Journal of Medicinal and industrial plants (2024) 2 (٤): ٦٠–71.
DOI: https://doi.org/10.32894/MEDIP.24.4.7
ISSN: (2959 – 121X)

Journal of Medicinal and Industrial Plants
(MEDIP)
http://medip.uokirkuk.edu.iq/index.php/medip

The effect of plough types and planting depths in productivity of two sunflower (*Helianthus annuus* L.) varieties at Erbil -Iraq

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KEY WORDS:
Sunflower productivity, moldboard and disc plow, depths, varieties.

Received:
23/12/2024
Accepted:
08/01/2025
Available online:
10/01/2025

ABSTRACT

The field experiment was conducted at this study at Grdarasha field of College of Agriculture engineering scinces Salahaddin University-Erbil Government Kurdistan Region- Iraq during summer growing season 2024, to investigate the effect of difference tillage on machinery performance, growth and yield of two variety of sunflower (Helianthus annuus). Three repetitions and a Split Randomized Complete Block Design (RCBD) were used to set up the experiment. The first factors include two difference of tillage: Moldboard plow (A1) and Disc plow (A2), the second factors included two sunflower variety: (Pshdar C1) (Erbil C2), the third factor included two different depths planting (3cm B1), (6cm B2). In more experimental characteristics, the disc plough clearly outperformed the moldboard plough when tilling the soil, in terms of Actual field capacity, fuel consumption, slippage and forward speed. The disc plow recorded maximum value of speed (3.80 km h^{-1}), slippage percentage (13%), and field capacity (0.42 ha h^{-1}), the minimum fuel consumption (32.43 L ha^{-1}), while moldboard plow recorded maximum value of speed (3.30 km h^{-1}), slippage percentage (27.10%), and field capacity (0.50 hr-1 ha), the minimum fuel consumption (37.91 L ha-^{1}). The difference tillage were significant affected on some growth and yield parameters; moldboard plow (A1) and disc plow (A2) The results of the total yield recorded a significant superiority in soil plowing with the disc plow over soil plowing with the (A2) its (3.975 t ha^{-1})but in (A1) its (3.082 t ha^{-1}).The highest value of plant height (181.84cm) in (A1) but in (A2) its (193.46cm), leaf area (391.82cm) in (A1), but in (A2) its (429.69cm), and sound seed of weight/head (46.23g) in (A1) but in (A2) its (59.63g), head diameter in (A1) its (16.20cm) but in (A2) its (18.40cm). No. of seed/head in (A1= 799.7), but in (A2=858.2).

