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Performance of locally manufactured chisel plough shanks In some different operation conditions.

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ABSTRACT
Included determining the dimensions and measurements required for the manufacture of excavator weapons, determining the appropriate type of metal, and manufacturing the plow weapons according to the dimensions and measurements. The field evaluation of competence took place. Manufacture of locally manufactured excavator plow weapons and compare them with traditional plow weapons and study some field performance indicators by conducting a practical experiment in which the following factors were adopted: The first factor is the use of the forward speed of the plow at the two levels (3.56 and 5.11) km $h^{-1}$and the second factor is the use of the type of metal. For excavator plow shanks. on two levels (traditional plow shanks and locally manufactured plow shanks). a study of the extent of the influence of these factors on the studied characteristics, which included: tillage appearance (the number of dirt blocks with a diameter of more than 5 cm/m^2), the work width utilization factor, and performance. A randomized complete block design (RCBD) with a split-plate system and three replications was used. The following are the most important results: The front plowing speed was (3.56) km h^{-1}significantly superior in giving higher values for the plowing appearance, while the front speed was (5.11)) km $h^{-1}$and was significantly superior in giving higher values for each of the parameters.(Exploitation. Job offer and performance efficiency). As for the plow, the manufactured plow weapons were significantly superior in recording higher values for both the labor supply utilization factor and performance efficiency, while the traditional plow weapons were significantly superior in recording higher values for the plow appearance. The bilateral interaction between the forward speed of plowing and the type of plow weapons was superior. Locally manufactured excavator plow weapons with a forward speed of (5.11) km h^{-1}give significantly higher performance efficiency values.

***Keywords*:** Chisel plow, shanks, Appearance of tillage ،Working supply exploitation coefficient ،Field efficiency.

INTRODUCTION
Chisel plough is considered as one of the plowing that helps to achieve the desired purpose of tillage and improves physical and biological properties of the plowed soil. Therefore, these ploughs are very popular among farmers and began to be widely used throughout Iraq. because these plough types have low stress resistance and low load on dependent energy sources [1]. The impact of several plough types of on actual productivity, they found chisel ploughs outperform the Mouldboard ploughs in terms of actual productivity, due to differences in the working width for designed ploughs [2]. Also, the increase in the forward speed for chisel ploughs led to an increase in the operating supply utilization coefficient, and the reason for this linked to the fact that the increase in the forward speed led to an increase in the excitation width due to the increase of machine momentum on the soil, which led to an increase in the width [3]. The relationship between tillage forward speed and soil clod number (untilled soil parts) is inverse, where increasing forward speed causes a decrease in soil clod number. It also showed that there is a clear effect of moisture on the soil clod number per unit area, where moisture content, which is near to ideal humidity, reduced the soil clod number, as confirmed by [4]. Efficiency performance increases by increasing operation speed, because the high operating speed leads to a reduction in the required time for soil tillage preparation [5].

Material and methods
This study conducted during growing season 2023-2024 at agricultural fields in Kirkuk Governorate - Hawija District - Al-Zab District which located southeast of Nineveh Governorate. The field area was (10) dunums, the land topography was flat and clay soil texture. Massey Forex ITM 285 G four-wheel drive puller with (75) horsepower was used. The three-row chisel plough was used, which had (11) weapons with a working width of 216 cm. The plough weapons were manufactured by the researcher at the industrial area - Kirkuk. Appropriate weapon dimensions were determined and its basic dimensions were adjusted to match the dimensions of the conventional weapons of chisel plough, thus, determining the required shape and type for a manufactured implement. Also, determining weapons form practically to ensure their success, Tables (1) and (2) show the chemical composition and metal mechanical properties. Figure (1) shows the design map of the local

manufactured weapon. The field was divided according to randomized complete block design (RCBD) according to the split plot design [6]. The factorial experiment includes two factors, the first was tillage front speed with two levels (3.56, 5.11). The second factor was metal type of chisel plough weapons with two levels (conventional plough weapons, local manufactured plough weapons), the experimental unit was (30) meters. The data was analyzed statistically and the comparison between the means was performed with Dunkin' multi-range test. The experimental field irrigated by the traditional method and moisture content has been monitored with a soil moisture device and the below traits were studied: Tillage appearance, exploitation coefficient of working width, performance efficiency Tillage appearance (represented by soil clods with a diameter more than (5 cm/m^2)):

1. Tillage appearance (represented by soil clods with a diameter more than (5 cm/m^2):

Tillage appearance was Estimated by using a wooden frame with an area of (1) m2, where the frame was placed on random areas of the plowed land. Then counting the soil clods which there diameter more than (5 cm), where the treatment that contains lower number and size of soil clods is the best treatments. Generally, tillage appearance of chisel plough is less rough than other plough types [7].

