Plant Archives Volume 20 No. 1, 2020 pp. 3141-3148 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF MECHANICAL PROPERTIES ON SOME GROWTH CHARACTERISTICS FOR WHEAT CROP

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Abstract

The effect of the angle of plough penetration of soil and tillage distances was studied based on some mechanical properties for type tillage machine (moldboard plough) and soil physical characteristics, were tested two the angle of plough penetration of soil levels of 45° and 65° and three levels tillage distances of 65, 75 and 85 cm. The experiments were conducted in a factorial experiment under randomized complete block design with three replications. The results showed that the angle of plough penetration of soil 45° was significantly better than the angle of plough penetration of soil 65° as while tillage distances at range 65 cm was significantly superior to the other two levels 75 and 85 cm in all studied conditions. The results showed fuel consumption of 10.088 and 10.007 $L.ha^{-1}$, slippage percentage of 8.103 and 7.662% power losses due to slippage of 2.492 and 2.267 Kw, field efficiency of 81.938 and 85.446%, drawbar power 10.704 and 10.709 kw germination percentage 89 and 88%, plant height 73.294 and 75.244 cm and number of branches 10 and 10 $branch.plant^{-1}$ for the angle of plough penetration of soil 45° and tillage distance 65 cm, respectively.

Key words: Wheat, tractor types, angles, tillage distances, moldboard plough.

Introduction

Tractors is used for tasks such as tilling and harrowing, etc are very adaptable pieces of agricultural machinery. They are made to maintain high levels of traction at slow speeds with the purpose of hauling trailers and agricultural machinery. all cultivation equipment of tillage , planter machine and harvesting is that they are most often pulled behind a tractor. The general aim of soil cultivation is usually to aerate, turn over, weed, or even just smooth out soil in an area tillage impact on the soil deliberately to produce crop and consequently affects the growing properties of crop.Tillage is the mechanical operation of the soil for the purpose of crop production affecting meaningfully the soil appearances such as soil water conservation, soil temperature, infiltration and evapotranspiration processes. Increase the tillage depth and soil moisture content leads to a decrease in yield productivity due to increased soil resistance to penetration (Alshrifi, 2009). The principle of conservation tillage encompasses maintenance of surface soil cover through retention of crop residues achievable by practicing zero tillage and minimal mechanical soil disturbance. This may provide farmers and other land users the information on the desirability of a conservation tillage system for sustainable crop yield increases with minimal negative impact on the soil and the environment. (Alsharifi and Sarah, 2018). Soil physical conditions detrimental to root proliferation in subsoil are generally related to tillage pans that develop below tilled layer. Tillage operation with the same implement over several years may lead to compacted layer in field soil. Ploughing at the same depth year after year reinforce the plough pan development, so use of different tillage implement may be the only solution to breakup this subsoil (Firouzi *et al.*, 2012).

Tillage technology leads to with high fuel consumption and labour requirement with slippage percentage increase and some soil physical properties (Fathollahzadeh *et al.*, 2010). Tillage contributes up to 20% from the crop production factors, Soil tillage is the important factors affecting soil physical properties (Khurshid *et al.*, 2006). Concluded that tillage process was effect on all growing properties for wheat crop as well as soil moisture of 12% was significantly superior to the other two levels of 14%

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and 16% in production of the wheat because 12% moisture soil was more effect on tillage process in this study for all studied properties (Mutlak, 2018). Conventional tillage practices modify soil structure by changing its physical properties, such as soil bulk density, soil penetration resistance and soil moisture content hence positively reflected on wheat properties during growth. Tillage is defined as mechanical manipulation of soil to provide a favorable environment for good germination of seeds and crop growth, to control the weeds, maintain infiltration capacity and soil aeration. A well planned tillage practice provides a favorable environment, suitable for better seed germination and effective plant growth. In addition, it also protects and maintains a strong soil structure to reduce soil erosion (Jassim and Alsharifi, 2007). The maximum force was observed at 90° angle, which decreased with the decreasing angles. It was also observed that varying angles have considerable effect on the width of cut, while minimum force was observed on the curvature of plough. It was also observed that moisture content has inverse relation with soil forces while depth has direct relation with soil forces (Mari *et al.*, 2014). That there was a great impact for the tillage process when using the moldboard plough on plant growth, plant height as well as seeds production.

