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# Evaluation of some technical indicators with the use of the plow on clay soil.

[1]Mohanad S. Al ezzy, [2]Asaad Kh. Almayyahi

***Abstract***

*The experiment carried out on clay soil from Diyala city in 2019, the experiments were included using tractor type (New Holland T7.185) with a chisel plow by changing the speed of the tractor and the plowing depth in the clay soil.Three plowing speeds were selected for tractor (0.888, 1.322, 1.744 m/sec) and variable plowing depth (0.14, 0.18,0.225 m) with technical indicators which included:Draft force of tractor, practical productivity, Soil Volume Disturbed and fuel consumption.The experiments were carried out in experimental method and in four repeated cases.Statistically, the differences were tested in the least moral difference level (0.05).According to the complete random design, based on the devices testing, we can conclude that the results of the experiments wererereliable.It was found that the increase plowing speed of the tractor led to increased Draft force of tractor, practical productivity, soil volume disturbed and fuel consumption, also was found that increasing plowing depth leads to increasing draft force of tractor, decreasing practical productivity, increasing soil volume disturbed and fuel consumption.The plowing depth (0.14 m) exceeded the plowing depths (0.18,0.225 m) in achieving the lowest draft force of (2.542 KN) and the highest , practical productivity (1.438 $m^2$/sec), while the working speed of the tractor (0.888 m/sec) exceeded In achieving the lowest draft rate of (2.796 KN) and the lowest practical productivity (0.94 $m^2$/sec) and the lowest Soil Volume Disturbed (0.169 $m^3$/sec) and the lowest fuel consumption (0.00161 L/sec), as for the practical speed of the tractor (1.744 m/sec) It exceeded the speed (0.888, 1.322 m/sec) in achieving the highest practical productivity (1.883 $m^2$/sec) at the plowing depth (0.14 m).*

***Keywords:*** *Draft force, Soil volume disturbed, Practical productivity, Specific fuel consumption*.

## I. Introduction

The agricultural machinery since knew agriculture, the agricultural machinery has evolved over generations, at first the man used the stone to dig the ground and put the seeds (Barger et al., 1963). began using the ax and tree branches to prepare the soil for cultivation then by relying on human energy, then used animals to incision the soil by drafting the plow and in irrigation, this has reduced the muscular effort of the farmers, as well as an increase in agricultural production to them, then he used the wheels in the agricultural machinery which move by animals such as plows and

[1]*Technical institute Baqubah, Iraq*
[2]*Vocational Education Department in Basrah- Al Hartha Industrial school, Iraq.*

other agricultural machinery, and this led to reduce the animal effort and increase the rate of performance of the machinery and increase the production of the farmer (Rusell, 1980).Soil excitation is defined as the application or practice of the art of soil preparation for agricultural purposes. It is also defined from the engineering point of view as sliding soil on the agricultural machine, excitement or plowing is considered a state to dismantle or reverse the position of the soil using a machine (manual or animal or mechanical machine) (Hunt, 1980). There are different types of plows: subsoiler plow, moldboardplow, Chisel plow, Rotary biller plow and disc plow.The subsoiler plow is the most prevalent species, so it is sometimes manufactured locally, as subsoiler plow requires almost the half tensile strength which required for the moldboard plow, for the same operating width and plowing depth, therefore, the farmers use the plow at a deeper depth than the moldboard plow to break the deaf layer, which formed under normal tillage in order to improve the penetration of water and roots. The plow dugs up the soil, disassembling it at depths ranging from 15-46 cm and does not turn it over or overtly with little coverage of plant residues, and the number of leaf tines vary between 7 to 9 tines, these tines are usually installed into two rows and sometimes into three rows (Bukhari, 1990). One of the advantages of these plows is that they preserve the surface layer of the soil, where fertility is concentrated, and when used in alkaline salt land, do not move the surface layer where salt concentrated to the ground damaging the roots of plants also leave the soil surface corrugated (Wolkowski, 1997), this case helps preventing erosion by wind or water, as well as improve the penetration of water to the soil, the plow consists of the following parts: 1. Shank is either in the form of a duck's foot or tapered spear (tongue of sparrow), 2. Beams are the parts on which the shanks are installed and linked to the plow frame. 3. Frame Plow: is usually placed in the corners or sectors and the other parts are installed on it and the frame is lifted and lowered by the operation of the hydraulic tractor.

