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Analysis of the stress affecting the cutting knives locally manufactured in the moldboard plough with the measurement of some of the indicators studied

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Abstract

The study was conducted in a theoretical part, using the finite element method and the main stresses and safety coefficients were adopted on the sliding and disk knives, which are among the auxiliary parts in the work of the moldboard plough. The second part is the field evaluation of performance evaluation of the plough through three factors: cutting knives the sliding knife, the disk knife and without a knife, two levels of moisture content 9.73 % and 16.22 %, and two ploughing depths 15-20 and 25-30 cm. The following indicators were studied: drawbar capacity, fuel consumption, and percentage For slippage, vertical deviation and lateral deviation, the results showed that the subtractive plough without the cutting knife recorded the highest values of the drawbar capacity and vertical deviation, however the plough with sliding knife achieved the lowest values for the indicators which mentioned, the moisture content 16.22% recorded the lowest significant value for each of the drawbar ability and the percentage of slippage and deviation Lateral. Increaseing plough depths achieved the highest value of traction power, fuel consumption, percentage of slippage and lateral deviation, and the overlap between the plough with the sliding cutting knife and the ploughing depth of 15-20 cm achieved the least significant value for the traction ability, and also the overlap for the depth of 15-20 cm with the disk knife plough had the lowest fuel consumption.

Key words: plough stresses, moldboard plough knife, power, fuel consumption, vertical and horizontal deviations

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Introduction

The ploughing process is one of the largest agricultural operations is a need for energy from the total energy required by agricultural operations and represents about 30-50% of the total energy spent to prepare soil and prepare the bed for the growth of seeds [1], mention of [2] the decrease in moisture content and the increase in the depths of plough this led to the increase in the stress on the bottom plough caused resistance and load on the plough, [3] found in effect of soil moisture content on the energy requirements of the plough in mixture soils, that the soil moisture 8.92% recorded higher drawbar force compared to soil with moisture content 16.62% by 191.6 kg and by 25.54%. The increase is due to the fact that the dry soil needs a high drawbar force to overcome the strength of the soil cohesion and thus increase the requirements of the drawbar force, between [4],The design of the geometric shape of the moldboard plough has an important and essential role in reducing the requirements of the force of drawbars and consumption of the body of the moldboard plough bottom by reducing the friction that takes about 30% of a The total of the drawbar force, as they found that covering the board, railway and the chain of transmission has reduced the drawbar force by 15.74 % in the moisturizer content 20-25 %, as the design of the body covered with colors from the flow of the plough penetration of the soil due to the lack of friction and adhesion with the body compared to the traditional plough, [5],mentioned that high pressure on the municipal plough during the ploughing led to increase in fuel consumption, [6] found that among the most factors affecting the drawbar power and fuel consumption are the depth of ploughing and soil moisture and that the depths increase from 10-20 cm. 30% on the drawbar force and the increase in the drawbar power had a significant impact on increasing the slider of the outsiders

[7] noticed in studying the effect of soil moisture and ploughing depths on some mechanical properties of the moldboard plough with two levels of soil moisture content 13-15% and 15-17% and three levels of depths of 10, 12 and 14 cm where the moisture content exceeded 13-15 Significantly, on the content 15-17% with a slippage rate of 8.36% and 9.35%, respectively, while the depth exceeded 10 cm, and the lowest slippage percentage was 7.960%, and when the depth increased to 14 cm, the highest slippage rate was recorded, which amounted to 9.83%. [8] showed that the moisture content has an important and influential role on the vertical deviation ratio and the actual ploughing depth, as when the moisture content decreased from 18% to 14%, it led to a decrease in the actual ploughing depth from 20.70 cm to 20.46 cm. Soil resistance to penetration of plough share increases with a decrease in the moisture content the soil, which leads to a decrease in the depth of ploughing, and this in turn is reflected in the percentage of vertical deviation in terms of increase and decrease.

The aim of the research is to know the effect of using locally manufactured cutting knives with the moldboard plough at the appropriate moisture content and ploughing depth by reducing the pressure on the main plough bottom and giving a well-defined and straight furrow wall and its reflection on reducing the required power requirements and improving the quality of ploughing.

Materials and methods

The agricultural field located in the Mosul city, Al –Rahmaniya area, which the experiment was conducted in 2019, the field area was used 2 hectares, experimental field was irrigated and the soil texture was a silty clay. M.F. 290 Tractor was used in the experiment, and at a forward speed 3.54 km/h, the moldboard plough made in Turkish was used And the type of the (AYDIN PULLUK), the weight of the plough is 290 kg with three cylindroidal bottoms type, the parts were used to help with the plough (the locally manufactured slider and disk knife) which showed in Figure 1 the shape of the design map of the slider knife and the disk knife that was designed with the arms attached to it and then manufactured by the researcher in the

Baraka laboratory in the manufacture of the right Mosul-Iraq, the metal test that the slider knife and the disk knife were made in the laboratories of the Department of Mechanical Engineering –College of Engineering-Mosul University which showed in table 1. After fixing the dimentions and measurements of the knives and the type of meyal used for them, the construction and desiggn was carried out using the finite element method (F.E.M.) in the (Ansys) program which showed in Fig. (2), the stresses distribution affecting on the knife as a result of the loads and forces applied to it. A factorial experiment was carried out according split split plot design of the Random Complete Block Design [9]. The experiment was containted three factors: the moisture content at two levels(9.73 and 16.22%), the type of cutting knives used with the plough with three levels (slider knife, disk knife and without the use of the knife), the ploughing depths with two levels (15-20) and (25-30) cm, and the variance was analyzed to show the significant defferences, Duncans multiple range test was used at the probability level (0.05) to compare the means of the different treatments and obtained data was statistical analyzed by using SAS system. The following indicators were studied:

The stress: The stress of the following equation [10],was calculated:

$$\sigma = \frac{F}{A} \quad ....(1)$$

σ : stress (N m^{-2}).
F : force (N).
A : area (m^2).