2. Exploitation coefficient of working width:

Exploitation coefficient of working width was Measured by using a metal measure tape (3 m), several measurements were taken for each treatment randomly. The mean for these measurements produced actual plowing width and the coefficient calculated from the following equation [7]:

$$B(\%) = (B_P/B_C) \times 100$$

Where:
B= Exploitation coefficient of working width (%)
Bp= Actual working width(cm)
Bc= Theoretical working width (designed) cm

3. Performance efficiency

Machine productivity means the performance rate that depends on machine type. The machine productivity units expressed in area units per time unit, i.e. hectare/hour or dunam/hour [8]:

1. Theoretical field productivity:

Defined as the maximum productivity which could be obtained at a specific speed, assuming that the whole machine width has been used in the work, or the machine is operating 100% during the performance time and specified speed for its full width. This can be calculated from the following equation:

TFc = S * W / A ....(7)
TFc = Theoretical field productivity (ha h^{-1})
S= speed (Km h^{-1})
W= machine width (meter)
A= area unit (10000 m^2)

The theoretical field of productivity gives greater value to machine productivity than actual work. Therefore, it is not suitable as a standard for evaluating performance rate for agricultural machinery and its operators. Therefore, it is necessary to calculate actual field productivity, which is always less than theoretical productivity.

2. Actual field productivity:

Defined as the machine's actual performance rate in the field, or when a crop is traded at a certain time, or is the actual area (number of hectares) that the machine completes in a specific time. It can be calculated from the following equation:

EFc = S * W * E / A ....(8)
EFc = Actual field productivity (ha/h)
S= speed (Km h^{-1})
W= machine width (meter)
E= efficiency (%) (equaled for chisel plough 75-90%) [9]
A= area unit (10000 m^2)
According to that, machine field efficiency can be calculated as:
FE (%) = (EFc / TFc) * 100 ....(9)

Table (1) shows the metal chemical shanks

Metal type	C	Mn	S	P	Cr	Cu	Fe
Manufactured	0.35	0.92	0.05	0.04	0.002	0.003	Rem
Conventional	0.26	0.65	0.04	0.03	0.003	0.003	Rem

Table (2) shows the metal mechanical properties

Metal type	Hardness (HRB)	Elongation ratio (%)	Ultimate tensile strength)Mpa)(N/mm^2(	Submission stress)Mpa)(N/$\boldsymbol{mm^2}$(
Manufactured	88	20	350	950
Conventional	72	25	280	440

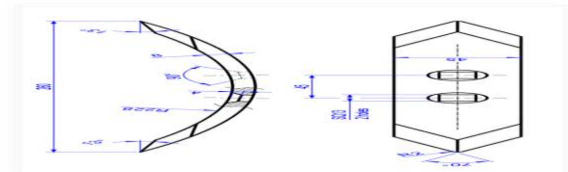

Figure (1) designed map for locally manufactured shank (mm)

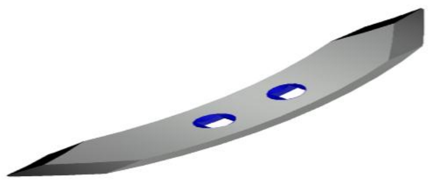

Figure (2) Final design for chisel plough shank

Results and discussion

1. The appearance of tillage is not limited to the number of clods only, but it includes many indicators in addition to the number of clods. Number of soil clods with diameter more than (5 cm/m^2) Table (3) indicates significant differences for tillage front speed on tillage appearance, where the tillage front speed (3.56) km / h achieved the highest value (7.51) mass/m^2, while the lowest value (6.57) mass/m^2 was for tillage front speed (5.11) km / h. The reason for this is due to the increased strength, tossed soil clods and collision these clods with each other. This leads to their further dismantling and fragmentation; this is consistent with [7], [4], [10], [11], [12] and [13] findings.

