University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Add the undercut weaponSWEEP to the locally manufactured developed drilling plough and its impact on mechanical performance indicators under different operating conditions

[1] Abdalsalam Jawad Kadhim, [2] Murtadha AA Alfaris [3] Majid HR Alheidary

[1*2]Department of Microbiology, College of Veterinary medicine and Surgery, Shatrah University, Iraq.

[1]*E- mail:* pgs.abdalsalam.jawad@uobasrah.edu.iq

[2]*E- mail:* murtadha.abdulnabi@uobasrah.edu.iq

[3]*E- mail :* **majid.reshaq@uobasrah.edu.iq**

Abstract

The experiment was carried out in one of the fields of the Agricultural Research Station affiliated with the College of Agriculture - University of Basra / Karmat Ali site in the north of Basra Governorate in a soil with a mixed clay texture..

The mechanical field experiment was conducted to study the performance indicators of the mechanized unit using a complete randomized block design.RCBD by hard cut method Split – Split PlotAnd threeReplications below 0.05 probability level. The experiment included studying the effect of four shapes of the undercut weapon (cut 20 cm, cut 15 cm, pointed 20 cm, and pointed 15 cm) with three ploughing depths (15, 25, and 35) cm in addition to two forward speeds, which are 1.87 km/h and 2.74 km/h., inDrag force and slip dustrubted area and Pulverization Index fuel consumption. The results indicated that the depth of 15 cm was superior in recording the lowest pulling force, as the second speed recorded the lowest pulling force of12.915 kN at a depth of 15 cm, while the triple interference showed the superiority of the 20 cm wide pointed weapon, as it recorded the lowest pulling force of8,019 kN at the same depth.And alsoThe 20 cm wide tapered weapon showed superiority in giving the lowest percentage of wheel slip of 31.37% while the weapon was recordedTraditional digger ploughThe highest percentage of slippage was44.4% It also excelled in giving the lowest fuel consumption rate of4.782L/ha. While the 20 cm wide cut weapon outperformed in increasing the percentagefragmentationsoilso The smallest diameter of soil clods was recorded at 28.79 mm. The traditional chisel plough also outperformed the conventional tillage plough in terms of loosened area and recorded the highest percentage of 459 cm2.

Keywords: Undercutting force, traction force, loose soil area, fuel consumption.

I. Introduction

Plowing is one of the processes and activities that take place. On the roofsoilThis is done in order to create or prepare a suitable bed for the seed by breaking up the soil clods and the surface layer of the soil and turning over the soil, including the residues resulting from the previous crop present in the land or the thickets resulting from previous agricultural operations or due to leaving the land without plowing and planting.. Companies manufacture different types of plows in various shapes and sizes. The reason for this is the diversity of the conditions for using these machines and according to the prevailing climatic conditions in each region, as they play a major role in the process of preparing the soil.(1).A number of factors affect the operation of the drill plough such as:WeaveThe soil, the speed at which the tractor operates when plowing, and the depth to which the plow reaches. (2). Drag forceRequired for

University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

withdrawalThe plow is affected by the depth at which it operates.Plow which increases in heavy soilsclay mixtureAnd clay,The amount of drag force increased and increased significantly with increasing depth.Tillage to increase soil strength andIts cohesion with increaseDepth (3).The modifications made to the chisel plough by researchers, the aim of which is to increase the efficiency and performance of the chisel plough and improve its productivity. (4)TPerformTo increase the amount of pulling force required to pull the plow. (5) thatIncreasing the depth of plowing will place an additional load on the tractor, increase the engine load and increase the fuel consumption rate, as plowingdeepIt will increase the amount of soil clods that the plough must break and crumble, which requires additional fuel and a lot of energy from the engine in order to overcome the load behind the tractor. (5)male (7)The plough-shaped dagger weapon outperformed the traditional and spearhead shapes, recording the lowest power compared to the other shapes.

The area of loose soil increases with increasing ploughing depth. The increase in the area of loose soil is proportional to the increase in the cutting width of the plow blade. The area of loose soil also increases with increasing cutting angle, as it causes the soil to be stirred and loosened on both sides of the plow blade and increases cracks from the bottom towards the surface of the plowed soil.(8) and(9).

And he explained(10) and (11) The effect of using a chisel plough on increasing or decreasing the value of the fragmentation index, as the chisel plough causesReducesThe value of the soil fragmentation index is due to it leaving more soil clods than the rototiller or disc plough, as it loosens the soil without turning it over, but the use of smoothing equipment after the excavator plough greatly reduces the values of the soil fragmentation index.While choosing the right type of drilling rig plays a role in producing and obtainingsmall earth blocksThe result fromThe collision of the plow blade with the soil masses, as the angle of entry of the plow blade plays a role in improving the soil fragmentation. (12). The research aims to: Study the effect of adding different forms of undercutting weapons on the performance of the developed backhoe plough in terms of traction force, fuel consumption rate, soil fragmentation degree, and determining the best combination for the best performance compared to the traditional backhoe plough.

II. Materials and working methods

useThe advanced digging plough designed and manufactured in the workshops of the machinery department.And machinesAgricultural College of Agriculture University of Basra.It consists of two rows and contains:Every leg of the plow inback rowOn holes for installationTwo types ofWeaponsOne above the other, which will help the lower weapon, which is of the bird's tongue type, penetrate the soil and work.groove lowestthe earthPlowed for ease DischargeExcess waterWhen planting,While the upper weapon, which is the subject of research, breaks up the blocks.Earthyresulting from the processPlowing And it isa jobWeaponsUpper rear row of plow in conjunction with the action of the armsexistingIn the rowFrontFrom the plow, as they are located on the same horizontal level..

Two pullers were used to carry out the experiment. The first puller (CaseJx75T) as a source of pulling power while the plough was attached to the second type of puller (Massey Ferguson 440 Xtra) and was placed in neutral condition, as its role was limited to controlling the depth of ploughing only. The drag force measuring device, the weight cell type, was connected to theCylindrical-s-BeamModel 600 LSBAmerican made, manufactured in 2009 by the companyfutek, between the two pullers. The front puller was equipped with a special system to calculate the fuel consumption of each experimental unit, containing a 5-liter tank and a 100-milliliter graduated tube connected to each other and connected to the puller engine by rubber tubes and has a special valve for use when starting the experiment.