The drawbar power: calculated by the following equation [11]:

$$Pf = Ft \times Vp / 270 \quad ....(2)$$

Pf: drawbar power (hp).
Ft: drawbar force (kg).
Vp: practical speed (km h^{-1}).

The drawbar force was read and measured directly from the dynamometer drawbar meter, calculated, as in the following [12] equation:

$$Ft = Fpm - Frm \quad ....(3)$$

Ft: the force required for drawbars (kg).
Fpm: power force for the rear wheels of the front drawbar (kg).
Frm: The power of rolling resistance to the back drawbar wheels (kg).

Fuel consumption: The amount of fuel consumed for the area unit was calculated by using a 1000 millimeters listed cylinder for each experiment units and a treatment line of 30 meters, then it was converted into a liter per hectare by the following equation [13]:

$$Fc = (Fca \times 10) / (Wp \times Lp) \quad ....(4)$$

Fc: the amount of fuel consumed for the area of space (L ha^{-1}).
Fca: the amount of fuel consumed and size (ml).
Wp: the actual work for ploughing (m).
Lp: The length of the transaction line (m).

The slippage percentage which calculated according to the following equation [14]:

$$S = ((Vt - Vp) / Vt) \times 100 \quad ....(5)$$

S: The percentage of slippage percentage (%).
Vt: Theoretical Speed (km h^{-1}).
Vp: Practical Speed (km h^{-1}).

The theoretical speed of the following relationship has been calculated:

$$Vt = (L / Tt) \times 3.6 \quad .... (6)$$

L: The length of the ploughing line (m).
Tt: Theoretical time is to travel the distance (s).

The practical speed of the drawbar was calculated from the following relationship:

$$VP = (L / Tp) \times 3.6 \quad .... (7)$$

L: The length of the ploughing line (m).
Tp: The actual time taken to travel the distance (s).

The percentage of vertical deviation which calculated by the following equation [15]:

$$asr = \sum ap/np \quad .... (8)$$

asr: Average depth (m).
ap: Size depth (m).
np: The number of repeated.

$$\Delta a = \sqrt{\sum (ap - asr)^2 / np} \quad .... (9)$$

$$\delta a = (\Delta a \; / \; asr) \times 100 \quad ....(10)$$

Δa: The average deviation of the depth (m).
δa: The percentage of vertical deviation (%).

The percentage of side deviation calculated by the following equation [15]:

$$bsr = \sum bp/np \quad .... (11)$$

bsr: Average width (m).
bp: Size show (m).
np: The number of repeated.

$$\Delta b = \sqrt{\sum (bp - bsr)^2 / np} \quad \text{......................... (12)}$$

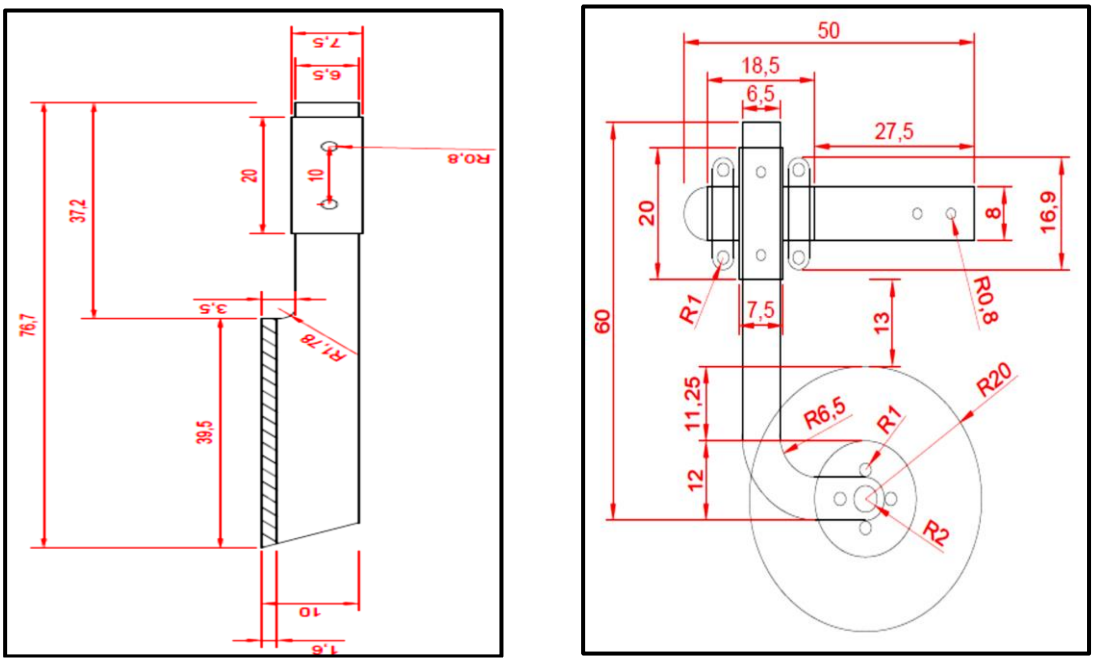
$$\delta b = (\Delta b / bsr) \times 100 \quad \text{.............................(13)}$$

Δb: The average deviation of the width (m).
δb: The percentage of side deviation (%).