**Table (1) Tractor specifications**

| | |
|---|---|
| Type of tractor | New Holland T7.185 (England) |
| Number of cylinders and valves | 6 cylinders - 24 valves |
| Bore \ stroke | 104 * 132 mm |
| Rated power (Ec 97/98) | 104.4 kw |
| Maximum power (Ec 97/98) | 140.2 kw |
| Torque | 679.4 N.m |
| PTO power | 85.8 kw |
| Weight | 5800 to 6100 kg. |
| Wheel base | 273 cm.<br>278 cm Terraglide |

| | |
|---|---|
| | 287 cm super steer |

**Table (2) Chisel plow specifications**

| | |
|---|---|
| Model number | 62700 |
| Description | 7 tines chisel plow completed (small frame) |
| Weight | 318 kg |
| Working width | 1.5 m |

## II. Materials and methods

The experiment was conducted in Diyala city in 2019 using practical experiments method and used four cases to study the effect of two factors in which: The working speed of the tractor: Included the speeds (0.888, 1.322 and 1.744 m/ sec), the tractor has operated with the chisel plow as one unit in the field allocated to reach the speed of the tractor during work, taking into consideration leaving a distance (15 meters) from the front of the field which its total length is (50 meters) until stability at the depth and speed of plowing required to calculate the technical indicators for each case.Depth of plowing were (0.14, 0.18 and 0.225 m) which have been measured by using the spear point plow.

**Study indicators**

Draft force: The Draft force has calculated by attaching the leader tractor New Holland T7.185 to the driven tractor New Holland TD80, which holds the plow in which the speed box was in neutral position. The two tractors run in the field with the dynamo meter connected between them. The force of rolling resistance (Fr)was measured and plow almost in touchwith the ground, and the lifting force of the plow ($F_{p)}$has measured when the plow was in the plowing state according to the depth and speed required for each case. The Draft force has calculated by the following equation:

$F_t = F_p - F_r$

Whereas:

$F_t$-Draft force (KN)

$F_p$-the lifting force of the plow in the plowing state (KN)

$F_r$-The force of rolling resistance when the plow almost touches the ground (KN)

**Practical productivity:**

The practical productivity depends on the actual working width of the plow (w) which have measured by the measuring tape, and also depends on the speed of the tractor (v), while the coefficient of exploitation of time ($F_t$) was about: (0.65-0.75)

$P_p = W*V* F_t$

$P_p$ = practical productivity ($m^2$/ sec)

W = actual width of the plow

V = tractor speed (m /sec)

$F_t$ = coefficient of exploitation of time

3- Soil Volume Disturbed: is the volume of soil that is raised by the plow during the unit of time

S.V.D. = D * $P_p$

S.V.D= Soil Volume Disturbed $m^3$/sec

D = plowing depth m

$P_p$ = practical productivity $m^2$/sec

**Specific fuel consumption:**

A cylinder inserted into the fuel stream was attached to the engine to measure the volume of fuel consumed per plowing depth and tractor speed. The time required for each operation has determined by using a stopwatch. Specific fuel consumption has calculated by the value of the volume of fuel consumed per unit of time.

$Q = V_L / t$

Q = specific fuel consumption L / sec.

$V_L$= volume of spent fuel L

t = time required for each operating Sec.

## III. Results and Discussion

Table (3) shows the effect of plowing depth and practical speed of tractor on draft force. The results of statistical analysis showed that there was a moral effect of plowing depth at (0.05) where the plowing depth (0.14m) exceeded with the lowest draft force of (2.185 KN). The plowing depth (0.225 m) has recorded the highest draft force (4.358 KN). In addition, it is clear from table (3) that the practical speed has a moral effect and the level of (0.05) exceeded the practical speed of the tractor (0.888 m/sec) by recording the lowest draft force of (2.796 KN) while the practical speed of the tractor (1.744 m/sec) has achieved the highest draft force (3.626 KN)

From Table (3), it was found that when the dual interfering between the plowing depth (0.14m) and the working speed of the tractor (0.888 m/sec) have given the lowest draft force by (2.185 KN). The interference at the plowing depth (0.225 m) and the practical speed of the tractor (1.744 m/sec) have gave higher draft force by (4.358 KN) was due to the fact that increase the speed of the tractor with increasing plowing depth will increase the draft resistance of the plow.

