University of Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 2 (2025) PP 520-525

https://iasj.rdd.edu.iq/journals/journal/issue/18682 https://doi.org/10.54174/utjagr.v13i1.323

Mechanization reducing on fuel consumption and energy consumption by using disk plow

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I. ABSTRACT

A field experiment was conducted in a field in the Shatrah region in Iraq seson 2025 to study Mechanization reducing on fuel consumption and energy consumption by using disk plow in silty clay soil texture. The main plots represented the plowing depths at three levels: (12.5, 14 and 18) cm, while the secondary plots represented the forward speeds of the tractor at three levels (3.5,4.70,6.25) km.hr^{-1}). The complete random design with three replications was used in the research. The results showed that the tractor speed of 6.28 km.h^{-1} achieved the less fuel consumption amounting to (15.56) L. ha^{-1}and energy consumption (733.34) m. ha^{-1}and highest slippage percentage (11.95)% by used disk plow. The tillage depth of (12.5) cm resulted in the lowest fuel consumption amounting (17.32)L.ha^{-1} energy consumption at (704.96)m.ha^{-1} and slippage percentage (9.12) % , the depth of(18)cm achieved the highest of fuel consumption (20.74 L.ha^{-1}) energy consumption (844.24m.ha^{-1}) and slippage percentage (11.53)%.

Keywords: clay soil , texture , slippage percentage.

II. INTRDUCTION

One of the most important goals of modern agricultural mechanization is to speed up work completion and reduce the time spent completing all agricultural operations with minimal effort According to ASABE (2006a). Tillage can be defined as a mechanical soil treatment and preparing suitable for seedbed germinate. Ploughing creates small clumps of soil to facilitate the movement of water and air through the soil layers, improving the soil's physical properties and thus increasing productivity. Jasim, (2018)and Galib ,(2025) If the appropriate plowing equipment, especially primary tillage, is not optimally selected, it can have negative effects that make it unsuitable for plant growth. Al-Hashimy,. (2015).The disc plough is a primary tillage equipment that leaves a rough soil surface after tillage buries plant residues, and controls erosion .Hamid,(2012). Because of the concave discs, the plow lifts the soil and turns it in one direction, disk plow work in hard sticky soil and hard dry soil Amer.(2019) .Fuel consumption is expressed as the consumption of a liter of fuel per working hour combined with the tractor's horsepower, according Vidas, and Janulevičius, (2022) taking into account the types and dimensions of the tractor used. Amer et al., (2021) .Most studies indicate that fuel consumption decreases with increasing tractor speed due to the shorter time spent completing work. Igoni,et al., (2020). The energy consumed decreases with increasing ploughing depth due to the increase in the volume of soil being disturbed and thus the need for more energy to complete the work. Mankhi, and Jebur. (2022)..The forward speed factors in the productivity of agricultural machinery. Jarad and Taher (2017)explained that increasing the tractor's speed from 3.42 to 4.7 and then 6.24 km.$^{hr-1}$ led to a decrease in fuel consumption values from 24.74 to 23.42 and then 21.84 Al-Jubouri et al. 2012 concluded that increasing the plowing speed from 2.66 to 3.82 and 5.71 km.hr^{-1} led to a decrease in fuel consumption values from28.23 to 22.38 and 17.90 L.ha^{-1} . The same source added that increasing the plowing depth from 15 to 25 cm led to an increase in the percentage of slippage from 8.82 to 10.64 % and an increase in fuel consumption from 21.50 to 24.18 L.ha $^{-1}$ Isaak, (2011). Slippage is defined as the reduction in practical speed when compared to theoretical speed. It is appropriate and maintains the nature of work during agricultural tasks, including heat, if it does not exceed 15%. However, if it exceeds the permissible limit, the nature of work becomes uneconomical, and field work conditions must be improved. It is considered one of the most important performance indicators, and maximum traction efficiency can be obtained when the wheel slip value is between 10 15 % . According Alhashmi ,2012 increase tractor speeds from 4.27 to 5.51 and 7.27

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km.hr-1 led to increase slippage from 9.02 to 10.24 and 12.16. The purpose of the study is to know the effect of using a disc plough at different speeds and different tillage depths and their effect on some mechanical properties of the tractor.

11. Materials and Methods

In order to reduce fuel consumption and energy consumption using a disc plough with an 80 hp tractor, soil modification, leveling and moistening operations were carried out to reach the appropriate moisture for primary tillage operations using a disc plough with a design width of 120 cm, a disc diameter of 60 cm, and The research included studying two factors: the first is the plowing depth at three a 10 cm concave at a 25 ^{0}. levels 12.5,14 and 18 cm , and the second factor is the tractor speed at three levels 3.5 ,4.70 and 6.25 km.hr^{-1}. 3*3*3 = 27 experimental units with a length of 30m. the experiment was carried out at a humidity 14-15%

STUDIED ATTRIBUTES

Fuel consumption is calculated by using kepner , 2005

Fq .=Q*10000/TL*Wp*1000

Fq:- fuel consumption (L /ha)

Q:- Quantity of fuel consumption during the transaction (mm/L)

TL:- Transaction length (m)

Wp:- Width practical (M)

Energy consumption (m j)

by using Al-Suhaibani, 1989.