Fuel consumption and slip percentage were calculated using the method mentioned in(13)

Fuel consumption rate (hectare/hour) = Amount of fuel consumed (ml)*10/Actual working width (m)*Process length (m)

University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42

https://jam.utq.edu.iq/index.php/main *https://doi.org/10.54174/utjagr.v13i1.323*

Slip percentage = {[Theoretical speed (km/h) / Practical speed (km/h)] / Theoretical speed} * 100

Rolling resistance as well as total traction force were measured according to the method described in((14

Drag force (KN) = total drag force (KN) - Rolling resistance (KN)

The dry sieving method was used to calculate the Pulverization Index by calculating the weighted diameter rate after plowing using the developed chisel plough and the traditional chisel plough in order to compare them as mentioned in(15)

Pl =$m* wi/\Sigma w$

Pi= Crumble guide mm

M= Average diameter of previous and subsequent sieve mm

Wi= Weight of soil collected on each sievekg

W= Total weight of the samplekg

The loosened area was calculated by removing the plowed soil from the plow path and the trench was cleaned with a brush so that the loosened area would appear clearly afterwards. Using a metal measuring tape, measurements and dimensions were taken for each of (b anddsanddcandw1andw2andsThese dimensions were converted into a regular geometric shape, Figure No. (1), and the area of the loose soil was calculated using Equation No. (1).

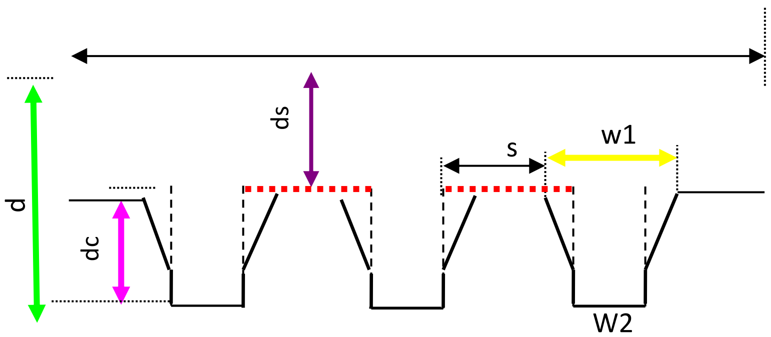


Figure (1) is a geometric diagram showing the shape of the soil section after plowing.

A= b*ds+(3*(w1+w2)/2) dc…….

Since

A = Area of loosened soil (m2)

b = actual working width after plowing (cm)

ds = depth of tilled soil (cm)

W1 = width of groove from top (cm)

W2 = width of the bottom of the groove (cm)

dc = groove depth (cm)

s = distance between the grooves of the rear arms (cm)

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42

https://jam.utq.edu.iq/index.php/main   *https://doi.org/10.54174/utjagr.v13i1.323*

A

B

Figure No. (2)AView showing the weapons used in the ploughBA view showing the developed drill plough during the experiments.

TransactionsExperience

The mechanical experiment to measure the field performance indicators of the developed drill plough included the following factors:

Four different types of upper arms in the back row were used in the developed chisel plough (cut with a width of 20 cm, cut with a width of 15 cm, pointed with a width of 20 cm, pointed with a width of 15 cm) and three depths of ploughing (15, 25, 35) cm and two forward speeds of the tractor (1.87 km/h and 2.74 km/h) and the number of engine revolutions was fixed at both speeds at 1500 revolutions/min to obtain the best torque from the engine. The traditional chisel plough was also used in the experiment under the same experimental conditions as a comparison treatment.

The codification of the levels of the coefficients used in the experiment is as shown in the table below.

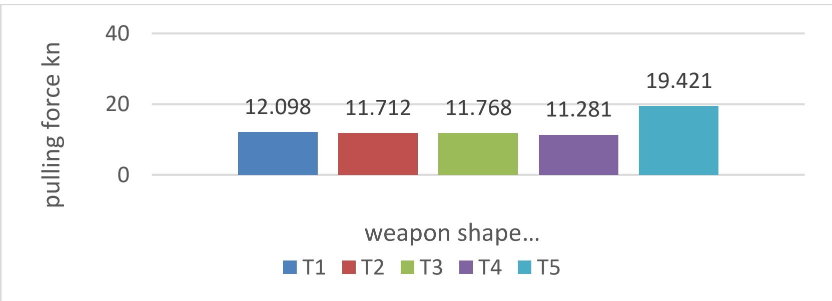
University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Weapon form levels	
T1	Cut to 20cm width
T2	Cut to 15cm width
T3	20cm wide tapered
T4	15cm wide tapered
T5	Sparrow tongue (traditional)
Plowing depth levels	
D1	Depth 15cm
D2	Depth 25cm
D3	Depth 35cm
Forward speed levels	
G1	First speed (1.87 km/h)
G2	2nd speed (2.74 km/h)

III. Results and discussion

Drag force

The results shown in Figure (3) show a highly significant effect of the type of weapon used, as the results showed the superiority of all types of weapons of the developed digger plough over the traditional digger plough(T5) The traditional drill plough recorded the highest pulling force of 19,421 kN.m^{-2}, while the 15 cm wide pointed weapon type outperformed (T4) and recorded the lowest pulling force of 11.281 kN.m^{-2}. This may be due to the shape of the developed plough blades, which facilitated the penetration of the soil and cut it from the sides as a result of the blade edges being cut at an inclined angle, thus reducing the required pulling force. This was in line withNaeemi(7) They noticed an increase in the amount of pulling force as the width and cross-sectional area of the plow blade used with the drilling plough increased..It is also noted from the results in Figure (4) that the pulling force increases as the ploughing depth increases, where the depth was recorded at 35 cm (D3) The highest pulling force reached 15.577 kN/m^2 while the depth exceeded 15 cm.(D1) with a record low drag of 10.807 kN. m^{-2}.andmayThis is because the pulling force increases as thePlowing depth increases soil strength with depth as well as increasingThe volume of soil accumulated in front of the plow, which increases with increasing plowing depth. (3).It is also noted in Figure (5) that the first speed is superior (G1) recording the lowest pulling force of 12.841 kn. m^{-2} while the drag force increased with increasing speed, as the second speed recorded 2.74 km/h (G2) Maximum pulling force was 13,671 kN. m^{-2}While the binary interaction between the depth of plowing and the shape of the weapon, Table No. (1) recorded the superiority of the pointed weapon with a width of 20 cm (T3) at a depth of (15 cmD1) It recorded the lowest pulling force of 8.019 kN/m^2. The reason may be attributed to the shape and width of the blade with the shallow depth to reduce the force required for pulling, while in the conventional plough (comparison factor) the width of the plough and the angle of inclination of the blades made it record the highest pulling force.