تأثير نوعين المحاريث وعمق الزراعة في إنتاجية صنفين من محصول زهرة الشمس

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الخلاصة

أجريت التجربة الحقلية في محطة ابحاث كردترشة التابعة الى لكلية علوم الهندسة الزراعية في جامعة صلاح الدين/ اربيل- اقليم كوردستان- العراق للموسم النمو الصيفي ٢٠٢٤، لمعرفة تأثير الحراثات مختلفة(للمحراث المطرحي القلاب **A1)** و(المحراث القرصي القلاب **A2**)ومدى تاثير دالك على الصفات النباتية و الميكانية للالة مع الساحبة التراكتور باستخدام صنفين من محصول الزهرة الشمس **(*Helianthus annuus*).** تم استخدام تصميم القطاعات الكاملة العشوائية المنقسمة لمرة واحدة وبثلاث مكررات لكل معامل تجريبية **(RCBD)**لإعداد التجربة. تضمن العامل الأول نوعين مختلفين من المحاربث: المحراث المطرحي القلاب **(A1)** والمحراث القرصي**(A2)** ، تضمن العامل الثاني نوعين فب محصول عباد الشمس **(Erbil) (Pshdar C1) : C2)**، تضمن العامل الثالث عمقين لزراعة (**B1 ٣CM .(B26CM)** وتاثيرهدة العوامل على الصفات النباتبة و الميكانية للالة مع الساحبة وفيها الانتاجية الفعلبة لالة و استهلاك الوقود و نسبة الانزلاق مع السرعة العملية الامامية للساحبة مع الالة الخصائص التجريبية، تفوق المحراث القرصي بشكل واضح على المحراث القالبي عند حراثة التربة، من حيث استهلاك الوقود والانزلاق والسرعة الأمامية. سجل المحراث القرصي أقصى قيمة للسرعة (٣.٨٠ كم/ساعة)، ونسبة الانزلاق (١٣%)، وسعة الحقل (٠.٤٢ هكتار/ساعة)، واقل كمية استهلاك للوقود (٣٢.٤٣ لتر/هكتار)، في حين سجل المحراث القالبي أقل قيمة للسرعة (٣.٣٠ كم/ساعة)، ونسبة الانزلاق (٢٧.١٠%)، وسعة الحقل تفوقت على المحراث القرصي حيث سجلت (٠.٥٠ كم/ساعة)، واكثر استهلاك للوقود (٣٧.٩١ لتر/هكتار). وكان لاختلاف الحرث تأثير كبير على بعض معايير النمو والعائد؛ وسجلت نتائج الحاصل الكلي تفوقاً معنوياً في حراثة التربة بالمحراث القرصي على المحراث المطرحي **(A2** إذ بلغت (٣.٩٧٥ طن/ هكتار) وفي **(A1** إذ بلغت (٣.٠٨٢ طن /هكتار). كما سجلت أعلى قيمة لارتفاع النبات (**cm**١٨١.٨٤) في **(A1** إذ بلغت **cm**١٩٣.٤٦) في**(A1** ومساحة الورقة **cm**^{2}٣٩١.٨٢) في **(A2** إذ بلغت **cm**^{2}٤٢٩.٦٩) في**(A1** وزن البذرة السليمة/رأس (٤٦.٢٣ **g**) في **(A2**إذ بلغت (٥٩.٦٣ **g**) ، وقطر الرأس في **(A1** إذ بلغت **cm**١٦.٢٠) وفي**(A2** إذ بلغت **cm**١٨.٤٠). عدد البذور/الرأس بلغت **(A1= 799.7)** ، ولكن في**(A2=858)**.

كلمات مفتاحية : المحراث المطرحي و القرصي , الاصناف, الاعماق, انتاجية عباد الشمس

1. INTRODUCTION

A member of the Composite or Asteracee family, sunflowers (*Helianthus annuus L.*) are among the few crop species that originated in North America; the majority came from Asia, South or Central America, or the Fertile Crescent. The sunflower crops are important due to its high quality and status as one of the five essential nutrients for human nutrition, sunflower is a drought-sensitive crop, it is drought tolerant because of its extensive root system, which can draw water and nutrients up to 3 meters deep reported by (Hussain et al., 2018). Sunflower varieties reach an average height of 183 cm, varying between 153 cm and 213 cm depending on the date of planting and soil conditions, the growth of the sunflower is directly related to its genetic composition reported by (Burke et al., 2005). In addition, the planting season affects its development; these seasons usually occur in mid-summer and early fall.

Tillage is one of the most important steps in crop production systems according to improving soil bed environmental conditions necessary for seed germination by mechanical means; tools are employed to achieve some desired effect such as pulverization, cutting, or movement and soil is tilled to change its structure, to reduce weeds, and to manage crop residues for sustainable agriculture according to (Gómez et al., 2016), seedling establishment, and crop growth. For seed sunflower growth, Soil tillage produced better seedbeds, and according to (Alsharifi et al., 2021).

A tractor is a type of engineering vehicle intended to provide strong tractive effort or torque at various speeds for use with agricultural machinery, including planters and plows. Additionally, any agricultural tool may be put on the tractor or pulled behind, and the tractor itself can do other duties, there are numerous uses for tractors. Since the tractor is an apparatus with several uses according to (Chethan et al., 2018). The aim of the study was to evaluate the effect of different plough types and planting depths on the productivity of two sunflower (Helianthus annuus) varieties, by analyzing their growth performance, yield, and response under varying soil preparation and planting conditions.

2. MATERIALS AND METHODS

Study Location Description or Study Area

This study area was conducted at Grdarash field, College of Agriculture Salahaddin University-

Erbil, the study sites for this present research (Latitude 36.113514° and Longitude 44.0522272'), and elevation of 415 meter above sea level by annual rainfall between (250-600) mm, during the summer growing season from (July 2024) to (November 2024) to study. The effect of plough types and planting depths in productivity of two sunflower (Helianthus annuus) varieties.