EFq= Fq* k

EFq:- Energy fuel Quantity (k j / ha)

Fq:- fuel quantity consumption (L/ ha)

K :- calorific value of diesel fuel (k J / L)

use of 40.695 KJ/ LL Slippage Percentage %

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$$SP = \frac{Vt - Vp}{Vt} \times 100$$

SP: Slippage percentage

Vt: Theoretical speed km.hr^{-1}

Vp : practical speed km.hr^{-1}

111. RESULTS AND DISCUSSION

fuel Consumption L.ha^{-1}

Table 1. shows the effected of tractor speed , tillage depths , and their interactions between on fuel consumption. increasing the tractor speed from 3.50 to 4.70 and 6.25 km .hr^{-1}laed to an decrease in fuel consumption from 22.36 to 18.92 and 15.56 L .ha^{-1}. This is Because higher tractor speeds reduce the time required to complete the work when using a disk plow. the gets highest value of was 22.36 L.ha^{-1}` at grouned speed 3.50 km .hr^{-1} while the lowest value was 15.56 at a speed 6.25 km .hr^{-1}, This is supported by (Isaak et al., 2024). Increaing tillage depths from 12.5 to 14 and 18 cm resulted in an increase fuel consumption from (17.32 ,to 18.78 and 20.74) L.ha^{-1}. may be attributed to the direct relationship between the tillage depth and the fuel consumption , aincreasing depth leads to a higher load on the tractor, .The Interaction between a tractor speed of 6.25 km.hr^{-1} and depth of 12.5 cm resulted in the lewst value amounting to 14.44 L.ha^{-1} . This is supported by Abdul-Kreem ,(2017).

Table1: Effect of tractor speeds,tillage depths and their interactions.
[1].

Practical Speed Km.hr^{-1}	Tillage depths CM			Practical speed average
	12.5	14	18	
3.50	2o.11	22.28	24.70	22.36
4.70	17.42	18.74	20.62	18.92
6.25	14.44	15.33	16.92	15.56
LSD	0.52			O.49
Tillage depths average	17.32	18.78	20.74	
LSSD	0.79			

Energy Consumption m.ha^{-1}

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Table 2 shows increasing the tractor speed from 3.50 to 4.70 and 6.25 km .hr^{-1}laed to an decrease in energy consumption from 910.03 to 770.21 and 733.34 m. ha^{-1}. This is due to the direct relationship between energy consumption and fuel consumption. (2024). the gets highest value of was 910.03 m.ha^{-1}` at grouned speed 3.50 km .hr^{-1} while the lowest value was 733.34m.ha^{-1} at a speed 6.25 km .hr^{-1}, This is supported by Azawi et al., (2024). Increaing tillage depths from 12.5 to 14 and 18 cm resulted in an increase energy consumption from (704.96 ,to 764.38 and 844.24) m.ha^{-1}. The Interaction between a tractor speed of 6.25 km.hr^{-1} and depth of 12.5 cm resulted in the lewst value amounting to 587.63 m.ha^{-1}.

Table 1.Effect of tractor speed ,tillage depths and their interaction on energy consumption m.ha^{-1}

Practical Speed Km.hr^{-1}	Tillage depths CM			Practical speed average
	12.5	14	18	
3.50	818.37	906.68	1005.04	910.03
4.70	708.90	762.62	839.13	770.21
6.25	587.63	623.85	688.55	733.34
LSD	0.48			O.41
Tillage depths average	704.96	764.38	844.24	
LSSD	0.59			

Slippage Percentage %

Table 3. shows the effected of parctical speed , tillage depths , and their interactions between on slippage percentage . the gets lowest value of was 8.89 % at grouned speed 3.50 km .hr^{-1} while the highest value was 11.95 % at a tractor speed 6.25 km .hr^{-1} Due to the lack of contact between the tractor wheels and the ground at high speeds, which increases the percentage of slippage This is supported by (Almaliki et al., 2021) .the tractor speed from 3.50 to 4.70 and 6.25 km .hr^{-1}laed to an increase in slippage precentage from 8.89 to 9.71 and 11.95 %. Increaing tillage depths from 12.5 to 14 and 18 cm resulted in an increase slippage precentage from (9.12 to 9.89 and 11.53 %)..The Interaction between a tractor speed of 6.25 km.hr^{-1} and depth of 18 cm resulted in the value amounting to 12.60 %.

Table 3.Effect of tractor speed ,tillage depths and their interaction on slippage % .

Practical Speed Km.hr^{-1}	Tillage depths CM			Practical speed average
	12.5	14	18	
3.50	6.92	8.12	11.63	8.89
4.70	9.11	9.66	10.38	9.71
6.25	11.35	11.90	12.60	11.95
LSD	0.53			O.44
Tillage depths average	9.12	9.89	11.53	
LSSD	0.56			

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1V. CONCLUSIONS

Use the disc plough at the appropriate speed (3.5,4.70and 6.25)km.ha^{-1} to carry out the tillage operations which to give the lowest fuel consumption, energy consumed values and slip percentage . This helps in completing the mechanization operations with tractors . Using a disc plough at different depths resulted in reducing fuel consumption and energy consumption at shallow depths (12.5)cm. Conduct future studies on other types of tillage machines with different speeds, depths, and other mechanical characteristics.

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