

## **EFFECT OF AGE AND PRESSURE OF THE REAR TIRE OF TRACTORS PERFORMANCE INDICATORS USING THE DISC PLOW**

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### **ABSTRACT**

The research included a standard study of the age of the which tires are (80%) and (50%) of standard condition and the inflation of the rear tire of the boat are (32) psi and (27) psi and the affect in both of the following properties(draft force, loss power to slippage, fuel consumption, effective field capacity, energy utilization efficiency, volume of soil disturbed, soil penetration resistance, dry bulk density) The experiment was carried out in a global experiment by using the Duncan test with experimental design (RCBD) was used to show the significance of the differences between the average transactions. The result showed a significant effect of the age of the tires in all the studied traits except for the description of the apparent density and showed a significant effect of the pressure factor of the tire bulge in all studied traits except of effective field capacity, volume of soil disturbed, dry bulk density. All the studied traits were significantly affected by the dual interference between the age of tires and pressure of bulge except for the dry bulk density which did not affect significantly.

**Key words:** Tire pressure, Age of tire, Draft force

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### **INTRODUCTION**

Agricultural equipments and machines have developed in the recent period and since the agricultural plow is the main source of capacity in the field and in the completion of agricultural operation .it is necessary to pay attention to the development of this effective part of the agricultural process and the research examined all part of the plow starting with the engine transmission box and the tires The plow is considered from the untreated land equipment. This is why their. technical specification differ significantly from those that work on paved roads. The plows are divided into two types are: tracked tractors and wheel tractors plastic tires were discovered by John Boyd Dunlop in the year (1887) which contains inside a tube of air features it reduces the sound, the shocks, the vibrations and increases speed and easy to install on the plow and is used in roads tiled and tumbled. From the practical experience of previous studies, it is found that one of the most important factors that affect the work of tires is the technical condition of tires where the technical condition of the tires is less than the standard status, causing the inefficiency of tires as well as internal air pressure of tires clearly affects the efficiency of draw efficiency and this effect is achieved by increasing the appendage of the tires to penetrate the soil and ensure good soil retention when pushed back.

Al-Banna (1990) also mentioned that the percentage of slip is affected by many factors including the speed and type of plow as well as the size and condition of tires. As well as that the pressure of air within the frame affects the area of tire contact with the soil, which plays a large role in determining the pushing force through the exploitation of the soil cohesion level ( Aday & Al-Sahauar ,2008), (Lancas ,et.al ,1996)studied pressure of tire bulge at a level between the first (165) kpa for both axes and the second (76,90) kpa for front and rear tires respectively and the effect of this in some performance indicators of the plow where the results showed that reducing the pressure of the above bulge led to reduce fuel consumption from (16,37) to (13,38) L /ha, and the slide from (10,8)% to (7,10)% and increase the production process from (4,95) to (5,32) ha / h.

Al-Hamed et.al,(2001) pointed out that the efficiency of the draw increases with the pressure of the bulge of the tires when the studying the effect of three pressure bulge of the rear tires (160,120,80) kpa where the draw efficiency increased from (49,24)% to (51,50)% by low pressure bulge from ( 160) to (80) kpa since the plows have major role in the agricultural process, the research required study of the traits that affect the type of plow. Rigid plows are primary soil preparation equipment that requires more pull power than others. The bad use of tools and agricultural machinery leads to the compaction of the soil and the destruction of it is their total as well as the deterioration of their physical properties and reduce the occurrence and increase fuel consumption (AL-Banna,1990,AL-Tahan& Mohammed,1988) .The study was preceded by two levels of compression and tire bulge and the objectives of the study included evaluating the technical condition of tires in a way that serves to improve performance of the mechanic of the trip and the best physical of the high visibility of tires and compare the appropriate pressure ranges with the technical condition of the tires and their impact in some performance indicators of the plow.