Soil sampling and analysis;

Before sowing the seeds, soil samples were collected from different points of the experimental soil at a depth (0-30 cm) after tillage.to determine the physical and chemical properties of the soil, soil samples were collected from different points in the experimental soil at a depth of (0-30) cm after tillage. The physical and chemical properties of the soil were determined.

Table.1. Some physical and chemical characteristics of the soil for experimental location.

Physical properties		Soil of mold plow	Soil of disk plow
Sand%	g kg^{-1} soil	13.2	13.2
Silt%		44.75	44.75
Clay%		41.3	41.3
Black density	g/ cm^3	1.33	1.35
Porosity		0.49	0.45
Texture		Silty clay loam	
Ece	dS m^{-1}	0.3	
pH		7.8	
Moisture	%	6	
Chemical properties			
N%		0.165	
P (ppm)		3.8	
K (ppm)		115	

Experimental Design

The experiment carried on 15 July 2024 has an organization based on to three factors with three replications, which was by Randomized Complete Block Design (RCBD), Split with three replicates in fields with using three factors. The number of experimental units of location = 2*2*2 *3 = 24Experimental Units. The first factor included different two plows (moldboard plow (A1) and disc plow (A2), the second factors sunflower was selected two varieties; pshdare variety originated in (sarwchawa) and second variety contain Erbil originated from Kurdistan, which were represented by (C1, C2), respectively. The third factors included different two: the first depth (B1) contains 3 cm and second depth (B2) contains 6 cm, and also the distance between plant to plant (20 cm). While each block was length 20 m and width 10 m area. And also, the distance between row to rows contain 65 cm.

Sampling method and Parameters:

The first factor includes two difference of tillage:

A-Moldboard plows (A1)

The term 'moldboard plow' describes an implement that cuts soil, lifts it, and turns it at least partly upside down by means of a curved plate, or moldboard this is used for primary tillage operations. It cuts trash and buries it completely. It is also used for turning green manure crop for decaying under the soil, which adds humus to the soil. It is also used for turning and mixing compost, farmyard manure or lime into the soil, and the depth tillage of plough (30 cm) in soil. The characteristics of tool are: three molds and width implement (180 cm), the weight of implements (510kg).

B-Disc plow (A2)

A disc plough is a strong farming tool used to break up and flip over the soil. It has big rotating disc, blades that cut through the soil and turn it upside down. The plough's weight and the force from the spinning discs help it to go deep into the soil. The disc plough is designed to work in all types of soil for functions such as soil breaking, soil raising, soil turning and soil mixing. It is used to open the new fields and to process the stony areas. It can be used easily at rocky and rooted areas, and this implement characteristics; it is have three disk, width implement (110cm) and the weight of implements (450 kg), the depth tillage of plough (25 cm) in soil.

The second factors two different depths planting

The used two different depths to planting of the sunflower seeds, 3cm(B1) and 6cm(B2). to compare their effects on seedling emergence and productivity.

The third factor is planting two different varieties:

a. Pshdar variety (C1)

The sunflower variety referred to as Pshdar likely pertains to sunflowers cultivated in the Pshdar region include (Saruchawa and Marga) of kurdistan-Iraq, located in the Kurdistan Region. The Pashdar variety is characterized by its large seeds, medium-sized stem, medium-sized leaves, and high production (Bapir and Mahmood, 2022).

b. Erbil variety (C2)

Sunflower varieties grown in the Erbil area of Iraq are usually selected for their adaptability to the local environment, which is characterized by hot summers and limited rainfall. Sunflower productivity in Erbil is an important factor, especially for edible seed varieties. Farmers often look for varieties that produce large, plump seeds with high yield potential for local consumption and the market. For edible sunflowers, seed size is a critical factor. Larger seeds are more desirable for human consumption. The Erbil sunflower variety has medium-sized leaves and a long stalk with a medium to large head (kaka Ahmed and Maaroof, 2022).

Machines parameters:

Forward Speed (Km h^{-1})

The forward speed of tractor was measured according to (Grisso et al., 2006)

$V=D/T*3.6$

V= speed tractor (km h^{-1}).

D= distance (meter).

T= time (s) operations in field.

3.6=36000/1000 convert meter / second to (km h^{-1}).

****Wheel Slippage (%)**

Slippage percentage was determined by using following equation,(Mamkagh, 2009).