The main goal of this research is to study the effect of angles of plough penetration of soil and tillage distances, on some mechanical properties for moldboard plough and wheat growth properties.

Materials and Methods

This study was conducted in 2018, to evaluate for two MF-250 and New Holland-TD80 machine with moldboard plough, the experiments were done at two levels of Angle of plough penetration of soil 45° and 65° ,and three distance between the point of share and the point of share other 65, 75 and 85 cm. Fig. 5. The moldboard plough was selected for the experiments of the plough organized on certain 20 cm depth by hydraulic device for tractor and soil moisture 13-15% using the pipette methods.

Moldboard plough specifications.

Parameters	Moldboard plough
Working width	120cm
Length	3010mm
Height	1130mm
Weight	320 kg
Weapon width	40cm

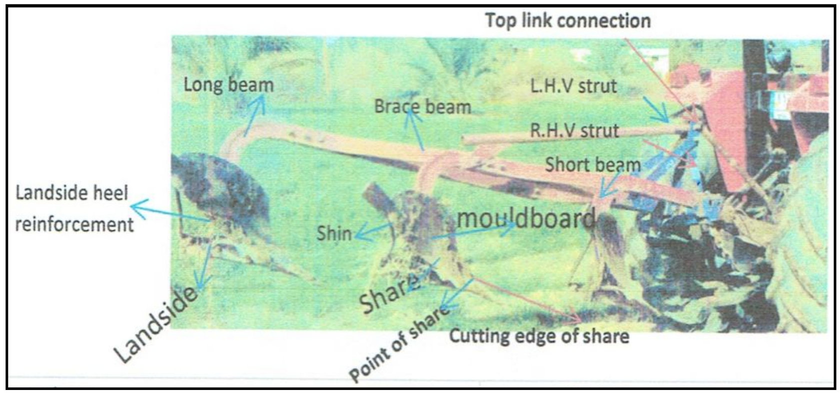

Fig. 1: Moldboard plough.

Mechanical characteristics

Fuel consumption

Fuel consumption is measured by the fuel consumption device in mL for treatment length (50 m) was calculated using Eq 1 (Alsharifi, 2009).

$$Q_F = \frac{Q_D \times 1000_0}{W_P \times D \times 1000_0} \qquad (1)$$

Where : Q_F fuel consumed amount L\ ha , Q_D fuel consumed amount for treatment length (100m), W_P machine width (m), D treatment length (100 m).

The fuel amount consumed was measured using graduated cylinder placed in the fuel duct between the tank and the fuel injection pump, After the cylinder dictated with fuel, will closed duct fuel from the tank by a tap. Fig. 1. The fuel is used from the cylinder when the treatment access, length 100m. When completed the treatment (length 100 m). Fills the cylinder with fuel and another treatment is started in three replication.

Slippage percentage

Measured by the practical and theoretical speed (Alsharifi 2009).

Practical speed : After tillage depth determination in the experiment the plough hacked in the soil with practical speed 3 km.hr^{-1}, within treatment length (100 m) for both soil moisture and tillage depth in three replication. The Eq (2) was used for calculation of practical speed.

$$V_P = \frac{3.6 \times D}{T_P} \qquad (2)$$

Where : V_P practical speed Km.hr^{-1}, T_P practical time (hr).

Fig. 2: Machines types (Mf 265s and TD80) used for experiment.

Theoretical speed : Without ploughing the soil , only the weapon touches the soil, with speed 3km.hr within treatment length (50 m) for both soil moisture and tillage depth in three replication. The Eq (3) was used for calculation of theoretical speed

$$V_T = \frac{3.6 \times D}{T_t} \tag{3}$$

Where : V_T theoretical speed Km.hr^{-1}, T_t theoretical time (hr).