### **RESEARCH MATERIALS AND METHODS**

The study was carried out in the field of the Samakia village area of Basheqa in February 2018 and the soil was green clay wiht (dry bulk density 1.59, moisture content 13.9 and porosity 13.6%).

The study included the use of plow type Massey Ferguson model 285S it is ability(75 hp ) for the purpose of traction and measurement of the studied indicators and the type of tiers were (Good year) Turkish origin and their size (18-4/30) at two levels of age . The first was (85%) of the standard case and the second (50%) of the standard case by measuring the height of the standard was (3.5) cm the first case was (2.97) cm and the second (1.75) cm. Two levels of pressure were used, the first was (32 psi) and the second (27psi) second (Tractor) used for raising and lowing plow with the same specification in terms of type and model of the first factor. Each level of tires was selected of both pressure on each side and the choice of draft force by using force draft device type (Dillon)to connect between two tractors to measure rolling resistance force and draft force by used (disc plow) Turkish model (2002) and working width (100 cm). The level age of the tires was determined by pattern fingerprint of size the tire frame by burke material filled with water and then measure the of water and then take a small piece of the rubber of the tire and

immerse it in water by Archimedes base and then weighted this piece , compare it by the removed water , volume and weight of removed water with the volume and weight of rubber \*40 compare with the number of template of one tire .

In the field each 30 meter process was fixed by a measuring tape, personalization and used accurate stop watch by used (RCBD) included eight transaction 2\*2\*2 and three repetition, I.e twenty four treatments, by using duncun test multi range in the level of probability (5%). The following equations were used to find the studied indicators:-

**1- Draft force :**

$$F_t = F_{pm} - F_{rm} \dots \dots \dots (1)$$

F<sub>t</sub>: draft force.( kN)

F<sub>pm</sub> = Power for rear wheels for first tractor.(kN)

F<sub>rm</sub> = Roll resistance to wheels for second tractor.( kN) (Al mashriky,1999)

**2-Loss power due to slippage:**

$$SP = F_t (V_t - V_p) / 3.6 \dots \dots \dots (2)$$

Sp : -Wasted power due slippage (kW).

F<sub>t</sub> : - Draft force (kN).

V<sub>t</sub> : Theoretical speed (km/h) .

V<sub>p</sub> : Practical speed(km/h). (mohammed ali et.al,1979)

**3-Fuel Consumption :**

$$FC = Q \times 10000 / TL \times WP \times 1000 \dots \dots \dots (3)$$

FC: The amount of fuel consumption per hectare (L/ha)

Q: The amount of fuel consumption during the process (ml)

TL: Processing length (m)

WP: Tillage actual working width (m) (AL Noaimi,2008)

**4- Volume of soil disturbed:**

$$S.D.V = EFC \times D_p \times 100 \dots \dots \dots (4)$$

S.D.V : Volume of the raised soil (m<sup>3</sup>/h)

EFC : Actual field productivity (ha/h)

D<sub>p</sub> : Actual tillage depth (cm). (Ahaneku,et.al,2010)

**5- Effective field capacity :**

$$EFC = (S \times W \times E) / 10 \dots \dots \dots (5)$$

EFC : Field productivity (ha/h)

S : The practical presentation of the plow (M)

W : Practical speed (Km/h)

E : Field efficiency (%) it is used (75%) (ASAE,2003) , (Al-tahan et.al,1991)

**6-Energy utilization efficiency:**

$$N = (1/S.R.) \times 100 \dots \dots \dots (6)$$

N : Energy utilization efficiency (M<sup>3</sup>/ mj)

S.R. : Quality resistance (kN/m<sup>2</sup>). (Mckyes,1997)

**7-soil penetration resistance:**

Soil penetration resistance = read the device × constant /9.81 × cone base area.....(7) (Baver,et.al.1972)

**8-Dry bulk density:**

$$P_b = M_s / V_t \dots \dots \dots (8)$$

Pb : Dry bulk density (gm / cm<sup>3</sup>)  
Ms : Solid block parts  
Vt : Total soil size. (Blak,Hartage.,1986)