Slippage % (S) = Vt-Vp/Vt* 100

Whereas:

S = wheel slippage (%)

Vt= velocity without load (Km h^{-1}), Vp= velocity with load (Km h^{-1})

Effective Field Capacity (ha.h^{-1})

The effective field capacity was calculated to (Gürsoy, 2021)

EFC = 0.1 x Vp x W x E.

EFC = Effective field capacity (ha h^{-1}).

0.1= 1000/10000 (Km/h^{-1})

Vp = Actual or partial speed (km h^{-1}).

W = Actual width (m).

E = Efficiency or the consumption of time modulus. Throughout the current investigation,was utilized with a value of 0.85.((Sudduth et al., 2004).

Fuel Consumption (L. Ha^{-1})

(HUSSEIN) used the following formulae to compute the amount of fuel used:

F. c = F. d x 10000 / w x s x 1000

Whereas:

F. c = fuel consumed (L ha^{-1}).
F. d = fuel day during the transaction (ml).
W = plow width (m).
S = length distance plowed (m).

Growth parameters:

Plant Height (cm)

Plant height was measured from the soil surface to the base of head

Leave Area (cm^{-1})

Using the following equation:

Leave Area = (leave length * leaf width) 0.65 (Elsahookie and Eldabas, 1982)

Head Diameter (cm^{-1})

The head diameter was measured using a ruler and the average was recorded.

Number of seed $head^{-1}$

The number of seeds per sunflower head varies by variety, growing conditions, and plant health, typically ranging from hundreds to over a thousand. Optimal conditions promote higher seed counts, improving overall yield.

Weight of sound seed $head^{-1}$

Real or full seeds are those that are fully grown and mature and usually have a well-formed kernel inside of a sunflower head. These seeds have grown to the appropriate size, shape, and weight and are ready to be planted or consumed. They can be distinguished from "hollow" or "empty" seeds, which are frequently lighter and devoid of a kernel. Successful pollination and ideal growing conditions, including sunlight, water, diverse soil types and kinds, and tillage, are necessary for the production of whole seeds.

Total yield (t ha^{-1})

The total seed yield of a sunflower crop depends on factors like variety, planting density, growing conditions, and management practices.

Statistical analyses

Data on plant growth, yield and two depth by used to moldboard plow and disc plow properties were subjected to Analysis of Variance (ANOVA) by using SPSS Statistics (IBM SPSS Statistics 21). Duncan's multiple range test at $P \leq 0.05$ was used to perform the mean comparison.

3. RESULTS AND DISCUSSION

Eeffect of different two plows on machine performance

Forward Speed (km hr^{-1})

Table (3.3) which showed the effect of the difference in tillage on the performance of the machines where the difference in tillage had a significant effect on the executed speed and the highest value (3.80 km/h^{-1}) was obtained from the disc plough (A2) which is faster compared to the mold plough when plowing as it recorded (3.30 km/h^{-1}), due to the influence of the shape, geometry, and size of the various plowing elements and depending on type of sol, at the same depth and speed, the moldboard plow revealed more intrinsic draft than the disc plow. High significant increases in draft were found for the tillers with the highest forward speed and tillage depth also are conformed by (Naderloo et al., 2009).

Wheel Slippage (%)

Wheel slippage (%) was significantly impacted, according to the analysis of variance data values in Table (2). Moldboard plow tillage (A1) had the highest mean value (27.10%), while disc plow tillage (A2) had the lowest mean value (13.70%). This is due to the increase in frictional resistance and the increased kinetic energy imparted to the soil as a result of the increased working speed of the machine unit. (Sahu and Raheman, 2006) stated that tillage depth has a significant effect, they attributed this to the increase in soil resistance with increasing depth and it depends type

of the soil. (Mamkagh, 2009) found that the pulling resistance force increases when the soil moisture is very high or low and the moldboard plow (A1) friction is more compared to the disc plow (A2), and the reason is that the disc plow is more efficient when plowing in dry soil and hard soil.