University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Figure (3) shows the effect of the weapon shape on the pulling force.(kiloNewton)

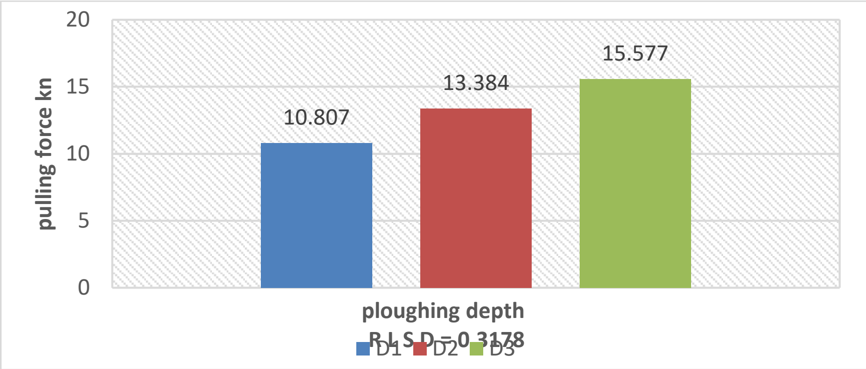


Figure (4) shows the effect of ploughing depth on the pulling force.(kiloNewton)

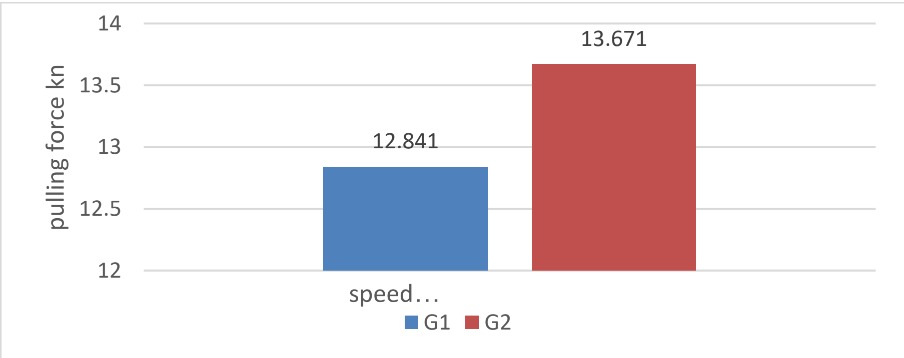


Figure (5) shows the effect of speed on the pulling force.(kiloNewton)

Table No. (1) illustrates the effectBinary interference toType of weapon and depth of tillage in pulling force (kilograms)Newton)

Plowing depth			Weapon type
D3	D2	D1	
13,810	11,648	10.835	T1
13,605	11.203	10.327	T2
14.100	13.185	8,019	T3
12,380	10.965	10.498	T4
23.988	19.918	14.357	T5

RLSD=0.7606

Disturbed area:

We note from Figure (6) that there is a highly significant effect of the type of plow and the weapon used on the characteristic of the loosened area, as the traditional digging plow is superior (T5) The highest rate of disassembled area was recorded at 4597 cm^2, followed by treatment (T1)The value of the dismantled area was recorded at 4015 cm^2. The reason for obtaining these results is that the design working width of the traditional chisel plough is greater than that of the developed chisel plough.(9).We notice from Figure No. (7)There is a significant effect of the depth of plowing on the loosened area of the soil, as we notice that the depth is superior(D3)If he recordedhigherspaceDisassembledAnd it reached5024cm^2While both depths recorded(D1) and (D2) averages were 2497cm^2 and 3547.cm^2

University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

respectivelyThe reason for obtaining these results may be attributed toTo the effect resulting from increasing the depth of plowingDepth is one of the basic components that go into calculating area.DisassembledThe area loosened increases in direct proportion to the depth of ploughing, as the cracks causing soil disintegration increase from the bottom of the ploughed soil section and move upwards, and this is consistent with what Get to it(16).As we note from Table No. (2) there is a significant effect of the two-way interaction between the type of weapon used in the developed digger plough and the depth of ploughing, as we note the superiority of the comparison treatment (the traditional digger plough(T5)And the depth of plowing(D3)By recording the highest value for the dismantled area if it reached 6463 cm^2, the reason for obtaining these results may be due to the large working width of the traditional chisel plough, while the lower cutting arms with a width of 20 cm helped in increasing the size of the section of the dismantled area, although the designed working width of the developed chisel plough is less than the traditional one. We note from Table No. (3)Having an impactMoral of the bilateral interaction between the used ploughing depth and the ploughing speed, as it is based on the dismantled area, as we notice the superiority of the ploughing depth(D3)With speed(G1)They recorded the highest value for the dismantled area, which amounted to 5041 cm, while the overlap between the ploughing depth was recorded(D1)Plowing speed(G2)The lowest value for the loosened area was 2339 cm^2. The reason for reaching these results may be attributed to the fact that the slow speed of the tractor makes the cracks that originate from the bottom of the plough foot get enough time to reach the surface of the plowed soil and thus obtain more cracks that contribute to increasing the loosened area to a greater extent.(17)