Table 1:The mechanical properties and chemical composition of the slider and disk knife mineral

Chemical properties	Knife type	
	Slider	Disk
Phosphorous (%)	0.05	0.03
Sulfur (%)	0.18	0.02
Nickel (%)	0.02	0.03
Molybdenum (%)	0.23	0.01
Chromium (%)	0.88	0.04
Silicon (%)	0.29	0.02
Manganese (%)	0.74	0.2
Carbon (%)	0.71	0.39
Material type AISI	1074	1040

Mechanical properties	Knife type	
	Slider	Disk
Impact test (j)	43	72
Tensile strength (MPa)	270	600
Hardness (HRC)	38	75
Yield strength (MPa)	170	400
Elongation ratio (%)	17	19
Material type AISI	1074	1040



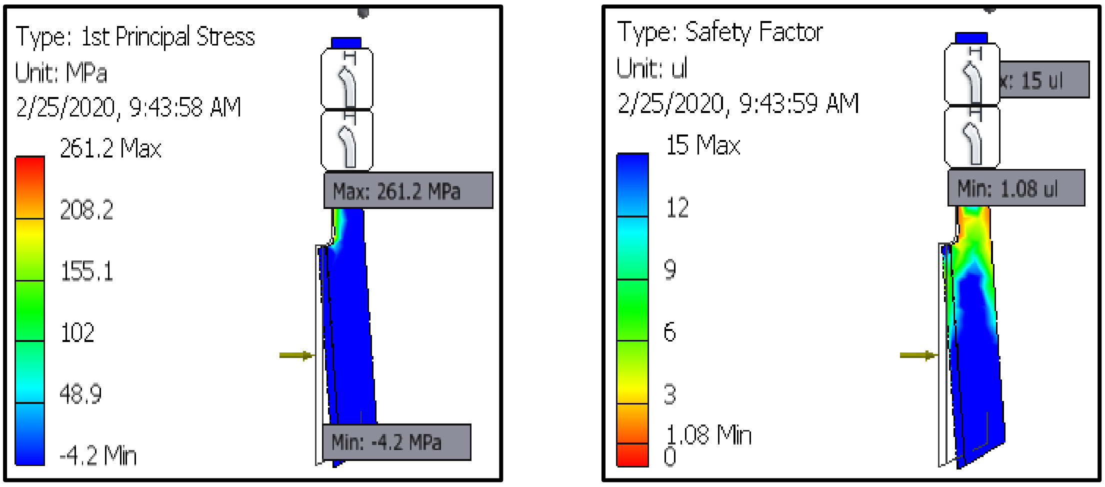
Slider cutting knife — Disc cutting knife

Figure 1: The scheme of the slider and disk cutting knife

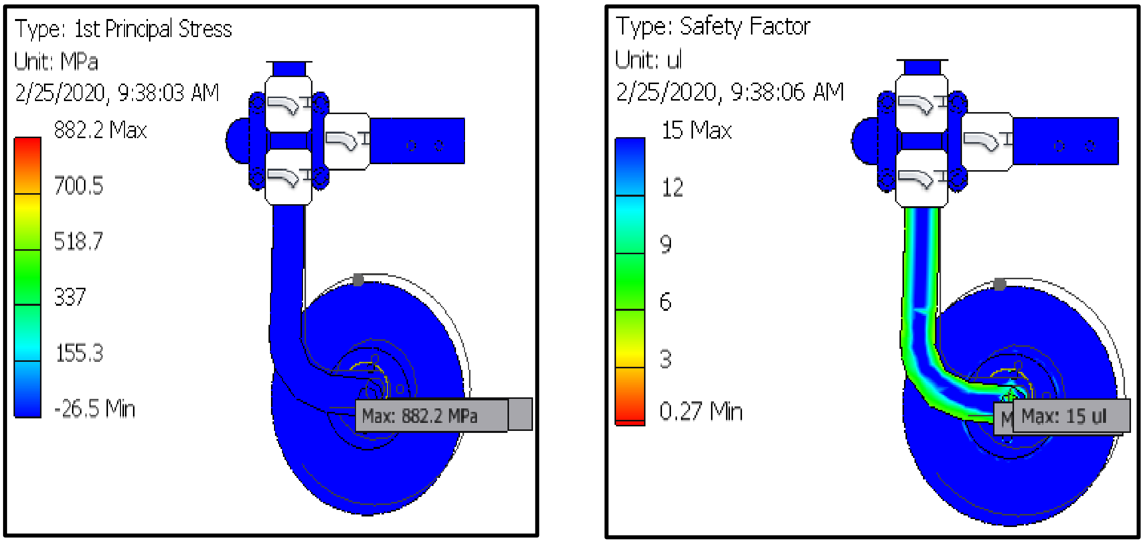
Results And Dıscussıon

Theoretical stresses (MN m²)

In figure 2. method (F.E.M.) was used in the (Ansys) program to show the stresses distribution that affect the cutting knife as a result the loads and the forces facing them under estimated conditions similar to the practical conditions by determining the main stresses and the safety factor of the locally manufactured sliding cutting knife and the disc cutter disc knife. Figure 2 shows the distribution of the main stresses and the safety factor, where the slider knife achieved the lowest main stresses 261.2 MPa, while the disk knife recorded the highest main stresses 882.2 MPa, and the safety factor of the slider and disk knife was 15.