Actual field capacity (ha h^{-1})

Field capacity was significantly impacted by the means of various tillage techniques, as shown in Table (2). Moldboard tillage produced the highest value (0.50) ha hr-1, whereas disk plow produced the lowest value (0.42 ha hr-1). Field efficiency is defined as the ratio between practical productivity to theoretical productivity of the machine and is affected by the speed and working width of the machine conformed by (Abualgasim and Dahab, 2013) . noted that there were significant differences in the effect of using two types of plows, moldboard and disc, the field efficiency in a sandy soil, as the moldboard plow was superior to disc plow in giving it the highest field efficiency.

Fuel Consumption (L ha^{-1})

Table (2), indicated the fuel consumption rate when using a moldboard plow was 37.91 L ha^{-1}, higher than the disc plow's 32.43 L ha^{-1}. This difference arises because the moldboard plow fully inverts and aerates the soil, requiring more energy to overcome soil resistance and perform deeper, more intensive tillage. In contrast, the disc plows works with a slicing action that disturbs less soil and requires less force, resulting in lower fuel consumption, they are depended on type of soil reported by (Moitzi et al., 2014) found that wheel slippage and fuel consumption increased almost quadratic ally with working depth.

Table.2. Impact of difference two plows on some machine performance

Tillage difference	Forward speed (km h^{-1})	Wheel Slippage %	Field capacity (ha h^{-1})	Fuel Consumption (L ha^{-1})
Moldboard plow (A1)	3.30^{b}	27.10^{a}	0.50^{a}	37.91^{a}
Disc plow (B2)	3.80^{a}	13.70^{b}	0.42^{b}	32.43^{b}

Means with different letters inside columns show significantly different according Duncan's multiple range test probability at 5%.

Effect of different two plows, two depth planting and two variety on some growth parameters and yield component of sunflower

Effect of different two plows on some plant growth and component of yield

The results in Table (3), shows in every studied plant attribute and yield component, the disc plow performed better than the moldboard plow, according to the comparison. Plant height (175.92 cm), larger leaf area (361.79 cm), and larger head diameter (16.22 cm) were all attained by plants cultivated with the disc plow. The disc plow also produced more no. of seeds per head (797.18), sound seed weight (54.90 g), and overall yield (3.65 t ha^{-1}) This implies that the disc plow can improve crop productivity and growth. Because it maintains soil structure, reduces compaction, and keeps organic matter close to the surface, the disc plow fared better than the moldboard plow the reason is that the moldboard plow does not work in dry and hard soil and cannot penetrate well compared to the disc plow which penetrates deeper and leads to root penetration and better root development and nutrient availability are encouraged by its slicing effect, which lowers evaporation

and retains moisture. These elements improved agricultural characteristics and increased production by promoting plant development, therefore achieved by better plowing according to (Yousuf, 2006).

Table 3. Effect of different two plows on plant growth and yield component

Types of plows	Plant high cm	Leaf of area cm^2	Head diameter cm2	No .of seed $head^{-1}$	Weight of Sound seed(g)	Total yield t ha^{-1}
Mold board(A1)	168.39b	337.01b	15.40b	731.95b	40.71b	2.73b
Disc plow(A2)	175.92a	361.79a	16.22a	797.18a	54.90a	3.65a

Effect of different two depths on plant growth and yield component:

The results in Table (4), shows in every studied plant attribute and yield component, the Compared to a 3 cm depth, planting sunflower seeds at a 6 cm depth greatly improves plant growth characteristics and yield components. At 6 cm, the following values are significantly higher than those at 3 cm: 164.67 cm, 310.67 cm², 14.88 cm, 730.87, 44.76 g, and 2.99 t ha^{-1}, respectively; plant height (179.65 cm), leaf area (388.13 cm²), head diameter (16.74 cm), number of seeds per head (798.26), sound seed weight (50.85 g), and total yield (3.39 t ha^{-1}). Better root-soil contact, which guarantees more constant moisture availability and promotes root development, accounts for the superiority of the 6 cm depth. Additionally, seeds are shielded from surface environmental stressors like drying out or displacement at this depth. Deeper planting therefore improves the plant's capacity to absorb water and nutrients, improving vegetative growth, reproductive efficiency, and overall yield potential also confirmed by(Mahdi et al., 1998), (A Dham and A Abdullah, 2012).