## RESULTS AND DISCUSSION

### 1-Effect of age of the tire in the studies properties

It is noticed from table (1) that there are differences in the effect of tire life (age) in all studied trails except for the (dry bulk density) which was non significantly affected. The first level of tire age (85%) surpassed at the second level of tire age (50%) of the standard condition with the lowest drift force of (7.66) kN having achieved the lowest wasted power due to slippage (0.88) kW, and the lowest fuel consumption was (18.99)L/h. and the highest energy utilization efficiency (21.56) M<sup>3</sup>/mj , also the highest effective field capacity (0.366) ha / h but the lowest soil penetration resistance (1213.75) kpa and the highest volume of soil disturbed (617.53) M<sup>3</sup>/h

It is noticed from table (1) that draft force is increased when tires are more consumed. The reason related to that the highest of promises in the tires lead to increase their permeability to the soil, hold it down reduce slippage and draft force this agreed with (Taylor, 1991). And the lack of loss power due to slippage when the tire in good condition related to that the promises of tires are planted in to the soil and achieve good catch leads to reduce slippage and decrease the draft force. The reason for the luck of fuel consumption in the case of tier 85% due to improve soil retention and reduce the slippage, and this is a greed with (Mowitz,1987) slippage is essential effective in fuel consumption. The largest effective field capacity in the age of the first tire because the good cohesion of the soil lowest the slippage and increased the forward speed this is agreed with (Al-Aanee ,1995). Effective field capacity was improved at the age of the first level tire due to the low traction strength after the slippage decreased and the quality of the soil decreased and the efficiency of energy utilization increased. The soil volume raised agreed with Mckyes, Maswaure, (1997). First level age of the tires leads to increased field productivity which is increased the size of the raised soil this is agreed with (Bukhary, 1988). Increase the strengt of the soil resistance penetrate to may be due to largest penetration of the tires promises and the weight is close to the standard (this is agreed with (Abo-Hamdeh, 2003).

Table(1): Effect of the age tire in the studies properties

Tire Age	Draft force kN *	Wasted power due to slipped Kw *	Fuel Consumpti on L/ha *	Effective field capacity ha/h *	Energy utilization efficiency M <sup>3</sup> /mj *	Volume of soil disturbed M <sup>3</sup> /h *	Soil penetration Resistance Kg/cm <sup>2</sup>	Dry Bulk density gm/cm <sup>3</sup> *
85%	7.66b*	0.88b*	18.99b *	0.36a*	21.56a *	617.53a*	1319.75a	1.39a*
50%	8.95a	1.37a	20.42a	0.34b	18.42b	571.84b	1213.75b*	1.47a

The value with the (\*) is the best

## 2-The effect of pressure of tire bulge in the studied properties

Table (2) indicates significant difference in the effect of pressure of tire bulge in all studied traits, except for the properties of field productivity, the size of the raised soil and the apparent density. The second production presser exceeded (27) psi in reducing the draft force of (7.87) kN and the missing capacity by slip (0.93) kW and the use of fuel to (19.26) L/ha and increased the efficiency of energy utilization (21.13) M<sup>3</sup>/mj. as the strength of soil resistance to penetrate from the level (1) was (1304.50) KPa.

Table (2) shows that the draft force decreases with the swelling of the bulge pressure improves tire contact with (singh and Thomas, 2002), the lost capacity has decreased due to decrease the pressure of the tire bulge increases the area of contact with the soil, less slippage, the capacity lost due to it and this is consistent with (Lancas, 1996) reduced the amount of fuel consumption because of it has registered the least capacity to slip due to increased contact and low fuel consumption and this is consistent with (AL –Hamed et.al, 2001) while the field productivity did not significantly affect the efficiency of energy utilization and the reason for this decline in the strength of draw due to the low quality of soil resistance and the area of raised soil increased and led to increased energy efficiency and this was consistent with ( Aday ,Humood,1995) the size of this soil was non significantly increased when the pressure of the tire bulge decreased , this is due to the increase in the contact area between the tires.