Slider cutting knife



Disc cutting knife.

Figure 2: The distribution of the main stresses and the safety factor on the slider and disk cutting knife

Drawbar power (hp)

Table 2 shows that the drawbar power decreases with the increase in moisture content, where the moisture content recorded 9.73% the highest drawbar power and it was 7.37 hp, while the moisture content achieved 16.22% the lowest value and it was 6.84 hp and the reason for this is that the soil The dry one needs a high drawbar force to overcome the cohesion of the soil, as the resistance to penetration of the plough share in to the soil is high, and since the drawbar force is one of the components of the drawbar power, and thus the drawbar power increases. These results agreed with [16]and [3].

And it was found that there is a significant effect of the type of knife on the drawbar power, as the plough with slider knife achieved 6.37 hp, while the plough with disk knife recorded a bigger value and reached 7.04 hp, and the plough without using the knife scored the highest value and reached 7.90 hp, and the reason is that the geometrical design of the slider and disk knife facilitated the process of penetrating the soil and reducing the pressure and resistance on the plough body with cutting the soil by reaching half of the ploughing depth, as the penetration angle of the slider knife, which is in the range (60-70) degrees, is always greater from the angle of friction of the soil with the knife, and for all these reasons, the knife reduced the friction between the soil slice and the plough bottom and its reflection on reducing the wear and consumption of thphe bottom, and thus all this led to a reduction in the required drawbar power, and these results are consistent with the results obtained [4].

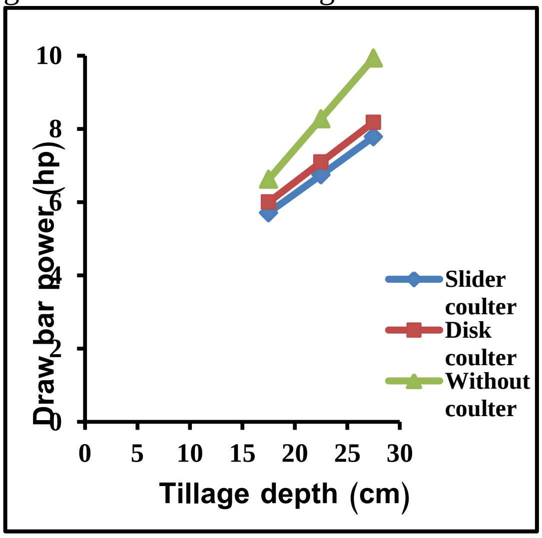
It was found that the depth of 15-20 cm was significantly superior to the depth of 20-30 cm in achieving the lowest significant value of the drawbar power amounted to 6.10 hp, while the depth of 20-30 cm recorded the largest significant value of the drawbar power and amounted to 8.10 hp and the reason is due This results in an increase in the load on the plough due to the increase in the volume of the ploughed soil with the increase in depth due to the high resistance it encounters, so the drawbar force increases.[17],[18],and moisture16.22% With the slider knife, the lowest drawbar power was 6.0 hp compared to other treatments, and the overlap between the depth of 15-20 cm and the moisture content was 16.22%, the lowest drawbar power was achieved, as it achieved 6.10 hp, and the depth was achieved 15-20 cm with the knife The slider has the lowest drawbar power of 5.48 hp compared to other treatments, caused the same reasons mentioned previously.

Table 2: The effect of the factors and their interactions on the character of the drawbar power (hp)

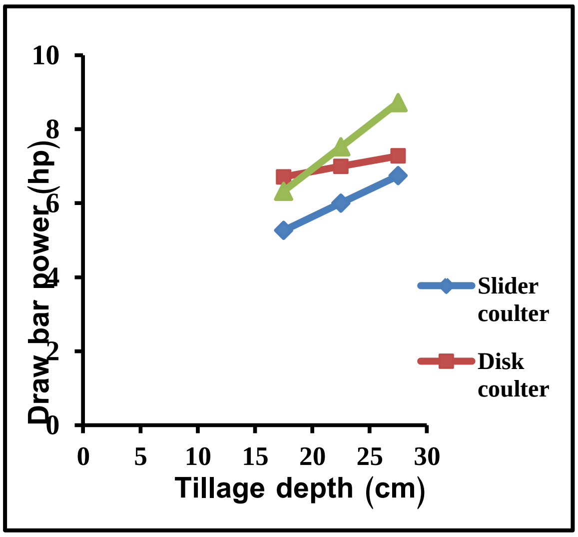
Knife type	Moisture content (%)		Tillage depth (cm)		Knife type effect
	9.73	16.22	20-15	30-25	
Slider	6.74	6	5.48d	b7.26	c6.37
Disk	7.09	7	6.36c	b7.73	b7.04
Without knife	8.27	7.52	6.47c	a9.33	a7.9
Moisture content effect	7.37a	b6.84			
The interaction between moisture content & depth	9.7 %		6.11	8.63	
	%16.22		6.10	7.58	
Tillage depth effect			6.1b	a8.1	

*Lower value is better

From Figure 3. for the triple interaction between the studied factors, the lowest drawbar power was recorded at the moisture content 16.22% for the depth of 25-30 cm with the plough with the slider cutting knife and it was 5.26 mechanical hp, while the highest drawbar power was recorded at the moisture content 9.73% with the plough without the knife and the depth 25-30 cm and was 9.93 hp.



