

ABSTRACT

The field experiment was conducted in one of college of agricultural fields – university of Baghdad – Abu ghraib for 2016 in a silty clay loam soil study power and fuel consumption requirements, two types of tractors and three types of plows were used as a machinery unit, this study design by a split plot under randomized complete block design with three replicates and tested by the average least significant difference with level of probability (0.05), the main factor was use two level of soil moisture content (18 – 20 %) and (14 – 16 %), the secondary factor was use three type of plow (moldboard, chisel and sweep), The research includes the study of fuel consumption (L/hr), specific fuel consumption (L/hr.hp), drawbar pull (kn) and specific energy (hp/m³).

The results showed that the soil moisture content (14 – 16 %) having less fuel consumption (8.36 L/hr) and less specific fuel consumption (0.221 L/hr.hp) and less drawbar pull (8.99 kn) and less specific energy (1.027 hp/m³), the sweep plow having a less fuel consumption (8.75 L/hr) and less specific fuel consumption (0.233 L/hr.hp) and less drawbar pull (9.07 kn) and less specific energy (0.887 hp/m³), the interaction between the soil moisture content (14 – 16 %) and sweep plow having a less fuel consumption (7.11 L/hr) and less specific fuel consumption (0.186 L/hr.hp) and less drawbar pull (7.9 kn) and less specific energy (0.844 hp/m³).

INTRODUCTION

These days one of the main concerns of farmers is the ability of the tractor field, where possible to reduce energy consumption in tractor by design it better and match tractor capacities with the equipment that has been linked with it and provide better working conditions for the tractor, the selection process appropriate to the size of certain agricultural process is an important decision for the operator, this requires an estimation of the requirements of the pull power and ability of machine.

Traction power Is the force needed to withdraw the machine associated with the tractor forward speed, Which means toward power source, and it Depends on forward tractor speed, soil moisture content, plow width, soil type, Soil resistance for penetration and rolling resistance. younis and ashiry, (2009)

Aday, (2013) conclude that the soil moisture content have a direct impact on traction power So that the fragile textures soil need the few pulling power when the soil moisture content was (14 – 16 %) Then the soil will crumble well, either the moist soil need high pulling power.

The moldboard plow is important plows, because it is a simple machine Cut off, dismantle and throw the soil, and it can work in different speed and when one of its parts damage we can replace the damaged part only Without the need to replace the whole plow, It is more prevalent plows In the central and southern regions from Iraq. al-bana, (1991)

Hussein and izzat, (1978) mention that the chisel plow leaves the surface of the soil flatter more than the rest of the other plows and less fit on large volumes of soil blocks, It contains several types of board including brushes and bold, and may be a one-way or two-way, So that you can easily replace the direction of board.

The sweep plow called Sometimes maintenance plow , coverage plow or plow after harvest , It may be used as a primary or secondary equipment or used direct after harvest or before planting , It used to keep the soil from wind and water erosion , Where does it cut down a section of soil surface of the soil without tilling the soil surface , the board was wide and long like Long and broad sharp like a character (V) . Frank et al. , (2012)

According to the results of al-Abdali , (2000) the moisture content of the soil has a significant effect on drawbar power of agricultural machinery where power rate record (13.65 kN) and (25.83 kN) and was moisture content the user is (13 – 16 – 19 %) .

One of the important factor that are used to evaluate engine performance is the fuel consumption who depends on several factors including : engine Characters design , air consumption value , engine type and The overhead that is exposed to the engine , Whenever the engine was a low fuel consumption and production of high power tractor was lower costs , Evaluation of fuel consumption for tractors usually based on the capacity produced by the engine like say (L / Hp) or on the plowed soil like say (L / m³) or on of fuel consumption during the time like say (L / hr) , and the fuel consumption varies by the engine hours power , engine conditions and soil moisture content . aday , (2016)

Also results of Jebur , (2013) show that when using more than agricultural equipment was fuel consumption between (4.3 and 19.36 L / hr) depending on the type of equipments , and the specific fuel consumption was from (0.4 – 1.1 L/hp.hr) .

