to no tillage. Statistical analysis for the yield revealed a significant effect between the various tillage systems, particularly between the DPDH treatment and the others as represented in Table 4. The greater effect was induced by treatment DPDH which resulted in the highest plant disc diameter, disc thickness and seed yield providing an increase of 31% in the head diameter and 36% in the seed yield compared with non tillage treatment.

Table 3: Effect of different tillage systems on vegetative growth (average of two seasons, 1999 and 2000)

Treatment	Plant height (cm)	No. of	Plant fresh	Leaf area/plant

		leaves/plant	weight (kg)	(m^2)
DPTH	186.00	32.33	5.20	2.10
MPTH	194.66	33.66	5.37	2.47
DPDH	232.66	40.00	7.20	3.28
CPDH	173.33	29.66	4.33	1.73
CONT	168.00	18.00	3.56	0.98
L.S.D. at 5%	19.70	3.98	1.32	0.57

The improvement in plant vegetative growth has shown a positive response towards the enhancement of the sunflower seed yield. This observation is similar to that of Eljack (1990) who concluded that tillage significantly increased sunflower head diameter and consequently higher grain yields were obtained. MPTH and DPTH systems also recorded 20% and 11% increase in crop yield over the others. However, there was no significant difference between these two systems. In addition, no significant difference was observed between the three systems of DPTH, CPDH and no tillage. Although, the two systems of DPDH and CPDH shared the disc harrow as a secondary tillage implement, however the former system was found to be always superior in the different measured parameters of the soil and plant. This is because the utilization of disc plow as a primary tillage machine has the ability to loosen the soil and to perform well in this type of soil resulting in much better soil properties compared to chisel plow as noticed previously. Consequently, a favorable plant growth and an increase in the final crop yield were gained.

Table 4: Effect of different tillage systems on disc shape and seed yield (average of two seasons, 1999 and 2000)

Treatment	Disc diameter (cm)	Disc thickness (cm)	Seed yield (kg/ha)
DPTH	25.6	2.66	3936
MPTH	28.6	3.23	4373
DPDH	30.6	3.80	5451
CPDH	23.3	2.60	3680
CONT	21.0	2.20	3509
L.S.D. at 5%	3.5	0.42	530

CONCLUSION

1. All tillage systems under study improved soil characteristics. Disc plowing followed by disc harrowing system was superior in producing the lowest values of soil density and the less soil penetration resistance through the layer of the plowing. Chisel plowing gave the highest initial and basic infiltration rate, while disc plowing followed by disc harrowing system gave slightly lower values, compared to chisel plowing but higher than the others.
2. The evaluated tillage systems had a significant effect on the root characteristics. Better root length, root distribution area, fresh and dry weight of the root were obtained by disc plowing followed by disc harrowing system. There was no significant difference between moldboard plowing followed by spike tooth harrowing and disc plowing followed by spike tooth harrowing on the root system, except root fresh weight. However, there was a significant

difference between disc plowing followed by spike tooth harrowing treatment and the others on the root characteristics, except root length.

3. Disc plowing followed by disc harrowing system resulted in the highest values of the vegetative growth, providing an increase of 28%, 55%, 51% and 70% in plant height, number of leaves per plant, plant fresh weight and average leaf area per plant, respectively over the no-tillage system. No significant differences were existed neither between moldboard plowing followed by spike tooth harrowing and disc plowing followed by spike tooth harrowing nor between disc plowing followed by spike tooth harrowing and chisel plowing followed by disc harrowing on the four vegetative parameters.
4. Seed yield and its components of sunflower showed a significant effect between the various tillage systems. The greatest effect was found by disc plowing followed by disc harrowing system which produced the best disc components, giving an increase of 31% in the disc diameter and 36% in the seed yield.
5. It is possibly to suggest that performing the system of disc plowing followed by disc harrowing could be the useful land preparation to enhance the yield of sunflower under the condition of this type of soil in AL-Hasa oasis.