Moisture content 9.73%



Moisture content 16.22%

Figure 3: The triple overlap between the studied factors in the characteristic of drawbar power

Fuel consumption (L ha^{-1})

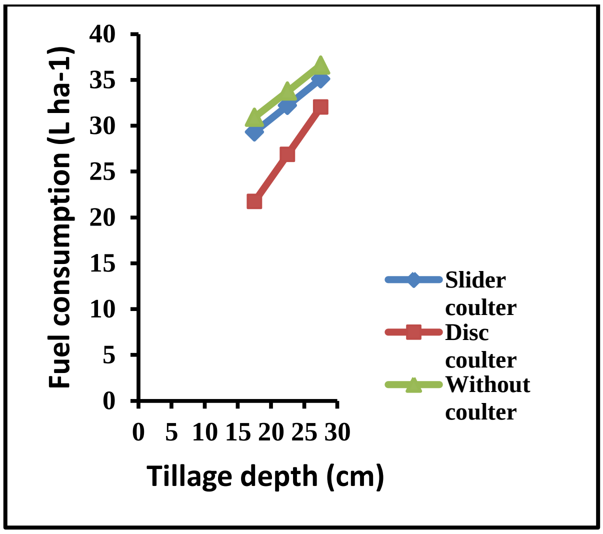
It is clear from Table 3 that there was on significant effect of moisture content on fuel consumption, as the moisture content 9.73% recorded the lowest fuel consumption at a rate of 30.9 L ha^{-1}, while the moisture content 16.22% recorded the highest fuel consumption value of 32.2 L ha^{-1}, and it was recorded the plough with the slider knife had the lowest fuel consumption of of 30.6 L ha^{-1} compared to the plough with the disk knife, which recorded a greater value of 30.9 L ha^{-1} and the plough without the knife, which recorded the largest value and reached 33.1 L ha^{-1}. The depth of 15-20 cm is significantly superior to the depth of 25-30 cm in achieving the lowest fuel consumption at a rate of 27.8 L ha-1 compared to the depth of 25-30 cm where it recorded 35.3 L ha^{-1}. By means of the plough weapons, which leads to an increase in the slippage of the tug tires and consequently an increase in fuel consumption [5]. The moisture 9.73% with the disk plough was fuel consumption amounted to 26.9 L ha^{-1} compared to other treatments, and the interaction between the moisture content was 9.73% with the ploughing depth of 15-20 cm less fuel consumption 27.3 L ha^{-1} compared to other treatments, and recorded disc knife at depth 15-20 cm less fuel consumption 26.6 L ha^{-1} compared to other treatments.

Table 3:The effect of the factors and their interactions on the character of fuel consumption (L ha $^{-1}$)

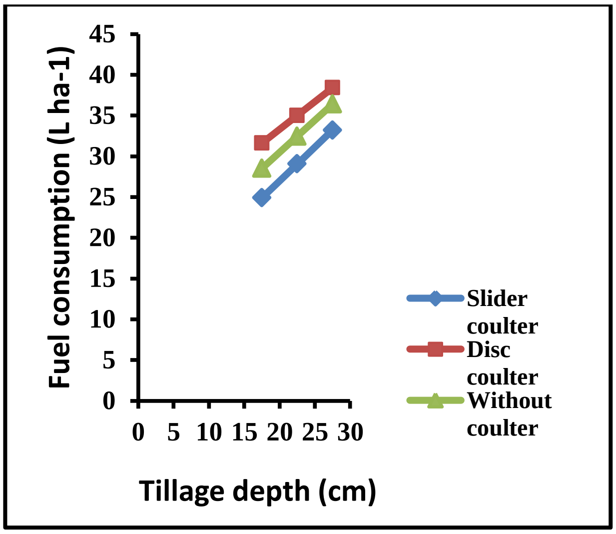
Knife type	Moisture content (%)		Tillage depth (cm)		Knife type effect
	9.73	16.22	20-15	30-25	
Slider	a32.2	b29.1	27.1	34.2	30.6
Disk	b26.9	a35	26.6	35.2	30.9
Without knife	a33.8	a32.4	29.7	36.5	33.1
Moisture content effect	30.9	32.2			
The interaction between	9.7 %		27.3	34.6	
moisture content & depth	%16.22		28.3	36	
Tillage depth effect			b27.8	a35.3	

* Lower value is better.

From Figure 4. for the triple interaction between the studied factors, the lowest fuel consumption was recorded at the moisture content 9.73% for the depth 15-20 cm with the disk plough and it was 21.7 L ha^{-1}, while the highest fuel consumption was recorded at the moisture content 16.22% with the disk plough The depth was 25-30 cm and was 38.4 L ha^{-1}.



Moisture content 9.73%



Moisture content 16.22%

Figure 4: The triple overlap between the studied factors in the characteristic of fuel consumption

Slippage percentage (%)

It is evident from Table 4 that the moisture content 16.22% was superior in achieving the lowest significant value of slippage at a rate of 13.92%, while the moisture content 9.73% recorded the highest significant value of 15.91%. The reason is that whenever the soil moisture content is ideal, the slippage is less due to the lack of cohesion of soil particles with each other with less soil adhesion to the working parts of the plough at the ideal moisture content the soil, which reduces the drag force and thus slippage. These results are consistent with the results obtained [19].