Table 4. Effect different two depths planting on plant growth and yield component

factors	Plant high cm	Leaf of area cm^2	Head diameter cm2	No .of seed $head^{-1}$	Weight of Sound seed(g)	Total yield t ha^{-1}
Depth 3 cm (B1)	164.67b	310.67b	14.88b	730.87b	44.76b	2.99b
Depth 6cm (B2)	179.65a	388.13a	16.74a	798.26a	50.85a	3.39a

Effect of different two variety on some growth plant and component:

The results in Table (5), show in contrast to the Pshdar variety (C1), which has a plant height of 165.01 cm and a leaf area of 330.09 cm², the Erbil variety (C2) has much larger plant height (179.30 cm) and leaf area (368.72 cm²). In contrast, the Erbil variety's head diameter (15.45 cm), sound seed weight (45.59 g), and yield (3.03 t ha^{-1}) are inferior to those of the Pshdar variety, which exceeds in head diameter (16.17 cm), sound seed weight (50.02 g), and overall yield (3.34 t ha^{-1}). According to these findings, the Pshdar variety more effectively devotes resources to reproductive features, resulting in larger yield and higher-quality seed, and nutrient density and large seed also are performed by (Bapir and Mahmood, 2022) . The Erbil variety is more suitable for vegetative growth (kaka Ahmed and Maaroof, 2022).

Table 5. Effect of different variety on plant parameter and yield component

factors	Plant high cm	Leaf of area cm^2	Head diameter cm2	No .of seed $head^{-1}$	Weight of Sound seed(g)	Total yield t ha^{-1}
Pshdar (C1)	165.01b	330.09b	16.17a	740.85b	50.02a	3.34a
Erbil (C2)	179.30a	368.72a	15.45b	788.28a	45.59b	3.03b

Effect of different two plows and two depths planting on plant growth and yield component:

The results in Table (6), shows in every studied plant attribute and yield component, this led to enhanced yield components, the best Combination of disc plowing and 6 cm depth (A2B2) produced the highest values across all parameters, including plant height (183.67 cm), head diameter (17.40 cm), seed count per head (821.72), sound seed weight (57.45 g), and total yield (3.83 t ha^{-1}). This indicates that optimal tillage and deeper planting depths enhance soil conditions and resource availability, maximizing sunflower productivity also performed by(Yankov and Drumeva, 2021) and(Mahdi et al., 1998).

Table .6. effect of different two plows and two depths planting on plant growth and yield component.

Plows	depths	Plant high cm	Leaf of area cm^2	Head diameter cm2	No. of seed $head^{-1}$	Weight of Sound seed(g)	Total yield t ha^{-1}
Moldboard (A1)	3cm (B1)	161.16^{c}	303.80^{d}	14.72^{c}	689.10^{c}	37.16^{d}	2.50^{d}
	6cm (B2)	175.63^{b}	370.23^{b}	16.08^{b}	774.80^{b}	44.25^{c}	2.95^{c}
Disc plow(A2)	3 cm (B1)	168.18^{c}	317.55^{c}	15.03^{c}	772.65^{b}	52.35^{b}	3.47^{b}
	6cm (B2)	183.67^{a}	406.03^{a}	17.40^{a}	821.72^{a}	57.45^{a}	3.83^{a}

Effect different two plows and two varieties on plant growth and yield component

The results in Table (7), show in contrast to the Pshdar variety (C1), which has a the Pshdar variety (C1) under disc plowing (A2) had the maximum sound seed weight (56.65 g), head diameter (17.00 cm), and total yield (3.76 t ha^{-1}). This is the more thorough analysis: Disc plowing (A2) improved plant growth and yield components and consistently outperformed moldboard plowing (A1). This improvement is due to improved root penetration, moisture retention, and soil aeration caused by disc plowing. The combination Pshdar variety(C1) with disc plow(A2) outperformed the Erbil variety (C2) with disc plow(A2C2) in important yield-related characteristics, including the largest head diameter (17.00 cm), the heaviest sound seeds (56.65 g), and the highest total yield (3.76 t ha^{-1}), whereas the Erbil variety (C2) produced the tallest plants (184.90 cm) and the largest leaf area (379.35 cm?) under A2. The ideal combination under disc plowing (A2), the Pshdar variety (C1), (A2C1) produced the highest overall yield (3.76 t ha^{-1}), most likely as a result of its superior capacity to transform resources into reproductive growth, as evidenced by head diameter and seed weight. This demonstrates how Pshdar's genetic potential can be used to increase productivity when paired with the best tillage techniques , the growth of the sunflower is directly related to its genetic composition . In addition, the planting season affects its development; these seasons usually occur in mid-summer and early fall.