Table (2) Effect of pressure of tire in the studied properties

Tire pressure	Draft force kN *	Wasted power due to slipped Kw *	Fuel Consumption L/ha *	Effective field capacity ha/h *	Energy utilization efficiency M <sup>3</sup> /mj *	Volume of soil disturbed M <sup>3</sup> /h *	Soil penetration Resistance Kg/cm <sup>2</sup>	Dry Bulk density gm/cm <sup>3</sup> *
32psi	8.71a	1.31a	20.15a	0.34a	18.85b	591.33a	1229.00b*	1.45a
27psi	7.878b*	0.93b*	19.26b*	0.35a*	21.13a*	598.04a*	1304.50a	1.41a*

The value with the (\*) is the best.

## 3- Effect of interaction between age of the tire and the inflation pressure.

Table(3)shows significant differences in the effect of tire age and compression factors .The interaction between tire age at the first level with low inflation pressure (27) psi in the achievement of the minimum dray of a kilo newton and the least capacity of missing slip of (0.61) kW and the lowest fuel consumption of (18.37) L/ha, the highest effective field capacity of (0.36) ha /h the highest energy utilization efficiency (23.46)M<sup>3</sup>/mj, the highest volume of soil disturbed (618.61) M<sup>3</sup>/h , the highest soil penetration resistance was (1354.00) kpa and the dry bulk density was non significantly affected by this properties.

It is noticeable from table (3) that the drag strength was less than that when the tire age of the first level was mixed with a low inflation pressure (27) psi low ratio by (23.27%) and the reason may be that the efficiency of the draw increases with less tire consumption and the contact between the tire and the soil increases when the pressure of the bulge is low and the lower power loss ratio. This is

consistent with (Bandar & Hamod ,2009) and the reduced slip capacity when working in the first level tire age and the lower tire pressure as well as the lower value indicator .The reason is that the good tire yields with the grator contact area with the soil at both levels reduced the slip and the capacity lost due to it .This is consistent with (Al-Hamed et.al,2001) and the fuel consumption has recorded the lowest value and it is the best at the same levels of the farmer and the reason mentioned in the previous paragraph also increased field productivity when overlapping the level of age of the first tire with the level of pressure of the second bulge and the reason for the improvement of soil retention and increase the contact area sliding process speed increased and then field productivity and this is consistent with (Amer, 2017) increased efficiency of energy utilization in the above mentioned levels the same as the strength of the dual of the unit of the area and increased energy efficiency because of the efficiency of the percentage of slippage and loss of capacity due to this is explained in the previous paragraphs , The highest volume of soil was raised when the age of the first tire interaction with the pressure of the second bulge and the reason for this supported (Al-Jobouri , 2001) that the effective field capacity increased the volume of the soil disturbed when the stability of the depth of tillage and the strength of the soil penetration resistance at these two levels increased more than any other due to the grounding of the soil because the age of the tire is new and the weight is higher . The presence of an air bag leads to the compression of movement during the movement and the international vibration on the unity of tolerance. There was no significant effect of the apparent dry bulk density of this properties.

Table (3) Effect of interaction between age of the tire and the inflation pressure

Tire Age	Tire pressure	Draft Force kN *	Wasted Power due to slipped Kw *	Fuel Consumption L/ha *	Effective Field Capacity ha/h *	Energy Utilization Efficiency M <sup>3</sup> /mj *	Volume of soil disturbed M <sup>3</sup> /h *	Soil Penetration Resistance Kg/cm <sup>2</sup>	Dry Bulk Density gm/cm <sup>3</sup> *
85%	32psi	8.34b	1.15b	19.61c	0.36a	19.66b	616.46a	1285.50b	1.40a
	27psi	6.98c*	0.61c*	18.37d*	0.36a*	23.46a*	618.61a*	1354.00a	1.37a*
50%	32psi	9.09a	1.47a	20.69a	0.33b	18.03d	566.21b	1172.50c*	.50a1
	27psi	8.77ab	1.26b	20.15b	0.34b	18.81c	577.46b	1255.00b	1.44a

The value with the (\*) is the best.