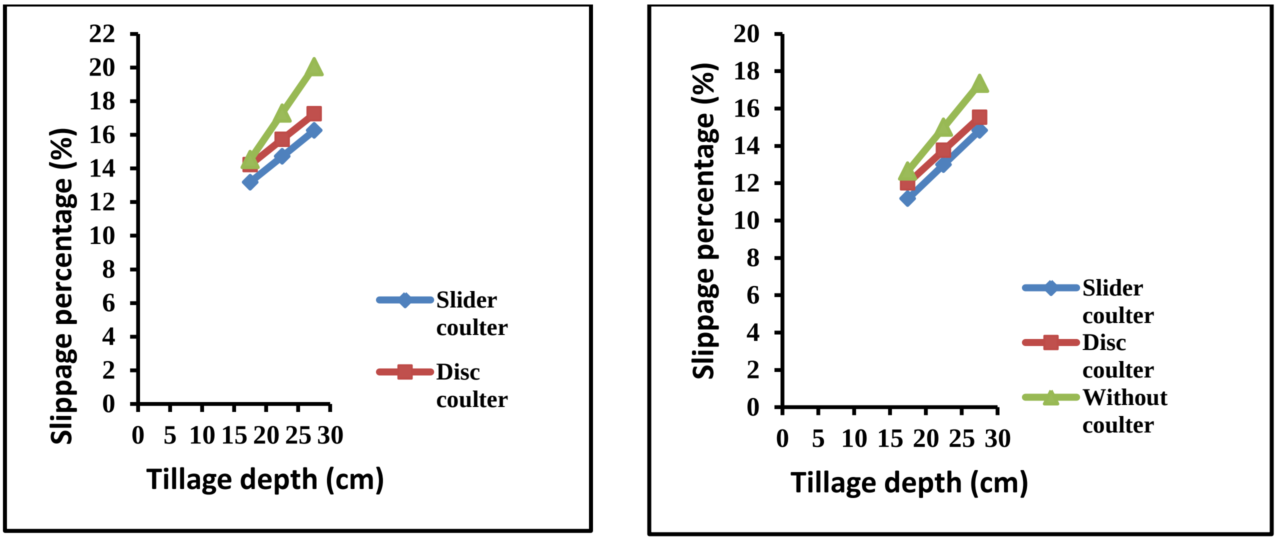
The plough with slider knife recorded the lowest slippage percentage of 13.86%, compared to the disk plough, which recorded a greater value of 14.75%, and the plough without knife, which recorded the highest slippage rate of 16.14%. Increasing the ploughing depths increased the percentage of slippage percentage. 15-20 cm was significantly superior to depth 25-30 cm in achieving the lowest slippage rate at a rate of 12.96% compared to depth of 25-30 cm, which recorded 16.87%. The reason for this is that increasing the depth of ploughing leads to an increase in the load on the plough due to an increase in the contact area between the soil slice and the plough body and an increase in the volume of the raised soil when the ploughing depth increases. These results are in agreement with the results obtained [20], and the interaction at the moisture content was 16.22% with the plough using the slider knife, the lowest percentage of slippage was 13% compared to other treatments, and the interaction between the moisture content was 16.22 % with ploughing depth of 15-20 cm the lowest percentage of slippage was 11.94%, compared with other treatments, and slider knife with moldboard plough at depth 15-20 cm recorded the lowest slippage rate of 12.17% compared with other treatments.

Table 4: The effect of the factors and their interactions on the character of slippage percentage %

Knife type	Moisture content (%)		Tillage depth (cm)		Knife type effect
	9.73	16.22	20-15	30-25	
Slider	14.72	13	12.17	15.54	13.86
Disk	15.73	13.77	13.12	16.38	14.75
Without knife	17.29	14.99	13.58	18.69	16.14
Moisture content effect	15.91a	13.92b			
The interaction between	9.7 %		13.97	17.85	
moisture content & depth	%16.22		11.94	15.9	
Tillage depth effect			12.96b	16.87a	

* Lower value is better

And from Figure 5. for the triple interference between the studied factors in the percentage of slippage, the lowest percentage of slippage was at the moisture content 16.22% with the plough with the slider cutting knife at a depth of 15-20 cm and it was 11.17%, while the highest slippage percentage was at the moisture content 9.73 % with a depth of 25-30 cm and a plough without a knife, and a value of 20.05% was recorded.



Moisture content 9.73% Moisture content 16.22%

Figure 5: The triple overlap between the studied factors in the characteristic of slippage percentage%

Vertical deviation ratio (%)