Table 7. Effect different two plows and variety on plant growth and yield component

Plows	Varieties	Plant high cm	Leaf of area cm^2	Head diameter cm2	No. of seed $head^{-1}$	Weight of Sound seed(g)	Total yield $t\ ha^{-1}$
Moldboard (A1)	Pshdar (C1)	163.08^{b}	315.95^{d}	15.33^{b}	720.25^{d}	43.38^{b}	2.93^{c}
	Erbil (C2)	173.71^{b}	358.08^{b}	15.47^{b}	743.65^{c}	38.03^{c}	2.53^{d}
Disc plow (A2)	Pshdar (C1)	166.95^{b}	344.24^{c}	17.00^{a}	761.45^{b}	56.65^{a}	3.76^{a}
	Erbil (C2)	184.90^{a}	379.35^{a}	15.43^{b}	832.92^{a}	53.15^{a}	3.54^{b}

Effect different two depths and two varieties on plant growth and yield component

The results in Table (8), shows in every studied plant attribute and yield component, The Erbil variety at 6 cm deep (B2C2) outperformed the others by showing the largest leaf area (410.76 cm2) and the tallest plant (187.65 cm). The Pshdar variety at 3 cm deep (B1C1), on the other hand, displayed the lowest values for these characteristics.The head diameter, number of seeds per head, sound seed weight, and overall yield all showed considerable variation in terms of yield components. At 6 cm deep, the Pshdar variety had the largest head diameter (17.30 cm), most seeds (775.50), and maximum seed weight (52.93 g) (B2 C1). A similar pattern was seen in total yield, with the Pshdar variety at 6 cm producing the highest yield (3.53 t/ha). Nonetheless, the Erbil variety also demonstrated competitive performance in a few attributes at a depth of 6 cm. The difference in value at two different (3cm B1,6cm B2) the depths is due to the fact that a depth of(6 cm B2) for planting seeds leads to deeper penetration into the soil and more stability in the soil and ease of access to nutrients. Likewise, the difference in varieties is due to a difference in genetic and hereditary composition.

Table 8. Effect of different depth and variety on plant growth and yield component

Depth	variety	Plant high cm	Leaf of area cm^2	Head diameter cm2	No. of seed $head^{-1}$	Weight of Sound seed(g)	Total yield $t\ ha^{-1}$
Depth3cm (B1)	Pshdar (C1)	158.38^{c}	294.67^{d}	15.03^{c}	706.20^{c}	47.10^{c}	3.16^{b}
	Erbil (C2)	170.96^{b}	326.68^{c}	14.72^{c}	755.55^{b}	42.41^{b}	2.82^{d}
Depth 6cm (B2)	Pshdar (C1)	171.65^{b}	365.51^{b}	17.30^{a}	775.50^{b}	52.93^{d}	3.53^{a}
	Erbil (C2)	187.65^{a}	410.76^{a}	16.18^{b}	821.02^{a}	48.77^{b}	3.25^{c}

Effect different two plows, two depths and two varieties on plant growth and yield component

The results in Table (9), shows in every studied plant attribute and yield component, this led to enhanced yield components, the interaction between disc plows, Erbil variety with depth 6cm planting (A2B2C2) showed superior performance across most traits of plant growth compared to the interaction between disc plows, Pshdar variety with 6cm depth planting(A2B2C1) . Plant height was highest (193.46 cm) with the Erbil variety planted at 6 cm depth using the disk plow, followed by 181.84 cm for the same variety at 3 cm using the moldboard plow. The Pshdar variety exhibited