Eq (4) was used for calculation of slippage percentage using two speeds the practical and theoretical.

$$S = \frac{V_C \times V_P}{V_t} \times 100 \tag{4}$$

Power losses due to slippage is calculated from the following Eq (5) (Alsharifi, 2009)

$$P_S = \frac{F(V_t \times V_p)}{270} \tag{5}$$

Where : P_S : Power losses due to slippage (kw)

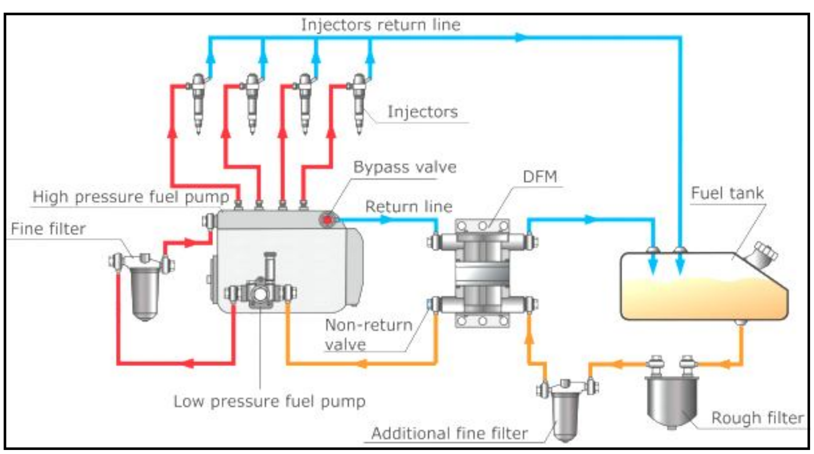

Fig. 3: Fuel consumption measurement device by graduated cylinder.

Measurement field efficiency:

Field efficiency is the ratio of effective field capacity to theoretical field capacity, and it can be affected by time lost in the field and full width of the machine.

Theoretical field capacity

Theoretical field capacity is the rate of work when the implement uses its full width and time and it was calculated as follow

$$T_{FC} = \frac{S \times W}{C} \tag{6}$$

Where : T_{FC}; theoretical field capacity ha h^{-1}, S Working speed (Km h^{-1}), W cutting width of implement (M), C Conversion factor (10)

Effective field capacity

Effective field capacity is the actual rate of work and it was calculated as follow

$$E_{FC} = \frac{A}{T} \tag{7}$$

Where : E_{FC} ; effective field capacity (ha h^{-1}), A distance (ha), T time (hour)

Eq (8) was used for calculation of field efficiency (Oduma *et al.*, 2015)

$$E_E = \frac{E_{FC}}{T_{FC}} \times 100 \tag{8}$$

Force of drag:

The drag force was calculated by dynamometer tied between the tractor New Holland -TD80 and the tractor Massey -Ferguson -265s pregnant for the moldboard plough , use a flexible cord. The tractor New Holland -TD80 which drag the tractor

Tractor specifications Tractor specifications (Massey Ferguson, Mf 265s and New Holland, TD80).

Parameters	Machine type	Mchine type	
	Massy Ferguson, Mf265s	New Holland, TD80	
Engine Power	75 Hp	Engine power	80 Hp
Engine speed (rpm)	2000	Engine speed (rpm)	2500
Engine type	Perkins (diesel)	Engine type	Perkins (diesel)
Cylinders number	4-cylinders Firing		
	order 1-3-4-2	Cylinders	4-cylinders Firing
	starter volts 12	number	order 1-3-4-2
PTO rpm	540		540
Weight	3470 Kg		3080 Kg

Massey -Ferguson -265s pregnant for the moldboard plough without soil penetrates, then subtraction (Reading old) from the measured number new in dynamometer screen when works the moldboard plough inside soil. Fig. 2. For both distances measured and angles of plough penetration. Eq (9) was used for calculation of drag force (Moeenifar, 2004).

$$F = T_{DP\ with\ load - T_{DP}\ without\ load} \tag{9}$$

F : drag force (KN), TDP with load; The total drag power for tractor when plough loading , T_{DP} without load: The total drag power for tractor when plough without loading.

Drawbar power

Drawbar power is calculated from the following Eq (10) (Alsharifi, 2009).

$$C_D = F \times V_b \tag{10}$$

Where : C_D capacity of drag (Kw), F force of drag (KN), V_p practical speed (Km.hr^{-1}).