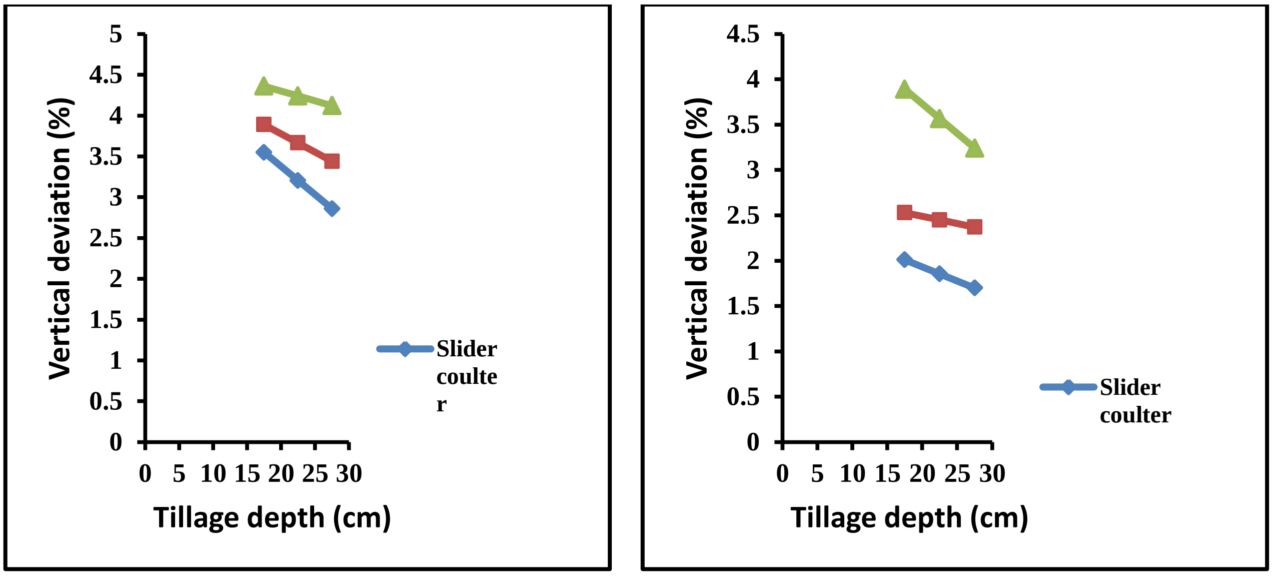
Table 5 shows that the moisture content 16.22% recorded the lowest vertical deviation rate of 2.62%, while the highest percentage of vertical deviation was recorded at the moisture content 9.73%, which amounted to 3.7%, and the plough with the slider cutting knife outperformed in recording the lowest vertical deviation rate of 2.53%, It was followed by the plough with the disk-cutting knife with a greater rate of 3.06%, while the plough without the cutting knife recorded the highest vertical deviation, which amounted to 3.90%. Cutting the soil with a small penetration angle and reducing the pressure on the bottom of the plough, thus maintaining the highest vertical stability with the lowest vertical deflection rate [21]. Depth 15-20 cm had the highest vertical deflection rate of 3.37%,while depth 25-30 cm less value it was 2.95% and the overlap between the moisture content was 16.22% with the slider knife, and the lowest vertical deviation rate was 1.85%, compared with other treatments, and the overlap between the moisture content was 16.22% with the depth 25-30 cm less A value of 2.44%, compared to other transactions irrigated, and the plough using the slider knife with a depth of 25-30 cm recorded the lowest value of the vertical deviation and it was 2.28%, compared with the other treatments.

Table 5**:** The effect of the factors and their interactions on the character of the Vertical deviation ratio (%)

Knife type	Moisture content (%)		Tillage depth (cm)		Knife type effect
	9.73	16.22	20-15	30-25	
Slider	3.21	1.85	2.78	2.28	2.53b
Disk	3.67	2.45	3.21	2.9	3.06 ab
Without knife	4.24	3.56	4.12	3.68	3.90a
Moisture content effect	3.7	2.62			
The interaction between	9.7 %		3.94	3.47	
moisture content & depth	%16.22		2.81	2.44	
Tillage depth effect			3.37	2.95	

* Lower value is better

The triple overlap of the studied factors of vertical deviation in Figure 6. showed that the moisture content 16.22% with the plough with the slider knife and the depth of 25-30 cm recorded the lowest value for the percentage of the vertical deviation and amounted to 1.7%, compared with the moisture content 9.73% with the plough without the cutting knife and the depth 15 -20 cm, which recorded the highest value of the vertical deviation was 4.36%.



Moisture content 9.73% Moisture content 16.22%

Figure 6: The triple overlap between the studied factors in the characteristic of Vertical deviation ratio%

Lateral deviation ratio (%)

It is clear from Table 6 that the moisture content outperformed 16.22% with the lowest lateral deviation rate of 0.55%, while the moisture content 9.73% recorded the highest lateral deviation rate of 0.75%, and the reason for this is that the increase in moisture content reduced the pressure of the lateral forces coming from the groove wall and preserved On the stability of the lateral plough, the plough with slider cutting knife recorded the lowest lateral deviation rate of 0.57%, compared with the disk plough with the highest lateral deflection rate of 0.70%, and the depth 15-20 cm achieved the lowest lateral deviation rate of 0.54%, while The depth of 25-30 cm recorded the highest lateral deflection rate and was 0.76%. The reason is that with increasing depths the pressure and the resistance of the lateral soil to the plough increase due to the increase in the volume and weight of the loosel y stirred soil that is placed on the body and leads to its deviation as a result of the lateral instability. These results are consistent with the results obtained by him [22].