The table also shows that~~,~~ there are significant differences for plough weapon type on tillage appearance, where conventional plough weapons achieved the highest value for the number of soil clods (7.94) blocks / m2, while the manufactured plough weapons recorded the lowest value (6.14) blocks / m^2. This happens due to the ability of manufactured weapon to greater raise for the soil and thus dismantle, fragment and crack more soil clods per unit area. The table also shows that there are no significant differences for interaction between forward speed and plough weapon type on tillage appearance.

Table 3: Effect of studied factors and their interactions on tillage appearance (number of soil clods with a diameter of more than 5 cm/m²)

Effect of plowing front speed km/h	Plough shanks type		plowing front speed km/h	
	Conventional	manufactured		
7.51 A	8.44	6.59	3.56	Interaction between plowing front speed and Plough shanks type
6.57 B	7.45	5.69	5.11	
	7.94 A	6.14 B	Effect of Plough shanks type	

2. Exploitation coefficient of working width:

Table (4) shows the effect of studied factors and their interactions on exploitation coefficient of working width, where there are significant differences in the effect of tillage front speed on exploitation coefficient of working width, where tillage front speed (5.11) km h^{-1}achieved the highest significant value of (97.56)%, while the (3.56km h^{-1}recorded (96.31)%, and the reason for this is that the increase in the front speed led to an increase in the width of the soil disturbance and overcome the longitudinal resistance. This increased the plough actual working width and this is consistent with the [14] and [3] findings The table also shows significant differences for plough weapons type on exploitation coefficient of working width, where the metal manufactured weapon achieved the highest value of exploitation coefficient of working width, which amounted to (97.28) %. while, the traditional weapon recorded the lowest value of exploitation coefficient of working width (96.59) %. The reason for this is that plough stability was better when the manufactured weapons were better in terms of maintaining the actual working width. This reflected on the working exploitation coefficient. It is also clear from the table that there are no significant differences in the interaction between tillage forward speed and plough weapons type for the exploitation coefficient of working width.

Table 4: Effect of the studied factors and their interactions on exploitation coefficient of working width (%)

Effect of plowing front speed km/h	Plough shanks type		plowing front speed km/h	
	conventional	Manufactured		
96.31 B	95.89	96.73	3.56	Interaction between plowing front speed and Plough shanks type
97.56 A	97.29	97.83	5.11	
		97.28A	Effect of Plough shanks type	

3. Performance efficiency

Table (5) shows that there are significant differences of tillage front speed on performance efficiency, where tillage front speed (5.11) km h^{-1} achieved the highest value of (74.53) %. while tillage front speed (3.56) km h^{-1} recorded the lowest value (70.86) %. The reason is increasing the speed, increase actual productivity rate, which is one of the main determinants involved in calculating actual productivity, which increases performance efficiency. This is consistent with [15] and [5]. The table shows that there are clear significant differences for plough weapons type, where manufactured plough weapons achieved the highest value of performance efficiency (72.97) %, while the lowest value of performance efficiency recorded by conventional plough weapons was (72.43) %. This is because the manufactured weapon maintained its actual working width, and this is confirmed by the exploitation coefficient of working width for this weapon, which also increased the actual productivity, which led to an increase in performance efficiency.

The table shows that there are significant differences for the interaction between forward speed and plough weapons type. Where the highest performance efficiency achieved (74.77) % for tillage front speed (5.11 km h^{-1} with a metal manufactured plough weapons. While the lowest performance efficiency value recorded (70.56) % for the tillage front speed (3.56) km h^{-1} with conventional plough weapons. This occurred due to the speed increase and the lack of lateral deviation of the plough weapons, which achieved the highest actual productivity and this lead to an increase in Performance efficiency.