Through the results of Jasim and Jebur , (2009) in their experience , which included the use of three types of plows and different seasons , The chisel plow in two seasons scored less fuel consumption compared with the moldboard plow and disc plow users in experiment where it recorded (10.6 – 11.7 L/ha) while the disk plow recorded (11.9 – 11.1 L/ha) while the moldboard plow recorded (11.2 – 11.3 L/ha) for the spring and autumn season respectively .

The Specific energy depends on the drawbar power and Fracture soils size And greatly affected by plow type and tillage depth and it speed , perdok and werken , (1982) found the specific energy of moldboard plow was (0.7 – 0.9 hp / m³) while to the chisel plow was (0.48 – 0.62 hp / m³) .

The aims of this study is Calculate the power for machinery unit with different plow and its effect on fuel consumption.

MATERIALS AND METHODS

The experimental work was carried out in one of college of agricultural – university of Baghdad – Abu ghraib for 2016 in a silty clay loam soil , at plow depth (20 cm) and speed tractor (3.95 km/hr) , the soil properties was :

Character	Value	unit	
Bulk density	2.65	gm/cm ³	
Density of the soil	1.43	gm/cm ³	
porosity	46	%	
Electrical conductivity	3.7	ds/m	
Water conductivity	0.6	cm/m	
Soil texture	sand	11	%
	clay	31	%
	silt	58	%
Soil type	silty clay loam		
Soil penetration resistance	5.18	kpa	

MACHINE USED

The first tractor used was Armatrac854e2010 it features (4wd) (83 hp) (3000 r.p.m) , And the second was ITMNEW2852013 it features (2wd) (80 hp) (2500 r.p.m) , Moldboard plow (width 105 cm) (3 board) , Chisel plow (200 cm) (11 board) , Sweep plow (200 cm) (2 board) .

Parameter measurement:

Fuel Consumption:

$$F.C = V \times 3600 / F \times 1000 \quad \dots (8)$$

Where :

F.C = fuel consumption (L/hr)

v = volume of consumed fuel during treatment (L)

t = Fuel exchange time (sec)

Drawbar Pull :

$$FT = FPU - FRM \quad \dots (7)$$

Where :

FT = Net Drawbar Pull (kn)

FPU = Tractive Force (kn)

FRM = Rolling Resistance (kn)

Specific Fuel Consumption :

$$S.F.C = F.C / P \text{ d.b} \quad \dots (9)$$

Where :

S.F.C = specific fuel consumption (L / hr . hp)

F.C = fuel consumption (L/hr)

P d.b = drawbar power (hp)

Specific Energy :

$$S.E = Pd.b / v \quad \dots (2)$$

where :

S.E = specific energy (hp/m³)

Pd.b = Drawbar power (hp)

V = Fracture soils size (m³)

RESULTS AND DISCUSSION

1 - fuel consumption (L / hr)

The table (1) shows the effect of the moisture content and primary tillage equipment and the interaction between them on fuel consumption (L / h) .

moisture content was Significant effect on fuel consumption , where the content (14 – 16 %) scored less average and it was (8.36 L / hr) , while the content (18 – 20 %) scored largest value it was (11.69 L / hr) , this is consistent with the results of Talabaniy , (2002) .

The type of tillage equipment Significant effect on fuel consumption , the sweep plow scored the less average was (8.75 L / hr) Followed by chisel plow (10.2 L / hr) then moldboard plow who scored largest value was (11.14 L / hr) , this is consistent with the results of Abid Ali , (2013) .

The interaction between moisture content and primary tillage equipment was Significant effect , where the interaction between content (14 – 16 %) and sweep plow scored less average was (7.11 L / hr) , while the interaction between content (18 – 20 %) and moldboard scored a largest value was (13.07 L / hr) .

Table (1) effect of moisture content and primary tillage equipment on fuel consumption

Soil moisture	Primary tillage equipment	Mean of moisture
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	moldboard	Chisel	Sweep	
18 – 20 %	13.07	11.63	10.38	11.69
14 – 16 %	9.21	8.77	7.11	8.36
L.S.D = 0.05	0.6995			0.8289
Mean of plow	11.14	10.2	8.75	
L.S.D = 0.05	0.1633			

2 - Specific fuel consumption (L / h.hp)

The table (2) shows the effect of the moisture content and primary tillage equipment and the interaction between them on specific fuel consumption (L / h.hp) moisture content was Significant effect on fuel consumption , where the content (14 – 16 %) scored less average and it was (0.221 L / h.hp) , while the content (18 – 20 %) scored largest value it was (0.294 L/h.hp) .