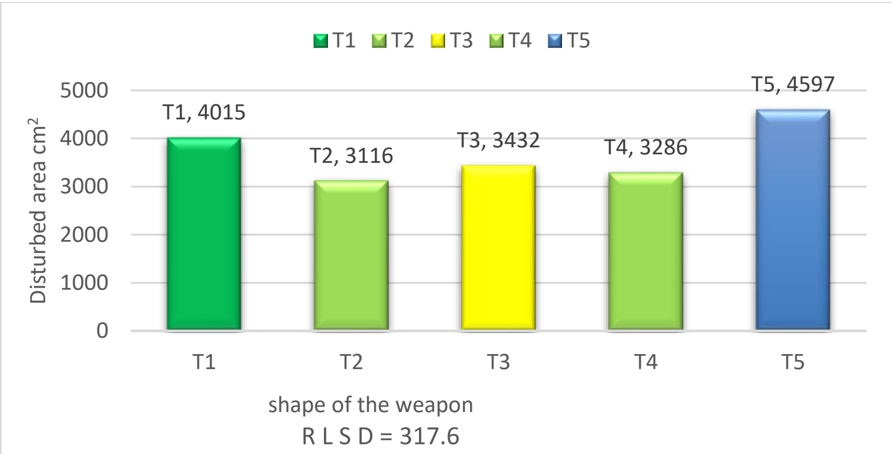
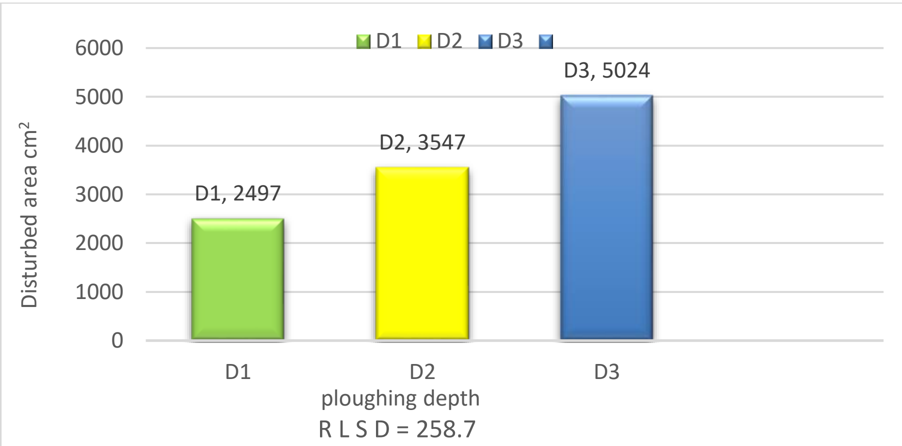


Figure (6) Effect of the shape of the weapon used on the Disturbed area of the soil in(cm^2)



University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Figure (7) Effect of ploughing depth on the Disturbed area (cm^2)

Table No. (2) The two-way interaction between the type of weapon and the ploughing depth in the Disturbed area cm^2

Plowing depth			Weapon type
D3	D2	D1	
5481	3785	2778	T1
4286	3133	1929	T2
4364	3353	2579	T3
4525	2860	2474	T4
6463	4604	2724	T5

RLSD =542.8

Table No. (3)Shows theinsideThe duo between plowing depth and plowing speed in Disturbed area cm^2

Plowing speed		Plowing depth
G2	G1	
2339	2656	D1
3628	3466	D2
5007	5041	D3

RLSD =287.7

Slipping percentage

The results of the statistical analysis showed that there was a significant effect of the type of plow weapon used on the percentage of slipping, as Figure No. (8) shows the superiority of the type of weapon(T4) The lowest percentage of slipping was recorded at 29.08%, while the traditional plough recorded(T5) The highest percentage was 44.4%. The reason for the increase in the slipping percentage of the traditional digger plough may be due to the working width as well as the shape of the traditional digger plough weapon which requires a higher pulling force and thus increases the slipping percentage. Also, the use of a duck foot weapon in the front row of the developed digger plough and two different weapons in the back row of the developed digger plough, which are a pointed upper undercut weapon and the other a bird tongue that is located at the bottom, contributed to facilitating the task of penetrating the soil and facilitating the work of the plough and plowing, thus reducing the percentage of slipping. This is consistent with what is recommended.tomechanism(7).

The results in Figure (9) also showed a significant effect of ploughing depth on the percentage of slipping, which increases in all types of weapons when ploughing depth increases, as the depth exceeds 15 cm (D1)The lowest sliding percentage was 27.53%, due to the increase in soil cohesion, the increase in the amount of its compression, and the alignment of soil particles as the depth of ploughing increases. This requires the expenditure of greater traction force to overcome the soil reaction, and this in turn makes the percentage of slipping increase with the increase in ploughing depth. These results are consistent with what was reached.(18)and(19).

thatThe ploughing speed has a highly significant effect on the percentage of slipping. We note from Figure (10) that the first ploughing speed(G1)The lowest slipping percentage was recorded at 32.35%, while the second ploughing speed was recorded at(G2)The highest slip percentage rate was 35.67%. This may be attributed to the decrease in torque generated by the tractor due to the increase in speed. This reduces the tractor’s pulling capacity and thus increases the slipping percentage. This is consistent with what was reached by(20)Which concluded that increasing the speed leads to an increase in the amount of pulling force to overcome the resistance of the soil masses gathered in front of the plow weapon. We note from Table No. (4) the presence of a significant effect of the triple interaction between the weapon type, plowing depth and plowing speed in the characteristic of the percentage of slipping, as we note the superiority of the weapon type, the tapered undercut with a width of 15 cm.(T4) And the depth of plowing(D1)With first forward speed(G1)It recorded the lowest percentage of slipping, reaching 21.65%, while the comparison transaction recorded(T5)With depth plowing(D3)Second front plow speed(G2)The highest percentage of slippage was 59.82%.