Physical properties:

Physical properties of the soils determined, were taken soil samples for six site randomly selected from the field and for three tillage depths determined in the experiment were 12, 16 and 20 cm by the hydraulic device for tractor according to the method used by (Fathollahzadeh *et al.*, 2010) were taken of the soil samples for different depths, when obtain 13-15% moisture soil. And then the first part was executed from experiment. For both distances measured and angles of plough penetration (Behzad *et al.*, 2014). each running test

Soil moisture:

Samples were taken to measure soil moisture in the surface layer, 12 cm, 16 cm and 20 cm. Soil samples were weighted and drying in oven with 105^{0}C. The moisture content of soil samples, was calculated by using Eq. 11 (Dehroyeh, 2005).

$$W = \frac{W_S}{W_S} \times 100 \tag{11}$$

Where : W: Is soil moisture percentage, W_W: Is weight wet soil, W_S : Is weight dry soil.

Soil bulk density

For measuring bulk density, three soil samples from different parts of the land were collected using the pipette method. The collected samples were immediately put in plastic bags to conserve moisture during transferring to the laboratory and weighed it, then dried at 105 ^{0}C for 48 hr. Mass of dried soils was weighted, Soil bulk density was determined by Eq. 12 (Langston, 2014).

$$P_b = \frac{M_S}{V_T} \tag{12}$$

Where : P_b : Dry bulk density (mg. m^{-3}), M_S : weight of the dried soil sample (mg): total volume of the soil sample (m^3).

Total soil porosity

The total porosity of soil samples collected for each treatment was calculated using following equation, an assumed particle density of 2.65 mg.m^{-3}. The Eq (13) was used for calculation of the total porosity of soil (Anna, Jacobs *et al.*, 2010)

$$T_{SP} = \left(1 - \frac{P_b}{P_S}\right) \times 100 \tag{13}$$

Where : T_{SP} : total soil porosity (%), P_b : dry bulk density (mg.m^{-3}), P_S : partial density (mg.m^{-3}) and shown in the table below.

The influence of soil moisture and tillage depth on soil bulk density and total soil porosity was shown in Table 1. All the interactions are significantly different and the best results (1.32 Mg.m^{-3} and 50.18%) have come from the overlap among moldboard plough, 11%-13% soil moisture and 12cm tillage depth while gives the interactions between among moldboard plough, 13-15% soil moisture and 12cm tillage depth the best results (1.34

$Mg.m^{-3}$ and 49.43%).

The crop and its components:

Germination percentage:

Percentage of germination is found for number plants growing in one square meter in three replications.

Plant height

Wheat height are measured by bar or ruler from soil surface till the spike, in three replications.

Number of branches

Taken 25 plants which growing in one square meter and calculated branches number each plant, in three replications.

The results were analyzed statistically by using the randomized complete block design RCBD and the difference among treatments for each factor was tested according to the least significant difference L.S.D test (Oehlent, 2010).

Results and Discussion

Fuel consumption

The influence of angles of plough penetration of soil on fuel consumption $L.ha^{-1}$, was shown in Table 1. The angle of plough penetration of soil of °45 has the lowest fuel consumption which required of 10.088 $L.ha^{-1}$, and the angle of plough penetration of soil of 65° has the maximum fuel consumption which required of 10.786 $L.ha^{-1}$. The high pressure on moldboard plough during tillage process caused fuel consumption increased. (Mari *et al.*, 2014). It is indicated that the fuel consumption of the level 65 cm tillage distance was significantly better than 85cm tillage distance. The results were 10.007, 10.342 and 10.921 $L.ha^{-1}$ respectively. High soil resistance of the plough movement caused increasing fuel consumption with tillage distances increased. These results are consistent with the results of (Alsharifi and Sarah, 2018). The best results (9.801 $L.ha^{-1}$) have come from the overlap among the angle of plough penetration of soil of °45 and tillage distance of 65 cm.

Table I: Experiment field properties.

Soil moisture %	Depth tillage cm	Soil bulk density $Mg.m^{-3}$	Total soil porosity %
11-13%	12	1.32**	50.18**
	16	1.36	48.67
	20	1.47	44.52
13-15%	12	1.34**	49.43**
	16	1.43	46.03
	20	1.51	43.01

Table II: Soil minutes volumes analysis in the experiment field.

Soil moisture%	Tillage depth Cm	silt	Clay	sand	Soil tissue
11-13 %	12	480	360	160	
	16	490	380	130	
	20	470	370	160	
Av		480	370	150	Silt Clay loam
13-15%	12	470	380	150	
	16	480	350	170	
	20	460	360	180	
Av		470	363.33	166.67	Silt Clay loam

Slippage percentage

The influence of tillage distances on the slippage percentage %. The increasing of the tillage distances led to the decrease of the slippage percentage and the results were 7.662, 8.627 and 9.568% respectively. This is due

Table 1: The effect of angles of plough perpetration of soil and tillage distances on fuel consumption. $L.ha^{-1}$.