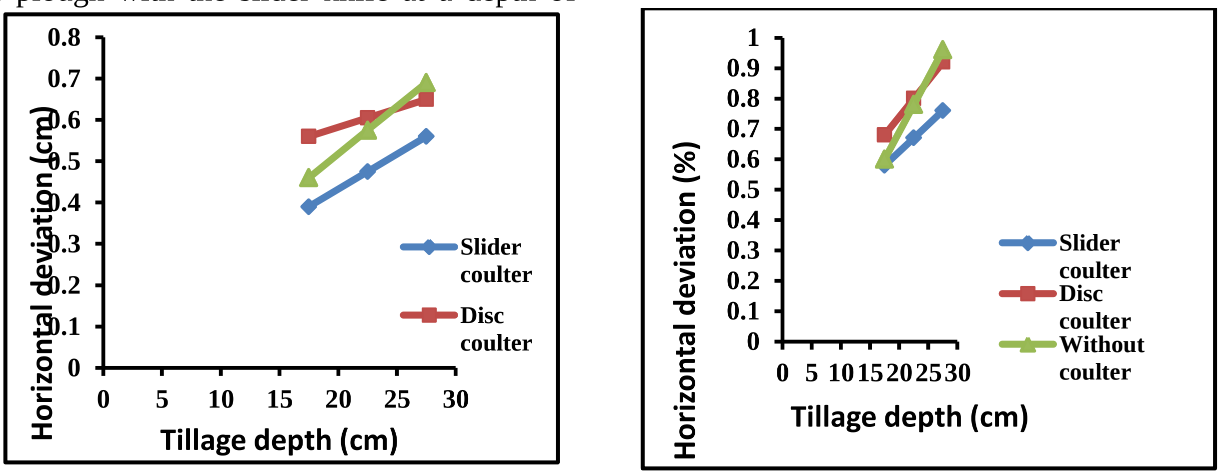
And the interaction between the moisture content 16.22% with the plough with the slider cutting knife recorded the lowest lateral deviation rate and was 0.48% compared with the other treatments, while when the interaction between the moisture content 16.22% with the depth of 15-20 cm, the lowest value recorded was 0.47% compared to the rest of the treatments. And from observing the interaction between the type of knife and the depth of ploughing, it was found that there is no significant difference on the characteristic of the lateral deviation ratio, as the slider knife with a depth of 15-20 cm gave the lowest lateral deviation of 0.48%, compared with the plough without a knife and the depth of 25-30 cm, which was recorded The highest value of the lateral deviation is 0.82%.

Table 6: The effect of the factors and their interactions on the character of the horizontal deviation ratio %

Knife type	Moisture content (%)		Tillage depth (cm)		Knife type effect
	9.73	16.22	20-15	30-25	
Slider	0.67	0.48	0.48	0.66	0.57
Disk	0.8	0.61	0.62	0.79	0.7
Without knife	0.78	0.58	0.53	0.82	0.68
Moisture content effect	a0.75	b0.55			
The interaction between	9.7 %		0.62	0.88	
moisture content & depth	%16.22		0.47	0.64	
Tillage depth effect			0.54b	0.76a	

* Lower value is better

Figure 7. shows the triple interaction between the studied factors in the aspect ratio characteristic that the lowest value was recorded at the moisture content 16.22% with the plough with the slider knife at a depth of 15-20 cm and it was 0.39%, while the highest value was recorded at the moisture content 9.73% with the plough Without a knife at a depth of 25-30 cm, it was 0.96%.



Moisture content 16.22% Moisture content 9.73%

Figure 7: The triple overlap between the studied factors in the characteristic of Horizontal deviation ratio%

Conclusıon

The slider knife achieved the lowest main stresses on the three axes than the disk knife, and when using the slider knife, it gave the lowest power, slippage percentage and vertical deviation ratio, when using the plough at the ideal moisture content 16.22% led to a decrease in the drawbar power, the percentage of slider and the percentage of lateral deflection. Low tillage depth delivers lower traction, fuel consumption, slippage percentage and lateral deviation ratio.

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تحليل الاجهادات المؤثرة في سكاكين القطع المصنعة محلياً للمحراث المطرحي القلاب مع قياس بعض المؤشرات المدروسة*

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المستخلص

أجريت هذه الدراسة بجزء نظري وذلك باستخدام برنامج (Ansys) طريقة العناصر المحددة (F.E.M) وقد تم اعتماد تأثير الإجهادات الرئيسة ومعامل الامان على السكين المنزلق والقرصي والتي تعد من الأجزاء المساعدة في عمل المحراث المطرحي، أما الجزء الثاني تم التقييم الحقلي لأداء المحراث مع السكاكين وبثلاثة مستويات هي السكين المنزلق والقرصي وبدون سكين وبمستويين للمحتوى الرطوبي 9.73% و16.22% وبعمقين للحراثة 15−20 و25−30 سم، تم دراسة الصفات التالية: قدرة السحب واستهلاك الوقود والنسبة المئوية للانزلاق والانحراف الرأسي والانحراف الجانبي، أظهرت النتائج ان المحراث المطرحي بدون سكين القطع سجل أعلى قيم قدرة السحب والانحراف الرأسي، فيما حقق المحراث مع السكين المنزلق أقل القيم للصفات المذكورة، وأن المحتوى الرطوبي 16.22% سجل أقل قيمة معنوية لكل من قدرة السحب والنسبة المئوية للانزلاق والانحراف الجانبي وان ازدياد أعماق الحراثة أعطى أعلى قيمة لقدرة السحب واستهلاك الوقود والنسبة المئوية للانزلاق والانحراف الجانبي وحقق التداخل بين المحراث بسكين القطع المنزلق وعمق الحراثة 15−20 سم أقل قيمة معنوية لقدرة السحب وايضا التداخل للعمق 15−20 سم مع المحراث بالسكين القرصي أقل استهلاك وقود.

الكلمات المفتاحية: الاجهاد، سكين القطع للمحراث المطرحي، القدرة، استهلاك الوقود، الانحرافات الرأسية والجانبية.