### CONCLUSIONS

1- Rely on sound tires by more than 75% being the best results on (draft force , Loss power due to slippage, fuel consumption , effective field capacity, energy utilization efficiency, volume of soil disturbed and not use the tires when the proportion of consumption more than 50% of the standard case for its mechanically negative effect.

2- the increased pressure of the tire bulge is over recommended Limits they were negative where increasing it means Increasing both (Loss power due to slippage, fuel consumption) and low energy efficiency.

## RECOMMENDATION

1-The studying recommends using tires more than 50% of the standard case of tires so to give it high mechanical and economic indicators.

2-take into account the pressure of bulge as appropriate with Agricultural process and use the appropriate recommended pressure for that process and according to the soil condition.

تأثير عمر وضغط انتفاخ أطار الساحبة الخلفي في بعض مؤشرات الاداء باستخدام المحراث القرصي  
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## الخلاصة

اجري البحث لدراسة تأثير عمر وضغط انتفاخ اطار الساحبة الخلفي في بعض مؤشرات الاداء باستخدام المحراث القرصي القلاب في شهر كانون الثاني للموسم الزراعي (2018) في منطقة السماقية /ناحية بعشيقية والتي تبعد 18 كم عن مركز المدينة وكانت نسجة التربة طينية غرينية وكانت الرطوبة (13.9) وباستخدام مستويين من عمر الاطار وكان المستوى الاول (85%) من الحالة القياسية والمستوى الثاني (50%) من الحالة القياسية وضغطي الانتفاخ للإطارات الخلفية للساحبة بالمستوى الاول (32) psi والمستوى الثاني (27) psi وتأثير ذلك في كل من الصفات: قوة السحب، القدرة المفقودة بالانزلاق، استهلاك الوقود، الانتاجية الحقلية، كفاءة استغلال الطاقة، حجم التربة المثارة، قوة مقاومة التربة للاختراق، الكثافة الظاهرية. نفذت التجربة بطريقة التجربة العملية واستخدام اختبار دنكن لبيان معنوية الفروقات بين متوسطات المعاملات، اظهرت النتائج المستحصل عليها: وجود تأثير معنوي لعمر الاطارات في جميع الصفات المدروسة عدا صفة الكثافة الظاهرية، كما اظهرت النتائج وجود تأثير معنوي لعامل ضغط انتفاخ الاطارات في جميع الصفات المدروسة عدا صفات الانتاجية الحقلية، حجم التربة المثارة، الكثافة الظاهرية، فيما كانت جميع الصفات المدروسة متأثرة معنويا بالتداخل الثنائي بين عمر الاطارات وضغط انتفاخها عدا صفة الكثافة الظاهرية التي لم تتأثر معنويا.

كلمات دالة: ضغط الإطارات، عمر الإطارات، قوة السحب

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## REFERENCES

- Abu- Hamdeh , Nidal H. (2003). Soil Compaction And Root Distribution For Okra As Affected By Tillage And Vehicle Parameters .*J. of Soil Res*, 74(1): 25-35 .
- Aday ,S.H. and T.D.AL-Sahwan (2008). An Investigation Into The Effect Both Tires Inflation Pressure And Weight Of Traction Wheels On The Field Performance. *Catalog of M.F. 285S tractor (special issue)*, vol(21).
- Aday, S.H. and M. S. Hmood (1995). The field performance of subsoiler when provided with wing and shallow tines in heavy Soil. *Mesopotamia J. of Agric*. 27(4): 15-20.
- Ahaneku, I, E, O, A .Ouelade ,and T.Faleye , (2010) .Comparative Field Evaluation Of Three Model Of A Tractor. Corresponding authors E-mail :[darhaneku@yahoo.com](mailto:darhaneku@yahoo.com).
- AL Anne, Reffat Nammk Abd Al Ftaah , (1995). Study the effect of high speed operation and different depths of plowing on some exploitative indicators