lower heights under all conditions. Similarly, leaf area was greatest (429.69 cm²) for Erbil at 6 cm depth with the disk plow (A2B2C2), while the smallest leaf area (283.24 cm²) was observed for Pshdar at 3 cm with the moldboard plow(A1B1C1). The head diameter was largest (18.40 cm) for the Pshdar variety at 6 cm depth with the disk plow, indicating a notable response to deeper planting. The highest number of seeds per head (854.60) were achieved by the Erbil variety with disc plows, but total yield (3.98 t ha^{-1}) were achieved by the Pshdar variety at 6 cm depth with the disk plow, showcasing its compatibility with these conditions. The lowest values for these parameters were observed for the Pshdar variety at 3 cm depth with the moldboard plow. The highest value in the weight of the filled seeds was obtained by the Bashdar variety with the disc plow at a depth of 6 cm, which is 59.63 g, and it was significant and superior to the Erbil variety at a depth of 6 cm with the disc plow, which is 55.37 g. The table shows that sunflower cultivation at a depth of 6 cm by the disc plow outperformed all treatments, and was better than the moldboard plow. This indicates that the disc plow when plowing the soil has distinctive characteristics in terms of more plowing depth and less pressure on the soil. It also shows that the Bashdar variety outperformed the Erbil variety in terms of yield components and has a larger and fuller seed size. The difference in value at two different two(3cm,6cm) depths is due to the fact that a depth of 6 cm for planting seeds leads to deeper penetration into the soil and more stability in the soil and ease of access to nutrients. Likewise, the difference in value in plant growth characteristics and the total yield of varieties is due to a difference in genetic and hereditary composition of the varieties also performed by (Aryafar et al., 2023),(Sadras and Calvino, 2001).

Table 9. Effect different two plows, two depths and two varieties on plant growth and yield component

Plows	depth	variety	Plant high cm	Leaf of area cm^2	Head diameter cm2	No. of seed $head^{-1}$	Weight of Sound seed(g)	Total yield t ha^{-1}
Mold board plow (A1)	3 cm	Psdar	156.74^{f}	283.24^{f}	14.47^{d}	678.33^{f}	40.53^{f}	2.77^{f}
		Erbil	165.58^{e}	324.35^{de}	14.97^{cd}	699.87^{e}	33.79^{g}	2.24^{g}
	6cm	Pshdar	169.42^{d}	348.65^{c}	16.20^{b}	762.17^{c}	46.23^{d}	3.08^{e}
		Erbil	181.84^{b}	391.82^{b}	15.97^{bc}	787.43^{b}	42.27^{e}	2.82^{f}
Disk plow (A2)	3 cm	Pshdar	160.01^{f}	306.11^{e}	15.60^{bc}	734.07^{c}	53.67^{b}	3.54^{c}
		Erbil	176.3^{c}	329.00^{cd}	14.47^{d}	811.23^{a}	51.03^{c}	3.40^{d}
	6cm	Pshdar	173.88^{c}	382.36^{b}	18.40^{a}	788.83^{b}	59.63^{a}	3.98^{a}
		Erbil	193.46^{a}	429.69^{a}	16.40^{b}	854.60^{a}	55.27^{a}	3.68^{b}

4. Conclusion

1- When the moisture is less than the required level for plowing, the mold plow plough(A1) cannot penetrate well, and friction with the soil increases, the slippage rate increases, and it needs more energy, which leads to an increase in the fuel consumption rate and reduces speed, but due to the increase in the working width, the field capacity increases, But when using the disc plough(A2), the speed increases and the slippage are reduced , but due to the small working width, the field capacity is reduced. The most important reasons for the mission that affect the increase or decrease of the machine's properties depend on the type of soil , soil depth and the driver's skill with the level of the soil surface.

2- The disc plow as different tillage were recorded the highest mean compared to moldboard plow.

3- The disc plow(A2) as different tillage were recorded the highest mean values of most growth characteristics and yield component such as: plant height (cm), leaf area (cm-2), no. of seed head^{-1}, head diameter(cm) sound of weight per head and total yield (t ha^{-1})compared to moldboard plow(A1)

4- Interaction treatments have significant effect on total yield (t ha^{-1}); the highest values were recorded from A2x B2 mean while the lowest values were obtained from A1x B1.

5- The interactions between treatments were affected significantly on total yield(t ha^{-1}) the increase yield was observed from A2 x C1, while the decrease yield was obtained from A1x C2 treatments.

6- The Pshdar variety (C1) was recorded the highest value for weight of sound seed compared to Erbil variety (C2), but (C2) was recorded the highest value for most growth parameter such as high plant (cm), leaf of area(cm^{-2}), no. of seed.

7- The superiority effect of triple interactions on grain yield (t ha^{-1}) was observed in A2x B2 x C1 when compared to interactions between A1x B1 x C2 treatments.

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