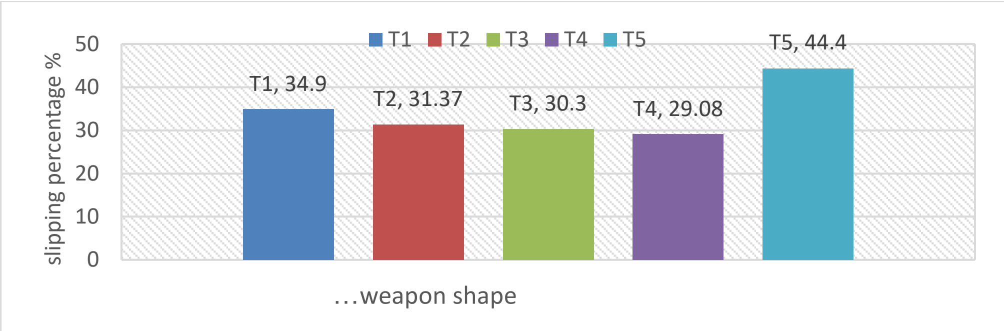


Figure (8) Effect of weapon shape on slipping percentage%

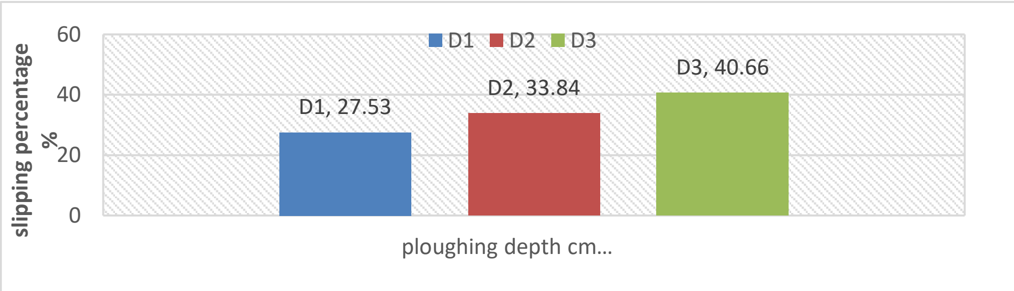
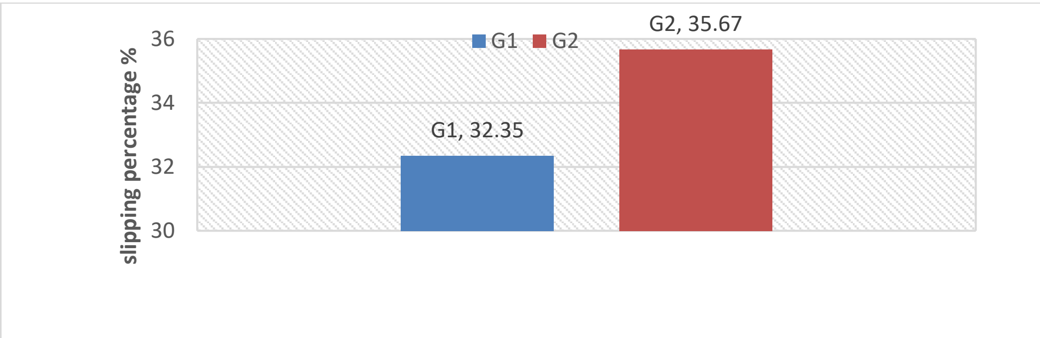


Figure (9) Effect of ploughing depth on the slipping percentage %



Shape number (10)Effect of tillage speed slipping percentage%

University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main *https://doi.org/10.54174/utjagr.v13i1.323*

Table (4)Effect of the type of weapon used, ploughing depth and ploughing speed on the percentage of slipping %

Plowing depth						Weapon type
D3		D2		D1		
G2	G1	G2	G1	G2	G1	
42.33	35.55	33.07	32.94	32.52	33.01	T1
37.11	35.86	35.26	28.82	27.82	23.33	T2
37.55	35.90	32.13	31.72	22.73	21.79	T3
37.10	36.55	33.33	23.35	22.48	21.65	T4
59.82	48.78	45.62	42.18	36.18	33.83	T5

R.L.S.D =5.796

Fuel consumption rate:-

Figure No. (11) shows the presence of a highly significant difference between the different types of weapons used in the developed drill plough. The results also showed that using the type of pointed weapon with a width (15 cm) (T4) With the developed digger plough, it contributed to reducing the fuel consumption rate, as it recorded the lowest fuel consumption rate of 5.726 liters.h^{-1}, while the traditional digger plough recorded the highest fuel consumption rate of 9.386 liters.h^{-1}. The reason for obtaining these results may be attributed to the high pulling force that must be available to pull the traditional digger plough and the shape of the traditional digger plough arms that require greater effort to penetrate the soil during plowing, while it was noted that the pulling force of the developed digger plough was less, as well as the ease of its penetration of the surface of the soil to be plowed, due to the presence of a different combination of arms, the front duck leg, as well as the bird's tongue in the back row, which facilitated the process of the plow penetrating the soil. These results are consistent with what is recommended.tomechanism (5)& (21).

The results also showed a significant effect of plowing depth and plowing speed on the fuel consumption rate, Figures (12) and (13), as the depth exceeded 15 cm (D1) It recorded the lowest fuel consumption rate of 6.06 liters/h^{-1} and the first speed exceeded 2.74 km/h^{-1} (G1)The lowest fuel consumption rate was recorded at 6.10 liters/h^{-1}. This may be due to the increased load on the engine when increasing the ploughing depth, as the plough blades work to break up a larger volume of soil. The cohesion and adhesion of the soil also increase when the ploughing depth increases, as the moisture content of the soil at a depth of 35 cm increases the cohesion between the soil particles and increases the adhesion between the soil particles and the surface of the plough blade. Increasing the ploughing speed also increases the fuel consumption rate. This may be due to the increased acceleration of the soil masses during ploughing. Increasing the speed also increases the required pulling force, which leads to an increase in the fuel consumption rate (22)&(6)

The results showed a significant effect between the interaction between the depth of plowing and the shape of the blade in the plow used on the fuel consumption rate, as Table No. (5) shows the superiority of the developed pointed type drill plow. (15 cm wide) with (15 cm) plowing depth (T4 D1) They recorded the lowest fuel consumption rate of 4.782 litres.h^{-1}, while the traditional drill plough with a ploughing depth of 35 cm (T5D3) recorded The highest fuel consumption rate reached 11.358 liters.h^{-1}The reason may be attributed to the increase in depth and thus the increase in the force required to overcome the shearing and stirring of the soil, while the shape of the weapon in the developed plough affected the process of penetrating and cutting the soil with less force requirements, and this reduced fuel consumption significantly (23) & (6).