- for the pulpit cast with the tractor is antar (71) In Abu Ghraib Area. *Journal of Iraqi Agricultural Sciences*, 26 (2): 261-256.
- AL Banna , (1990). Soil Preparation Equipment. Directorate Of Dar Al Kutub For Printing And Publishing, University Of AL Mosul, Ministry Of Higer Education And Scientific Research, IRAQ.
- AL- Hamed ,S . A . ,A .M. Aboukarima and M.H.A. Kabeel (2001) . Effect of rear tire inflation pressure on front wheel assist tractor performance. *Misr J . of Agricultural Engineering* , 18(3): 175-725.
- AL Jubouri , Muzaffar Karim , (2001). Field performance testing for the pulpit cast with plow (71) in green clay soil .*Journal of Iraqi Agricultural Sciences* , 196-183 (2) 32 .
- AL Noaimi ,Waddah Nouri Hammadi ,(2008). Effect Of The Angle Of Inclination Of The Body Of The Plow In Some Capacity Requirements, And The Number Of Physical Properties Of The Soil. Master Thesis, Agricultural Machanization Department, College of Agriculture and Forestry, University of AL Mosul, IRAQ.
- AL Tahaan.Yassen Hashem and Mohammed Jassem AL Neema ,(1988). Machinery and Agricultural Machinery, Dar AL Kutub for printing and publishing, University of AL mosul, Ministry of Higher Education and Scientific Research, IRAQ.
- AL Tahaan Yaseen Hashem and Medhat Abdullah Hammedh and Mohammed Kadree Abd AL Wahaab, (1991). Economics And Machinery Management And Agricultural Machinery, Dar Alkutub for printing and publishing, University of AL mosul, Ministry of Higher Education and Scientific Research, IRAQ.
- Amer ,Khaled Zamam, (2017). Different speed effect for two type of plow in some performance indicators for the mechina unit. *Journal of Iraqi Agricultural Sciences* , 48(4) : 1147- 1141.
- Bander ,Salem Agar and Majid Saleh Hamoud ,(2009). Study the effect of pressure tires on the drive performance pull for plow anter (80). *Basra Research Journal*, 35(4): 36-51.
- Baver, L.D.; W.H. Gardener and W.R. Gardener. (1992). Soil Physics. 4<sup>th</sup> Edition, John Wiley and sons, New Yourk.116-117.
- Blake ,G. R. and K. H. Hartge ,. (1986). Bulk Density In Particle Size Analysis Method Of Soil Analysis Part 1. Physical And Mineralogical Methods Second Edition Agronomy (A) Ed . Klute.
- Bukhari, S., Masood Ahmad Bhutto, jan Muhammed, Baloch Mirani. (1988). Performance of selected tillge implements . *Agric Mech. In Asia, Africa and Latin America* 19 (14): 17-19.
- Lancas , K. P. , S. K. Upadhyaya , M. Sime and S. Shaffii (1996). Overinflated tractor tires waste fuel, *Reduce Productivity California Agriculture*, 50 (2) : 28 – 31.
- Mckyes , E. and Maswaure, J. (1997). Effect of design parameters of flat tillage tools on loosening of a clay soil and tillage. *Energy Utilization J.*, 46(2):195-204.



- Mowitz , D. and C. Fink (1987). Putting power back into tractor performance, machinery management issue successful farming, *The Magazine Farm Management . February .Paper No:9-15.*
- Taylor , R. , M. Schrock, K. Wertz (1991) . Getting The Most From Your Tractor. Department Of Agricultural Engineering, Cooperative Extension Service, Kansas State University, Manhattan.
- Thomas, E.V. and B. Singh (2002). Performance of tractor implement combination. *Agricultural Mechanization In Asia 32(2):25-28.*