The angles of plough perpetration of soil	Tillage distances cm			Means of angles
	65	75	85	
°45	9.801**	10.001	10.461	10.088
°65	10.213	10.682	11.381	10.786
LSD = 0.05				0.231
Means of tillage distances	10.007	10.342	10.921	
LSD = 0.05				0.602

Note: L.S.D means Least Significant Difference

Table 2: The effect of angles of plough perpetration of soil and tillage distances on slippage percentage %.

The angles of plough perpetration of soil	Tillage distances cm			Means of angles
	65	75	85	
°45	7.103**	8.092	9.115	8.103
°65	8.221	9.163	10.921	9.135
LSD=0.05				0.402
Means of tillage distances	7.662	8.627	9.568	
LSD=0.05		0.766		

Note: L.S.D means Least Significant Difference

Table 3: The effect of angles of plough perpetration of soil and tillage distances on power losses due to slippage Kw.

The angles of plough perpetration of soil	Tillage distances cm			Means of angles
	65	75	85	
°45	2.164**	2.422	2.891	2.492
°65	2.369	2.814	3.001	2.728
LSD=0.05				0.213
Means of tillage distances	2.267	2.618	2.946	
LSD=0.05		0.451		

Note: L.S.D means Least Significant Difference to increased drag force when increase tillage distances led to increase slippage ratio. These results are consistent with the results of (Jassim and Alsharifi, 2007). From Table 2, it is indicated that the slippage percentage of the angle of plough penetration of soil °45 was significantly better than the angle of plough penetration of soil °65, the results were 8.103% and 9.135% respectively. The effect of the penetration angles of soil was found to be correlated with the tillage distances. These results are consistent with the results of (Firouzi, *et al.*, 2012). The best results (7.103%) was achieved for moldboard plough, at °45 angle of plough penetration of soil and 65 cm tillage distance.

Power losses due to slippage:

The influence of tillage depth soil moisture on the power losses due to slippage Kw. At the tillage distance of 65cm the result indicated the lowest power losses due to slippage of 2.267 Kw more over the tillage distance of 85 cm presented the highest power losses due to slippage of 2.946 Kw. Due to the increased drag force required for the moldboard plough led to increased power losses due to slippage. These results are consistent with the results of (Alsharifi and Sarah, 2018). From Table 3, it is indicated that the power losses due to slippage of the angle of plough penetration of soil 45° was significantly better than the angle of plough penetration of soil 65°. The results were 2.492 Kw and 2.728Kw respectively. The best result (2.210Kw) was obtained by moldboard plough at 65 cm tillage distance and angle of plough penetration of soil °45.

Field efficiency

The influence of angles of plough penetration of soil on field efficiency %, was shown in Table 4. The angle of plough penetration of soil of °45 has the highest field efficiency which required of 81.938%, while the angle of plough penetration of soil of 65° has the lowest field efficiency which required of 80.295%. The field efficiency reduction was due to the high pressure on the moldboard plough during the tillage process, there was an inverse relationship between penetration angles and tillage distances. It is indicated that the field efficiency of the level 65 cm distance tillage was significantly better

Table 4: The effect of angles of plough perpetration of soil and tillage distances on field efficiency %.

The angles of plough perpetration of soil	Tillage distances cm			Means of angles
	65	75	85	
°45	86.692**	80.113	79.010	81.938
°65	84.201	78.991	77.692	80.295
LSD=0.05				1.234
Means of tillage distances	85.446	79.552	78.351	
LSD=0.05		2.043		

Note: L.S.D means Least Significant Difference

Table 5: The effect of angles of plough perpetration of soil and tillage distances on drawbar power Kw.

The angles of plough perpetration of soil	Tillage distances cm			Means of angles
	65	75	85	
°45	10.314**	10.556	11.241	10.704
°65	11.103	12.596	12.983	12.227
LSD=0.05				0.171
Means of tillage distances	10.709	11.576	12.112	
LSD=0.05		1.363		

Note: L.S.D means Least Significant Difference

Table 6: The effect of angles of plough perpetration of soil and tillage distances on germination percentage %.