University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

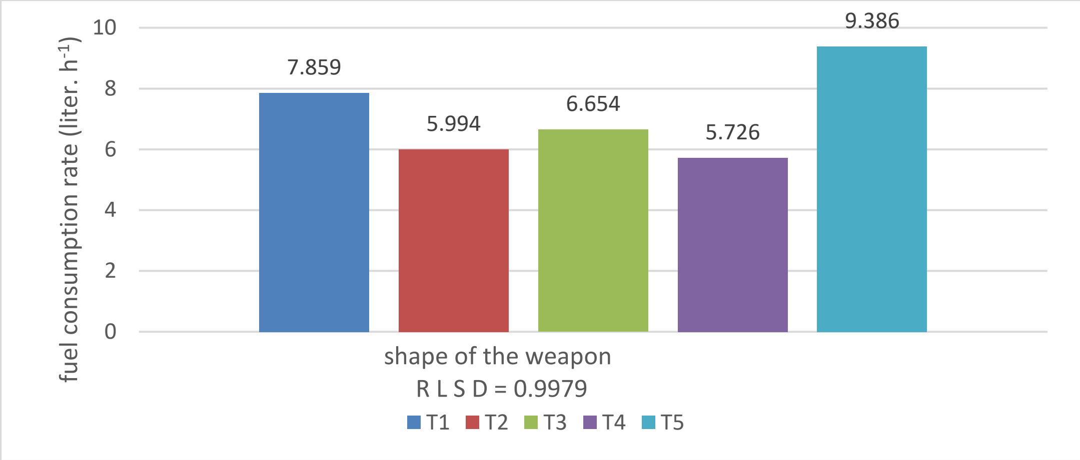


Figure (11) The effect of the shape of the weapon used on the fuel consumption rate (liter. h^{-1})

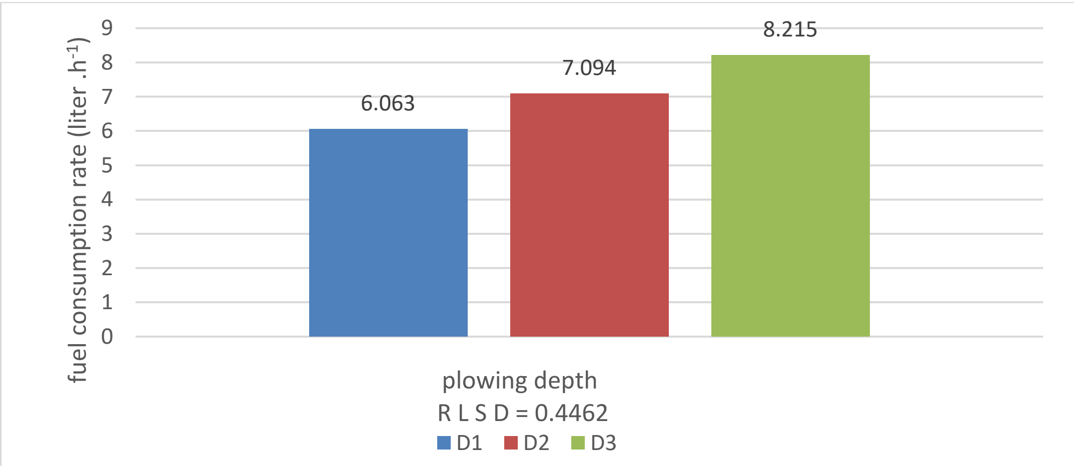


Figure (12) Effect of plowing depth on fuel consumption rate (liter .h^{-1})

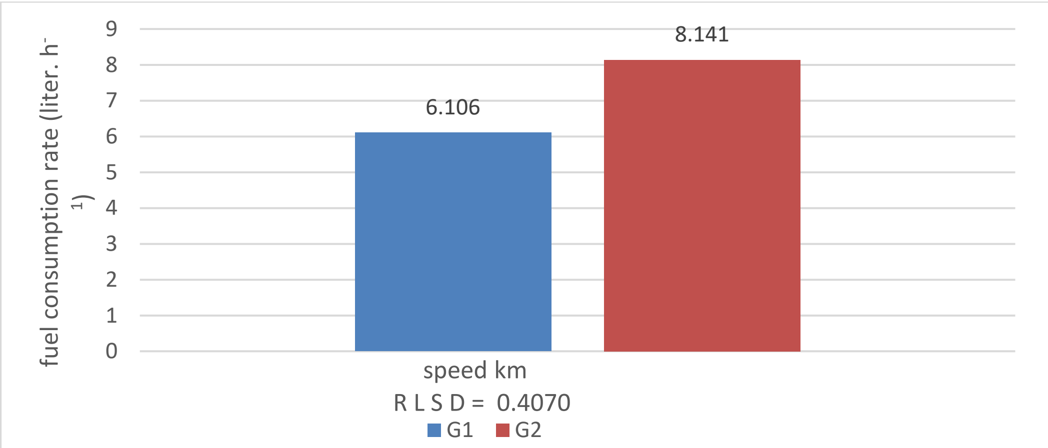


Figure (13) The effect of speed on fuel consumption rate (liter. h^{-1})

University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Table No.(5)Effect of weapon shape and ploughing depth on fuel consumption rate(liter. h^{-1})

Plowing depth			Weapon type
D3	D2	D1	
9.19	8.57	5.818	T1
6.483	5.503	5.995	T2
7.478	6.667	5.817	T3
6.563	5.833	4.782	T4
11.358	8.895	7.905	T5