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أثر أنظمة حرث التربة على صفات التربة وإنتاجية محصول دوار الشمس تحت ظروف منطقة الأحساء بالمملكة العربية السعودية

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هدفت الدراسة الحالية إلى مقارنة تأثير أربع أنظمة من طرق حراثة التربة على صفات التربة وكذلك على نمو ومحصول دوار الشمس. ولتحقيق هذا الهدف فقد تم إجراء التجارب الحقلية على تربة طينية جافة خلال الموسمين ١٩٩٩ و ٢٠٠٠م في مزرعة مركز أبحاث الزراعة والمياه بمنطقة الأحساء بالمملكة العربية السعودية وقد كانت أنظمة الحرث هي: الحرث باستخدام المحراث القرصي يتبعه المشط المسنن، الحرث بالمحراث المطرحي يتبعه المشط المسنن، الحرث بالمحراث القرصي يتبعه المشط القرصي، الحرث بالمحراث الحفار يتبعه المشط القرصي، بالإضافة إلى معاملة بدون حراثة (المشاهدة). أظهرت النتائج وجود فروق معنوية في قيم كثافة التربة الظاهرية على عمق ١٠ سم و٢٠ سم من التربة بين الأنظمة المختلفة من الحرث. كما بينت النتائج أن عملية الحرث باستخدام المحراث القرصي يتبعه المشط القرصي أعطت أقل قيمة لكثافة التربة الظاهرية على هذين العمقين. كذلك سجلت هذه العملية أقل قيم لمقاومة اختراق التربة خلال الطبقة المحروثة من التربة. كما وجد أن جميع أنظمة الحراثة المذكورة آنفاً قد أدت إلى زيادة في معدل الترشيح الابتدائي والأساسي مقارنة مع معاملة المشاهدة، حيث لوحظ أن عملية استخدام المحراث الحفار يتبعه المشط القرصي قد أعطت أعلى زيادة في معدل الترشيح الابتدائي والأساسي، تليها عملية استخدام المحراث القرصي يتبعه المشط القرصي التي تقل عنها بقليل. كما أشارت نتائج الدراسة إلى وجود فروق معنوية بين المعاملات المختلفة في صفات المجموع الجذري وكذلك مجموع النمو الخضري للنبات. فقد تم الحصول على أطول جذور وأكبر مساحة انتشار وكذلك أعلى وزن طازج وجاف للجذور من معاملة الحرث باستخدام المحراث القرصي يتبعه المشط القرصي. كما أوضحت النتائج عدم وجود فروق معنوية بين نظام الحرث باستخدام بالمحراث المطرحي يتبعه المشط المسنن ونظام الحرث بالمحراث القرصي يتبعه المشط المسنن في صفات المجموع الجذري عدا وزن الجذر طازج، بينما كانت هناك فروقاً معنوية بين نظام الحرث بالمحراث القرصي يتبعه المشط المسنن ومعاملات الأنظمة الأخرى في صفات المجموع الجذري عدا الطول الأساسي للجذر. كذلك أظهرت الدراسة أن عملية إعداد التربة باستخدام المحراث القرصي يتبعه المشط القرصي أعطت أعلى قيم للمجموع الخضري فقد أعطت هذه المعاملة زيادة قدرها ٢٨%، ٥٥%، ٥١% و ٧٠% في طول النبات، عدد الأوراق لكل نبات، الوزن الطازج للجذور والمساحة الورقية لكل نبات على التوالي مقارنة مع معاملة المشاهدة. أما بالنسبة لإنتاجية محصول البذور فقد كان هناك تفاوت معنوي كبير بين معاملة المحراث القرصي يتبعه المشط القرصي والمعاملات الأخرى، حيث أنتجت هذه المعاملة أفضل مواصفات لمكونات القرص لنبات دوار الشمس معطية زيادة بلغت ٣١% في قطر القرص و٣٦% زيادة في كمية البذور الناتجة من هذا المحصول بالمقارنة مع معاملة المشاهدة.

يمكن القول أنه من الممكن اقتراح استخدام نظام الحرث بالمحراث القرصي والتمشيط بالمشط القرصي كأفضل وأنسب معاملة لزيادة نمو وإنتاجية محصول دوار الشمس تحت ظروف واحة الأحساء.