The angles of plough perpetration of soil	Tillage distances cm			Means of angles
	65	75	85	
°45	90**	89	87	89
°65	85	83	81	83
LSD=0.05				1.231
Means of tillage distances	88	86	84	
LSD=0.05		2.054		

Note: L.S.D means Least Significant Difference

Table 7: The effect of angles of plough perpetration of soil and tillage distances on plant height cm.

The angles of plough perpetration of soil	Tillage distances cm			Means of angles
	65	75	85	
°45	78.170**	75.031	66.681	73.294
°65	72.317	69.720	63.411	68.482
LSD=0.05		1.064		
Means of tillage distances	75.244	72.367	65.046	
LSD=0.05		1.785		

Note: L.S.D means Least Significant Difference

Table 3: The effect of angles of plough perpetration of soil and tillage distances on plant branches number branch.plant^{-1}.

The angles of plough perpetration of soil	Tillage distances cm			Means of angles
	65	75	85	
°45	11**	10	9	10
°65	9	8	7	8
LSD=0.05		1.504		
Means of tillage distances	10	9	8	
LSD=0.05		2.082		

Note: L.S.D means Least Significant Difference than 85 cm tillage distance. The results were 85.446, 79.552 and 78.351% respectively. Because of high soil resistance of the plough movement and thus decreasing field efficiency when distances of the tillage increased. These results are consistent with the results of (Mari *et al.,* 2014). The best result (86.692%) was obtained by moldboard plough at 65 cm tillage distance and angle of plough penetration of soil °45.

Drawbar power

The influence of tillage distances on the drawbar power %. The increasing of the tillage distances led to the increase of the drawbar power and the results were 10.709, 11.576 and 12.112 Kw respectively, at different tillage distances. This is due to increased drag force when increase tillage distances leads to increase drawbar power and also result the high force on the moldboard plough when tillage process with tillage distances increased .These results are consistent with the results of (Alsharifi and Sarh, 2018). From Table 5, it is indicated that the drawbar power of the angle of plough penetration of soil °45 was significantly better than the angle of plough penetration of soil 65°, the results were 10.704 and 12.227 Kw respectively. The effect of the penetration angles of soil was found to be correlated with the tillage distances. The best results (10.314 Kw) was achieved for moldboard plough, at °45 angle of plough penetration of soil and 65 cm tillage distance.

Germination percentage

The influence of tillage distances on the germination percentage %. The increasing of the tillage distances led to the decrease of the germination percentage and the results were 88, 86 and 84% respectively, at different tillage distances. The tillage leads to improve soil ventilation which its a significant impact in the absorption of water by the roots. These results are consistent with the results that gained by (Alsharifi 2009). From Table 6 it is indicated that the germination percentage of the angle of plough penetration of soil °45 was significantly better than the angle of plough penetration of soil 65°, the results were 89 and 83% respectively. The best results (90) was achieved for moldboard plough, at °45 angle of plough penetration of soil and 65 cm tillage distance.

Plant height

Table 7 shown indicate that increasing the distances of tillage leads to decrease the plant height and the results were 75.244, 72.376 and 65.046 cm respectively at different tillage distances. This is due to soil fragmentation when affinity of tillage distances hence plant height increased. These results are consistent with the results of (Mutlak, 2018). The angle of plough penetration of soil 45° was significantly better than the angle of plough penetration of soil 65°, the results were 73.294 and 68.482 cm respectively. The best results (78.170 cm) was achieved for moldboard plough, at 45° angle of plough penetration of soil and 65 cm tillage distance.

Number of branches

Table 8 shows the influence of tillage distances on the plant branches number branch.plant^{-1}. The increasing of the tillage distances led to the decrease of the plant branches number and the results were 10, 9 and 8 branch.plant^{-1} respectively, at different tillage distances. The tillage leads to improve soil ventilation which its a significant impact in the absorption of food and water by the roots hence increasing plant branches number with decreased tillage distances. These results are consistent with the results that gained by (Alsharifi 2009). From Table VII it is indicated that the plant branches number of the angle of plough penetration of soil 45° was significantly better than the angle of plough penetration of soil 65°, the results were 10 and 8 branch.plant^{-1} respectively. The best results (11 branch.plant^{-1}) was achieved for moldboard plough, at 45° angle of plough penetration of soil and 65 cm tillage distance.