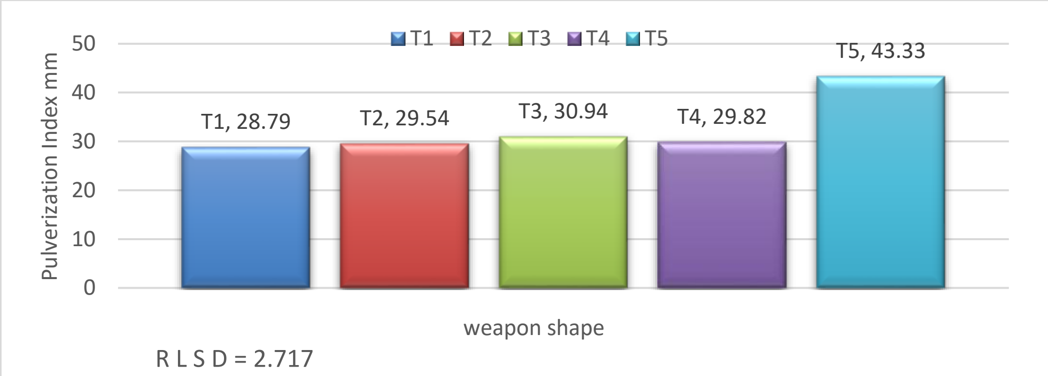
RLSD=1.2128

Pulverization Index

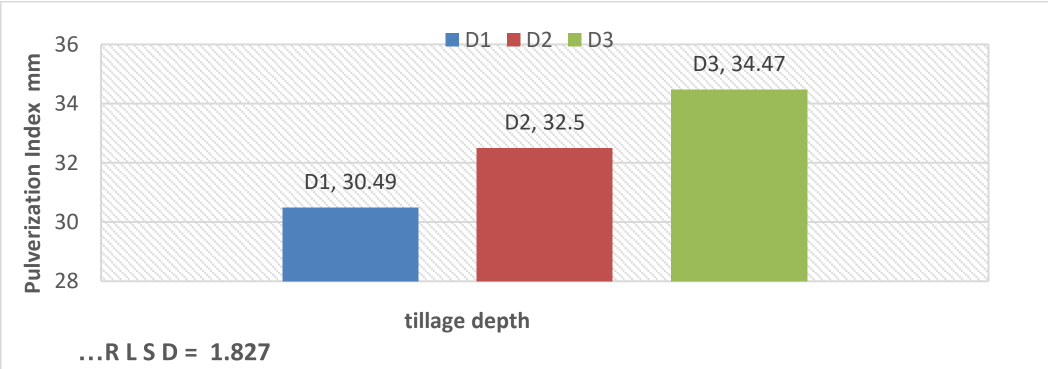
The results of the statistical analysis showedThere is a highly significant effect of the type of undercut weapon used in the developed drilling rig on the property of the Pulverization Index

(weighted diameter rate), as we notice from Figure No. (14) Superiority of the shear weaponCut (20cm wide) (T1) The lowest weighted diameter was recorded at 28.79 mm, while the traditional chisel plough(t5) recorded The highest rate of Pulverization Index is 43.33 mm. The reason for the superiority of the lower cut shear weapons may be due to the large area of frontal contact between them and the plowed soil masses. This matter contributed to their superiority and the increase in the percentage of fragmented soil masses and their recording of the lowest rate of weighted diameter compared to the traditional digger plough, whose work is limited to only splitting the soil and lifting the soil masses upwards only. This is consistent with what is recommended.tomechanism(24). Figure No. (15) shows the presence of a highly significant effect of ploughing depth on the Pulverization Index characteristic, as we notice the superiority of depth.(D1)Recording the lowest weighted diameter of 30.49 mm, it surpassed the depth(.D3)The highest recorded Pulverization Index was 34.47. mmThe reason for obtaining these results is attributed to the increase in the size of the large soil masses and the increase in the depth of plowing, as the soil in the lower soil layers is more cohesive and has a high apparent density and low porosity and is compacted due to the passage of time or the passage of agricultural machinery. These matters contribute to the formation of larger soil masses the deeper we plow, and this is similar to what the researcher has reached. (24) We note from Table No. (6) the presence of a highly significant effect of the two-way interaction between the shape of the weapon and the depth of plowing on the characteristic of the Pulverization Index, as we note the superiority of the type of weapon(.T1)With plowing depth(D1)The lowest value of the Pulverization Index was recorded at 23.94. mm while the comparison treatment (traditional chisel plough T5) recorded With plowing depth(D3)The highest value of the Pulverization Index was 44.94 mm.The reason for obtaining this result may be attributed to the role of the lower shear weapon in increasing the fragmentation of the swollen earth masses resulting from soil ploughing, if the shape of the weapon and its wide contact area contributed to exposing the earth masses to pressure from this weapon, which led to increased fragmentation of the swollen earth masses resulting from ploughing (17).

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323



Shape number (14)Effect of weapon shape on Pulverization Index (mm)



Shape number (15)Effect of tillage depth on Pulverization Index (mm)

Table No.(6)Effect of weapon shape and tillage depth on Pulverization Index (mm)

Plowing depth			Weapon type
D3	D2	D1	
34.12	28.30	23.94	T1
31.67	29.45	27.50	T2
32.91	30.44	29.47	T3
28.70	31.77	29.00	T4
44.94	42.54	42.50	T5

RLSD=4.073

IV. Conclusions

1-Weapon type superiority(T4)(15cm wide)(tapered undercut weapon) recorded the lowest pulling force and lowest slipping percentage, as well as the lowest fuel consumption rate and the lowest amount of power lost by slipping.

2- Superiority of weapon type(T3)(20 cm wide) (pointed undercut weapon) in the two characteristics of actual field productivity and the volume of soil stirred, as it was observed that it recorded the highest rates in these two characteristics.

3- Superiority of weapon type(T1)(20cm wide undercut shear weapon) in the form of a Pulverization Index.

4- The first plowing depth is greater(.D1)In all mechanical performance indicators of the chisel plough except for the characteristics of loosened area and volume of soil disturbed, in which the ploughing depth exceeded(D3).