**Table (3): Effect of some plowing depths and tractor speed on draft force (KN).**

| Indicator Studied | Plowing depth(m) | Speed of tractor m/sec | | | Average plowing depths |
|---|---|---|---|---|---|
| | | 0.888 | 1.322 | 1.744 | |
| Draft force (KN) | 0.14 | 2.185 | 2.546 | 2.895 | 2.542 |
| | 0.18 | 2.734 | 3.281 | 3.626 | 3.213 |
| | 0.225 | 3.471 | 4.017 | 4.358 | 3.948 |
| L.S.D (0.05) | | 0.1379 | | | 0.0859 |
| Average working speed of tractor | | 2.796 | 3.281 | 3.626 | |
| L.S.D (0.05) | | 0.0993 | | | |

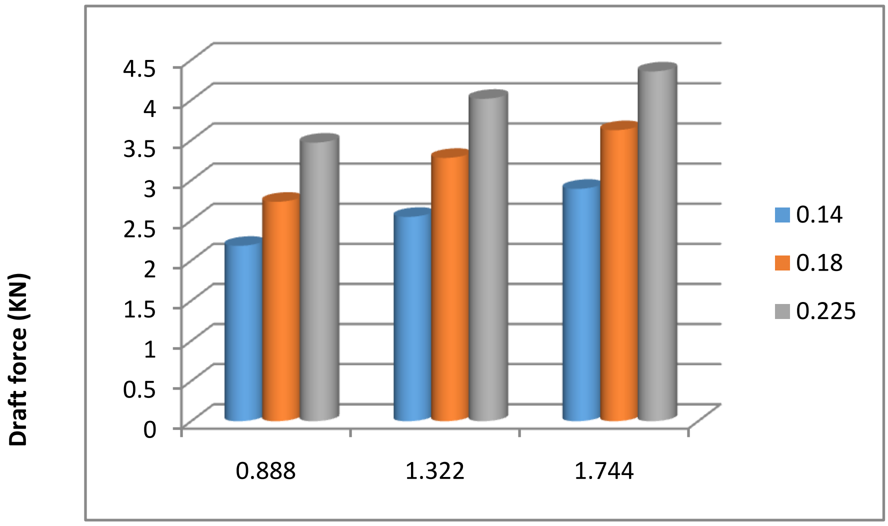



**Figure :1** **Speed of tractor (m/sec)**

from table (4) it is clear that there was a moral effect of plowing depth and working speed of tractor on practical productivity where it gave plowing depth (0.14m) and working speed of tractor (1.744 m/sec) the heights practical productivity ( 1.883 $m^2$\sec) , while plowing depth was (0.225 m) and working speed (0.888 m/sec) the lowest value of the practical productivity (0.892 $m^2$\sec) , it has found out that the working speed of the tractor had a moral effect at the level of (0.05) where the working speed of the tractor (1.744 m/sec) was exceeded in its highest recording of the practical productivity which reached (1.813 $m^2$/sec) , while the working speed of the tractor (0.888 m/sec) recorded the lowest rate of practical productivity reached (0.940 $m^2$\sec), this is due to the fact that the working speed in the basic elements in determining the productivity of the machine and increase it lead to increased practical productivity.

Table (4): Effect of some plowing depths and tractor speed on practical productivity ($m^2$ / sec)

| Indicator Studied | Plowing depth(m) | Speed of tractor m/sec | | | Average plowing depths |
|---|---|---|---|---|---|
| | | 0.888 | 1.322 | 1.744 | |
| practical productivity ($m^2$ / sec) | 0.14 | 0.985 | 1.447 | 1.883 | 1.438 |
| | 0.18 | 0.945 | 1.388 | 1.805 | 1.379 |
| | 0.225 | 0.892 | 1.308 | 1.752 | 1.317 |
| L.S.D (0.05) | | 0.0321 | | | 0.02 |
| Average working speed of tractor | | 0.940 | 1.381 | 1.813 | |
| L.S.D (0.05) | | 0.023 | | | |