Conclusions

The angle of plough penetration of soil 45° was significantly better than the angle of plough penetration of soil 65° in all studied condition, the tillage distance 65cm was significantly superior to other two levels 75 and 85cm in all studied properties. The best results were obtained by moldboard plough at angle of plough penetration of soil 45° and 65 cm tillage distance.

Recommendation

The present recommends to carry out future studies using other of machinery types and conduct other organizations on machine and the moisture content to know their effect on the physical characteristics of soil and machine.

References

Aday, H., Shaker, A. Walled and S.A. Noor (2016). Effect of ploughing and planting methods on corn (*Zea mays* L.) growth and yield, *Al - Muthanna J. of Agri. Sci.,* **4(2):** 1-10.

Anna, Jacobs, M. Helfrich, S. Hanisch, U. Quendt, R. Rauber and B. Ludwig (2010). Effect of conventional and minimum tillage on physical and biochemical stabilization of soil organic matter. *Biology and Fertility of Soils,* **46:** 671-680.

Al Sharifi, S.K. (2009). The effect of two types of ploughs at different depths and speeds in the performance of mechanical unit and some physical soil properties. *J. of Uni. of Babylon,* **17(1):** 182- 205.

Behzad, S. and Ahmad G. Ahangar (2014). Effect of conservation tillage on soil fertility factors: *A review Int. J. of Biosciences,* **4(11):** 144-156.

Dehroyeh, M. (2005). Investigation of tire air pressure influences of drive tractor wheels on soil compression, engaged drive wheels and tractor consumed fuel. M.Sc Thesis. Agricultural machinery machines, Bio-system engineering faculty, Tehran University.

Firouzi, S., M.R. Alizadeh, H. Aminpanah and M.N.S. Vishekaei (2012). Some moisture-dependent physical properties of bean seed (*Phaseolus vulgaris* L.) *J. Food Agric Environ.,* **4(3):** 713–717.

Fathollahzadeh, H., H. Mobli, A. Rajabipour, S. Minaee, A. Jafari and S.M.H.B. Tabatabaie (2010). Average and instantaneous fuel consumption of Iranian conventional tractor with moldboard plough in tillage ARPN *J. of Eng. and Applied Sci.,* **5(2):** 30-35.

Jassim, A. and S.K. Alsharifi (2007). The effect of the plough type and the tractor practical speed at two levels of soil moisture in some performance indicators and soil physical properties. *J. of Uni. of Babylon,* **14(2):** 181- 188.

Khurshid, K., M. Iqbal, M.S.A. and A. Nawaz (2006). Effect of tillage and mulch on soil physical properties and growth of maize. *Int. J. Agric. Biol.,* **8:** 593-596.

Langston, A.S. (2014). Soil hydraulic and physical properties as affected by logging management A Thesis Master of Science, Faculty of the Graduate School, University of Missouri.

Mari, J.A., C. JI, A.A. Tagar, F.A. Chandio and M. Hanif (2014). Effect of soil forces on the surface of moldboard plough under different working conditions Bulgarian *J. of Agri. Sci.,* **20(2):** 277-281.

Mutlak, N. Naiem (2018). Effect of soil moisture and tillage depth on some growth characteristics for wheat crop. *Euphrates J. of Agri. Sci.,* **10(1):** 10-21.

Moeenifar, A., S.R. Mousavi-Seyedi and D. Kalantari (2014). Influence of tillage depth, penetration angle and forward speed on the soil/thin-blade interaction force. *Agric. Eng. Int: CIGR Journal,* **16(1):** 69-74.

Oduma, O., J.E. Igwe and D.I. Ntunde (2015). Performance evaluation of field efficiencies of some tractor drawn implements in Ebonyi State. *Int. J. Eng. Tech.,* **5(4):** 199-204.

Oehlent, G.W. (2010). A First Course in Design and Analysis of Experiments. Design-Expert is a registered trademark of Stat-Ease, Inc. Library of Congress Cataloging-in-Publication Data. University of Minnesota.

Rashidi, M. and F. Keshavarzpour (2007). Effect of different tillage methods on grain yield and yield components of maize (*Zea mays* L.). *Int. J. Agric. Biotechnol.,* **2:** 274-277.