Table 5: Effect of studied factors and their interactions on performance efficiency (%)

Effect of plowing front speed km/h	Plough shanks type		plowing front speed km/h	
	Conventional	Manufactured		
70.86 B	70.56 D	71.17 C	3.56	Interaction between plowing front speed and Plough shanks type
74.54 A	74.30 B	74.77 A	5.11	
	72.43 B	72.97A	Effect of Plough shanks type	

Conclusion

Tillage forward speed (5.11) km/h recorded the highest value for the exploitation coefficient of working width and performance efficiency, the lowest value for tillage appearance. While tillage forward speed was recorded (3.56) km/h for tillage appearance, the lowest value for both exploitation coefficients of working width and performance efficiency. On the other hand, conventional plough shanks recorded the highest value in tillage appearance and the lowest value for both exploitation coefficients of working width and performance efficiency. While the manufactured plough shanks recorded the highest value both the exploitation coefficient of working width and performance efficiency, and the lowest value for tillage appearance. Interaction between tillage forward speed (5.11) km/h and manufactured plough shanks recorded the highest value for performance efficiency.

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اداء أسلحة المحراث الحفار المصنعة محليا في ظروف عمل مختلفة.

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قسم المكائن والآلات الزراعية / كلية الزراعة والغابات / جامعة الموصل.

الخلاصة

أجريت هذه الدراسة بهدف تقييم عمل أسلحة المحراث الحفار المصنعة محلياً. وقد تم تنفيذ الدراسة على مرحلتين: المرحلة الأولى: تضمنت تحديد الأبعاد والقياسات المطلوبة لتصنيع أسلحة الحفار، وتحديد نوع المعدن المناسب، وتصنيع أسلحة المحراث حسب الأبعاد والقياسات. المرحلة الثانية: تم فيها التقييم الميداني للكفاءة. تصنيع أسلحة المحراث الحفار المصنعة محليا ومقارنتها بأسلحة المحراث التقليدية ودراسة بعض مؤشرات الأداء الميداني من خلال إجراء تجربة عملية تم فيها اعتماد العوامل التالية: العامل الأول هو استخدام السرعة الأمامية للحراثة عند المستويين (3.56 و 5.11) كم/ساعة، والعامل الثاني هو استخدام نوع المعدن الخاص بأسلحة المحراث

الخاصة بالحفار. على مستويين (أسلحة المحراث التقليدية، وأسلحة المحراث المصنعة محلياً). ودراسة مدى تأثير هذه العوامل على الخصائص المدروسة والتي شملت: مظهر الحراثة (عدد الكتل الترابية التي يزيد قطرها عن 5 سم/م^2)، عامل الاستفادة من عرض العمل، وكفاءة الأداء. تم تنفيذ التجربة خلال الموسم الزراعي الخريفي (2023) في أحد الحقول الزراعية في قضاء الزاب – قضاء الحويجة – محافظة كركوك. تم استخدام تصميم القطاعات العشوائية الكاملة ***(RCBD)*** بنظام الألواح المنشقة وثلاثة مكررات. وفيما يلي أهم النتائج التي تم الحصول عليها من خلال الدراسة: تفوقت سرعة الحراثة الأمامية (3.56) كم/ساعة معنوياً في إعطاء قيم أعلى لمظهر الحراثة، بينما كانت السرعة الأمامية (5.11) كم/ساعة وكان تفوقا معنويا في إعطاء قيم أعلى لكل من معاملات الاستغلال. عرض العمل وكفاءة الأداء. أما بالنسبة للمحراث، فقد تفوقت أسلحة المحراث المصنعة معنوياً في تسجيل قيم أعلى لكل من عامل الاستفادة من عرض العمالة وكفاءة الأداء، بينما تفوقت أسلحة المحراث التقليدية معنوياً في تسجيل قيم أعلى لمظهر المحراث. أما التفاعل الثنائي بين السرعة الأمامية للحراثة ونوع أسلحة المحراث فكان متفوقا. أسلحة المحراث الحفارة المصنعة محلياً والتي تبلغ سرعتها الأمامية (5.11) كم/ساعة تعطي قيماً أعلى لكفاءة الأداء بشكل ملحوظ.

الكلمات المفتاحية : المحراث الحفار ، أسلحة المحراث ، مظهر الحراثة ، معامل استغلال العرض الشغال ، كفاءة الاداء .