5- The ploughing speed is superior.(G1)In all technical indicators of mechanical performance of the drill plough, except for the two characteristics of actual field productivity, in which speed was superior.(G2)By recording the highest value.

6- Adding the lower cut-off shear weapon to the developed drill plough has contributed to increasing soil fragmentation after ploughing and decreasing the value of the Pulverization Index

7- The addition of the tapered undercut weapon has contributed to increasing the volume of the soil stirred and the area of the soil loosened.

8- The bilateral interactions were significant in all the characteristics of the mechanical performance indicators studied.

V. Refrences

Upadhyaya, S.K.; Lancas, K.P.; Santos–Filho, A. G. and Raghuwanshi, N. S. (2001). Evaluation of one-pass tillage equipment versus conventional tillage system. University of California, Davis, CA 95616.

Muhsin, S.J. (2017). Determination of energy requirements, plowed soil volume rate and soil pulverization ratio of chisel plow under various operating conditions. Basrah Journal of Agricultural Sciences, 30(1), 73-84.

Moinfar, AM ; and G. Shahgholi. (2018). Dimensional Analysis of the Tractor Effective Efficiency Parameters. Acta Technological Agriculture. 21(3): 94-99.

Moeenifar, A., Seyedi, S. M., & Kalantari, D. (2013). Determination of traction force acting on a wide blade using dimensional analysis method. International Journal of Agriculture and Crop Sciences, 5(13), 1403.

O, AN, Dahab, M.H., Wenyou, H., Ahmed Mohamed, M., Rahma, A.E., Elsir, A., Jiao Dong, H., Izzeldin, S., & Abdeen, M. (2018). Effects of chisel plow shank*s distribution arrangements and forward speed on machine performance index in clay soil*.www.globalscientificjournal.comwww.globalscientificjournal.com

Ghali, Aleawi.A. (2019). Effect of soil Moisture and Tillage Depth on some Mechanical Properties for Tillage Machines Type (Moldboard Plow). Journal of University of Babylon for Pure and Applied Sciences, 27(2) 195-207.

Al Nuaimi, B., & Al Rijabo, S. (2020). Design and Manufacture of Chisel Plow Shares and Their Effect on Some Field Performance Indicators. Tikrit Journal for Agricultural Sciences, 20(1), 10-19.

Alfaris, M. A., Almaliki, S., & Muhsin, S. J. (2020). Effect of Adding Wings to the Shallow Tines on the Performance of Subsoiler Plow in the Soil Disturbed Area, Soil Pulverization Index & Equivalent Energy of Pulverization. Basrah Journal of Agricultural Sciences, 33(2), 196-206.

Salar, M.R., Karparvarfard, S.H., Askari, M., & Kargarpour, H. (2021). Forces and loosening characteristics of a new winged chisel plow. Research in Agricultural Engineering, 67(1).

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 2 (2024) PP 28-42
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Alsharifi, SKA, Ghali, AA, & Hamzah, IJ (2021a). A study some growth characteristics for maize, Bohooth 106 variety under affecting mechanical for machine (moldboard plow type). In IOP Conference Series: Earth and Environmental Science (Vol. 735, No. 1, p. 012007). IOP Publishing

Ranivoson, AZ; SC Gupta, and JF Monerief (2001). Wapp simulated tillage effect on run off and sediment losses in a corn–soybeans USDA rotation. Natural soil erosion research lab. 877-881.

Blednykh VV, Svechnikov PG, Troyanovskaya IP (2015). Analytical model of soil pulverization and tillage tools. International Conference on Industrial Engineering.Procedia Engineering 129; 69 – 74

Kepner, R. A. Bainer, R. and Barger, E. L. (2000). Principles of farm machinery. third edition. CBS polishers and distributors. New Delhi. India.

Mekyes, E. (1985). Soil Cutting and Tillage.1st. ed. Elsrvier science publisher.

Hillel, D. (1980). Application of soil physics. Academic press New York.

Siddiq, A., & AL-Obaidi, YYM (2019). Evaluation of heavy chisel plow performance at different speeds in terms of some mechanical performance indicators. Mesopotamia Journal of Agriculture, 47(1), 59-69.

Abd Al, MAAA, & Al-Faris, N. (2023). Study of the effect developed chisel plow on some energy requirements and some soil properties in a clayey mixture soil. University of Thi-Qar Journal of agricultural research, 12(2), 59-69.

Dahham, Ghazwan Ahmed (2018). Study effect of some field factors in determining the performance of agricultural tractors, Rafidain Agriculture Journal, Volume (46), No.(4). edition. CBS polishers and distributors. New Delhi. India.

Mamkagh, Amer M. (2019). Effect of Soil Moisture, Tillage Speed, Depth, Ballast Weight and, Used Implement on Wheel Slippage of the Tractor: A Review. Asian Journal of Advances in Agricultural Research, 9(1): 1-7, 2019; Article no. AJAAR.46706 ISSN: 2456-8864.

Abdul-Kreem, TT (2017). Studying of some Mechanical Indictors for Different Mechanized Units of Tillage Systems under Gypsum Soil Conditions. Tikrit Journal for Agricultural Sciences, 17(2).

Barut, Z. B., & Özdemir, S. (2024). A Research on Metal and Metallurgical Properties of Chisel Plow Shanks. In BIO Web of Conferences (Vol. 85, p. 01007). EDP Sciences.

Jebur, Hussain A., Yasir A. and A. Alsayyah (2016). the effect of soil moisture content on the energy requirement and fuel consumption of the machinery unit. International Journal of soil. Engine Engineering Sciences & Research Technology, 5(10), 261-266.

Alfaris, M.A., & Almaliki, S. (2022, July). Effect of tillage depth and lateral distance of shallow plows on the mean weight diameter and the energy of soil fragmentation by using locally manufactured Subsoiler plow. In IOP Conference Series: Earth and Environmental Science (Vol. 1060, No. 1, p. 012129). IOP Publishing.

Abo-Habaga, MM (2022). Comparison among Three Chisel Plow Shares Forms. Journal of Soil Sciences and Agricultural Engineering, 13(1), 39-42.