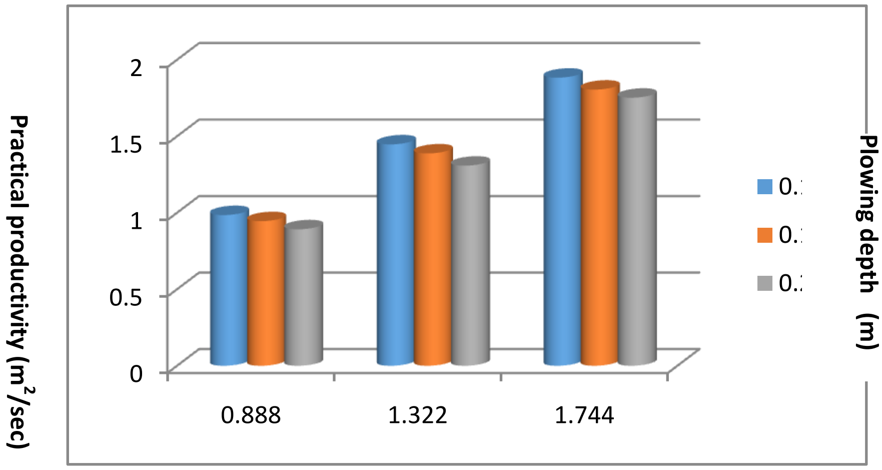
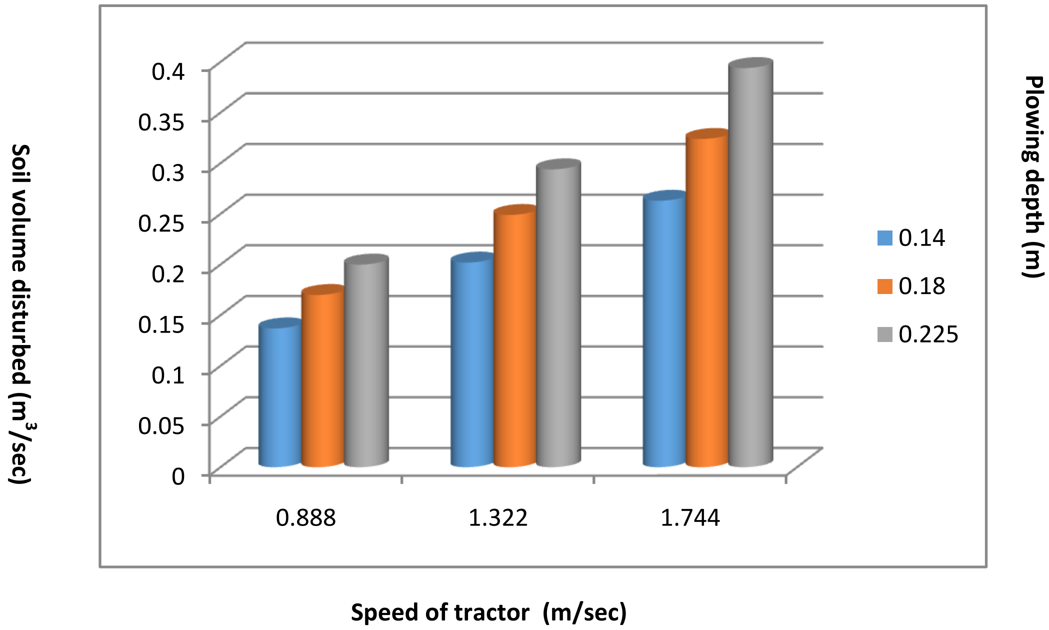



**Figure: 2Speed of tractor (m/sec)**

Table (5) shows the effect of plowing depth and working speed of tractor on the soil volume disturbed. The results of the statistical analysis showed that there was a moral effect of plowing depth at the level of (0.05), where the depth of plowing (0.225 m) was exceeded that recorded the highest value of soil volume disturbed reached (0.296 $m^3$\sec), While the plowing depth (0.14 m) achieved the lowest rate (0.2 $m^3$\sec) on the level (0.05), as Table (5) shows that the working speed of the tractor moral effect on level (0.05) when the working speed of the tractor (1.744 m/sec) recorded the highest soil volume disturbed reached (0.327 $m^3$/sec) while the working speed of the tractor (0.888 m/sec) recorded the lowest soil volume disturbed (0.169 $m^3$/sec) at the level (0.05), Table (5) gave an overlap between the plowing depth (0.225 m) and the working speed of the tractor (1.744 m /sec), the highest value of the soil volume disturbed (0.394 $m^3$/sec), While the overlap between the plowing depth (0.14 m) and the working speed of the tractor (0.888 m/sec) gave the lowest value of the soil volume disturbed (0.137 $m^3$/sec) ,the reason for this is that the plowing speed is directly proportional to the soil volume disturbed.