The type of tillage equipment Significant effect on fuel consumption , the sweep plow scored the less average was (0.233 L/h.hp) Followed by moldboard plow (0.278 L/h.hp) then chisel plow who scored largest value was (0.262 L/h.hp) .

The interaction between moisture content and primary tillage equipment was Significant effect , where the interaction between content (14 – 16 %) and sweep plow scored less average was (0.186 L / hr.hp) , while the interaction between content (18 – 20 %) and chisel scored a largest value was (0.310 L / hr.hp) .

Table (2) effect of moisture content and primary tillage equipment on specific fuel consumption

Soil moisture	Primary tillage equipment			Mean of moisture
	moldboard	chisel	Sweep	
18 – 20 %	0.292	0.310	0.280	0.294
14 – 16 %	0.232	0.246	0.186	0.221
L.S.D = 0.05	0.014			0.017448
Mean of plow	0.262	0.278	0.233	
L.S.D = 0.05	0.003944			

3 - drawbar pull (kn)

The table (3) shows the effect of the moisture content and primary tillage equipment and the interaction between them on drawbar pull (kn) moisture content was Significant effect on fuel consumption , where the content (14 – 16 %) scored less average and it was (8.99 kn) , while the content (18 – 20 %) scored largest value it was (11.34 kn) .

The type of tillage equipment Significant effect on fuel consumption , the sweep plow scored the less average was (9.07 kn) Followed by chisel plow (10.23 kn) then moldboard plow who scored largest value was (11.19 kn) .

The interaction between moisture content and primary tillage equipment was Significant effect , where the interaction between content (14 – 16 %) and sweep plow scored less average was (7.9 kn) , while the interaction between content (18 – 20 %) and moldboard scored a largest value was (12.49 kn) .

Table (3) effect of moisture content and primary tillage equipment on drawbar pull

Soil moisture	Primary tillage equipment			Mean of moisture
	moldboard	Chisel	sweep	
18 – 20 %	12.49	11.29	10.25	11.34
14 – 16 %	9.89	9.17	7.9	8.99
L.S.D = 0.05	3.442			3.688
Mean of plow	11.19	10.23	9.07	
L.S.D = 0.05	0.403			

4 - Specific energy (hp/m³)

The table (4) shows the effect of the moisture content and primary tillage equipment and the interaction between them on power (hp) moisture content was Significant effect on fuel consumption , where the content (14 – 16 %) scored less average and it was (1.142 hp/ m³) , while the content (18 – 20 %) scored largest value it was (1.027 hp/ m³) .

The type of tillage equipment Significant effect on fuel consumption , the sweep plow scored the less average was (0.887 hp/ m³) Followed by moldboard plow (0.948 hp/ m³) then chisel plow who scored largest value was (1.417 hp/ m³) .

The interaction between moisture content and primary tillage equipment was Significant effect , where the interaction between content (14 – 16 %) and sweep plow scored less average was (0.844 hp/ m³) , while the interaction between content (18 – 20 %) and moldboard scored a largest value was (1.495 hp/ m³) .

Table (4) effect of moisture content and primary tillage equipment on specific power

Soil moisture	Primary tillage equipment			Mean of moisture
	moldboard	chisel	sweep	
18 – 20 %	1.495	0.999	0.931	1.142
14 – 16 %	1.340	0.898	0.844	1.027
L.S.D = 0.05	0.04695			0.02902
Mean of plow	1.417	0.948	0.887	
L.S.D = 0.05	0.03952			

CONCLUSION

The main results in this study can be summarized as following:

- 1- The reducing soil moisture content from (18 – 20 %) to (14 – 16 %) caused decreasing fuel consumption and decreasing specific fuel consumption and decreasing drawbar pull and decreasing specific energy .
- 2- The moldboard plow have largest value of fuel consumption and specific fuel consumption and drawbar pull and specific energy .
- 3- The interaction between the soil moisture content (14 – 16 %) and the sweep plow got a less value of fuel consumption and specific fuel consumption and drawbar pull and specific energy .

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