**Table (5): Effect of some plowing depths and tractor speed on Soil Volume Disturbed ($m^3$/sec).**

| Indicator Studied | Plowing depth(m) | Speed of tractor m/sec | | | Average plowing depths |
|---|---|---|---|---|---|
| | | 0.888 | 1.322 | 1.744 | |
| Soil Volume Disturbed S.V.D $m^3$/ sec | 0.14 | 0.137 | 0.202 | 0.263 | 0.2 |
| | 0.18 | 0.170 | 0.249 | 0.324 | 0.247 |
| | 0.225 | 0.200 | 0.294 | 0.394 | 0.296 |
| L.S.D (0.05) | | 0.0389 | | | 0.0242 |
| Average working speed of tractor | | 0.169 | 0.248 | 0.327 | |
| L.S.D (0.05) | | 0.028 | | | |




**FigureSpeed of tractor (m/sec)**

table (6) shows the effect of plowing depth and working speed of tractor on fuel consumption. The results of the statistical analysis showed that there was a moral effect on plowing depth. The plowing depth (0.14 m) was exceeded by recording the lowest fuel consumption (0.00184 L/sec) at the level (0.05). While plowing depth (0.225 m) recorded the highest fuel consumption (0.00234 L/s) at the level(0.05), As shown in table (6) that the working speed of the tractor had a moral effect at the level (0.05), where the working speed of the tractor (0.888 m/sec) recorded the lowest fuel consumption rate was (0.00161 L/sec) while the working speed of the tractor (1.744 m/sec)recorded highest fuel consumption (0.00265 L/sec), This is due to the fact that the increased working speed of the tractorincreases the capacity of the engine, which increases fuel consumption.

Table (6): Effect of some plowing depths and tractor speed on fuel consumption (L/ sec).

| Indicator Studied | Plowing depth(m) | Speed of tractor m/sec | | | Average plowing depths |
|---|---|---|---|---|---|
| | | 0.888 | 1.322 | 1.744 | |
| Fuel consumption L / sec | 0.14 | 0.00135 | 0.00177 | 0.00242 | 0.00184 |
| | 0.18 | 0.00161 | 0.0021 | 0.00271 | 0.00214 |
| | 0.225 | 0.00189 | 0.0023 | 0.00284 | 0.00234 |
| L.S.D (0.05) | | 0.0000983 | | | 0.0000613 |
| Average working speed of tractor | | 0.00161 | 0.00205 | 0.00265 | |
| L.S.D (0.05) | | 0.0000707 | | | |

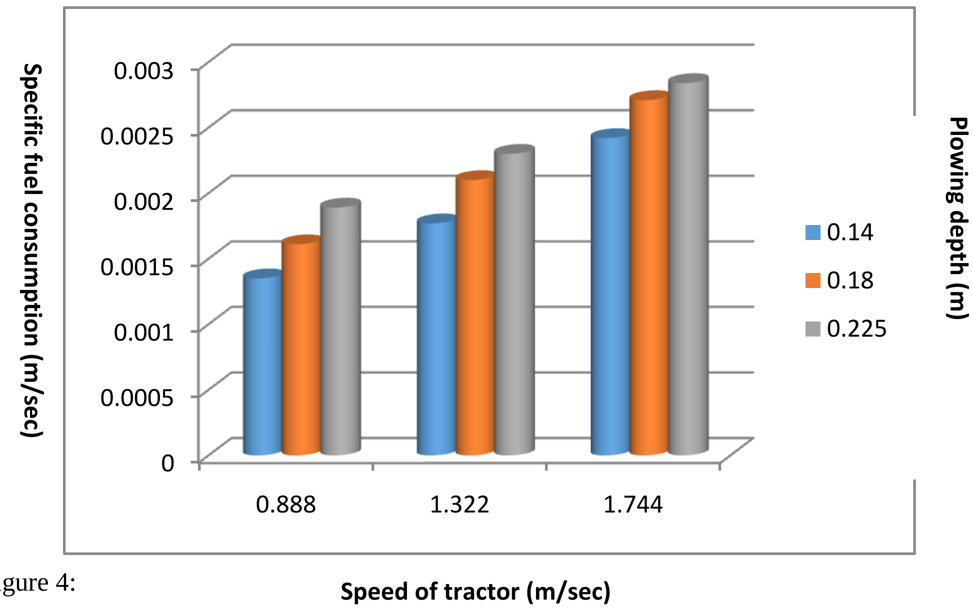



Figure 4:

## IV. Conclusions

The draft force increases when increasing the forward speed of the tractor and the plowingdepth, and this indicates that the draft force of the plow is directly proportional to both the forward speed and the plowing depth.The practical productivity decreases when the plowing depth increases, and the practical productivity increases when the forward speed increases, so we conclude from this that the practical productivity is inversely proportional to the plowing depth and is directly proportional to the forward speed of the tractor.The Soil Volume Disturbed increases with increasing both the plowing depth and the forward speed of the tractor, this means that the soil volume disturbed is directly proportional to the plowing depth and the forward speed.The fuel consumption rate increases when the forward speed of tractor and plowing depth increase, and we conclude from this that the fuel consumption rate is directly proportional to the forward speed and plowing depth.

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