# POWER BALANCE FOR SOME DIFFERENT TYPES OF TRACTORS USED IN IRAQ

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## ABSTRACT

*The aim of present study was to determine the most suitable tractor to complete the implementation of the basic agricultural operations through technological time in the agricultural production conditions in Iraq.*
*A field experiment was conducted at the Faculty of Agriculture, Baghdad University during 2011, to evaluate the performance and power requirements for these tractors.*
*To achieve this goal 3 tractors of different powers ranging from 70 – 105 HP were used to execute the commonly mechanized operation in Iraq. Three different operations were used: ploughing with mouldboard plough, harrowing with disc harrow and land levelling by land leveller.*
*The optimum tractor power requirement under Iraqi agricultural conditions was selected according to the evaluation of the following criteria: the performance, and tractor power balance for these tractors, Therefore it might be suggested from the results of this investigation covering many technical aspects that the engine horsepower required for executing must of the main Iraqi agricultural operations. To select the New Holland tractor (80HP) for carrying ploughing and harrowing operations and to select Tumosan tractor (105 HP) for carrying levelling operation.*

## INTRODUCTION

The development of the agricultural sector depends on the mechanization of different agricultural operations and these processes need to different operating powers. The farm tractor is the key source of power on the farm, which meets these requirements of the required power but there are diversity and significant difference of existing tractors in the agricultural field in many countries of the world, including Iraq.

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These tractors differ in terms of models and powers, for example, there are more than 20 models of tractors of power ranging between (60–120) HP in Iraq (Al-Iraq Al-Hadieth Company, 2011) and this diversity could lead to many problems, which should work on resolving them.

The choice of used implement and the type of used appropriate tractor and for different operating conditions requires the user to know the power of resistance traction the machine and which help them to choose the suitable tractor and implement without problems affecting the productivity of the machine in order to obtain suitable results, in order to obtain appropriate results and high efficiency for both the tractor and the machine together (Grisso *et at.* 1996).

It is found that when not using tractors and agricultural machines on a regular and correct basis lead to raise of the operating costs and make them consist a large proportion of the total cost of agricultural (Mayfield *et al.* 1981), especially if we knew that the operating costs of agricultural implement in the implementation of various agricultural operations form about (50%) of the total costs of agricultural production (Al-Izzi 1980).

Naderloo *et al.* (2009) indicated that tillage operations require more power in the field, so the traction and power requirements are important for determination of the capacity of the tractor size of the tractor that can be used with particular equipment. Traction needed for particular equipment depends on soil conditions and geometry for tillage machines.

Al-Ajili, (2008) explained the superiority of the mouldboard plough to get the least rate of traction force relative to other tillage systems, The reason beyond this refers to workable width for mouldboard plough and ease to penetrate soil. The percentage of slip is less than the rest of the ploughs.

Al-Tamimi, (2010) explained that increasing the depths of tillage to mouldboard plough lead to increase of the required traction force and that achieved at depths of (10, 15 and 20) cm traction rate at (10.978, 11.853 and 12.958) kN, respectively.

Hilal (2010) reached to that tillage speed has significant impact on the traction force and increasing tillage speed lead to the increase of traction force, and on this the foundation the primary speed recorded (3.35) km/h the least traction force, reaching (6.149) kN while third speed reached (6.55) km/h the highest traction force, reached to (7.821) kN. The reason attributed to that increase accelerated tillage led to further accelerate in soil compounds and increase the energy given to the soil as a result of increased speed.

Aday and Al-musawi (2009) conducted field study to calculate the utilized energy to traction of agricultural machinery (mouldboard plough). They found that an increase in forward speed of the tractor led to increased traction power for all engine speeds and additional weights, the forward speeds of the plough recorded (2.088, 3.744 and 4.500) km/h traction power (39.2%, 42.71%, 69.4%), respectively and reason refer to increase the proportion of slipping.

Al-Suhaibani and Ahmed (2010) indicated that about (26.7%) of the traction force used to cut the soil and (73.3%) acted to soften the soil, as well as indicated the depth has a clear impact on the traction force of speed as increase in the depth of tillage of chisel plough in silt clay loam From (11.5) to (16) and then to (23) cm led to increased traction force of the machine from (3.74) to (7.11) and then to (10.31) kN, respectively at speed (6.3) km/h, either when increasing tillage speed from (2.7) to (4.32) and then to (6.3) km/h, the traction force of the machine increased from (8.19) to (9.47) and then to (10.31) kN, respectively at (23) cm depth.

Madloul (2010) indicated to a significant effect of tractor speed in the percentage of slip, as the percentage of sliding increased from (7.48) % to (11.42) % and then to (14.73) % led to increased speed of (3.27) to (5,00) and then to (6.72) km/h, respectively. The reason for this is that increase of actual speed lead to an increase traction resistance and reduced the chance of cohesion of driving wheels on the ground.

Nowatzki and Pedersen (2011) indicated that the best values of the slipping of 4WD tractors Ranging from (8-10)% depending on the speed and type of used implement, if slipping values exceeded this rate, this means that weights on the rear wheels are not enough e and then this tractor needs for adding weight.

Furlani *et al.* (2010) found that the depth of tillage is one of the factors affecting the fuel consumption for tillage implement, as it increases fuel consumption with the increase of tillage depth and the reason for this is attributed to the increase in the depth of tillage means disturbance of large amount of soil and this disturbance means large achievement of work.

Al-Saadi (2011) said that the deep tillage has significant effect on fuel consumption using primary ploughs, as depth (15 – 20) cm achieved the highest value for fuel consumption amounted to (34. 24) L/ha, while the depth from (5-10) cm have achieved the lowest value for fuel consumption amounted to (17.04) L/ha, indicating that the reason for this achievement of larger work through increase the depth of tillage, which gives rise to a larger amount of soil disturbance that needs to large amount of fuel.

The aim of the study was to determine the most suitable tractor to complete the implementation of the basic agricultural operations through technological time in the agricultural production conditions in Iraq.

## MATERIALS AND METHODS

A field experiment was conducted at the Faculty of Agriculture, Baghdad University during 2011, to evaluate the performance and power requirements for some types of tractors. It was the work of laboratory analysis of the soil under study was found silt clay loam. The different agricultural operations which are: tillage, harrowing and land levelling, each treatment was carried out in three replicates, the area of one replicate equal 2500 m². The number of the total replicates equal 27 replicates.

**Machines and Equipment in Experiment:**

1. Tumosan 105-80, 105 HP, 4WD, Turkey, (2010).
2. New Holland TD 80, 80HP, 4WD, Turkey – Iraqi, (2010).
3. Jinma , 70 HP, 4WD, (2011), China
4. Mouldboard plough, (design width 105 cm. depth 17-20 cm)
5. Disc harrow, (design width 160 cm. depth 10-12 cm)
6. Land leveller, (design width 220 cm, depth 5-7 cm.)

**Measurements and Calculations:**

**Power Requirement:** (Nasr, 1985)

1. Determination of the rolling resistance: (R.R.)

The rolling resistance in the drawbar pull or its equivalent required moving a tractor or an implement over a given surface, the term coefficient of rolling resistance is the rolling resistance force divided by the load on the wheel. In this work a special area of about a quarter of hectare (2500 $m^2$) was allocated for determination of the rolling resistance at different speeds for each operation. This estimation of the rolling resistance of the machine was necessary in order to calculate the net drawbar pull required for the machine.

The rolling resistance of the New Holland tractor with mounted machines was determined at no load by fixing the dynamometer between another rubber wheel tractor and the agricultural working unit under test.

2. Determination of the recording pull:

The dynamometer was fixed between a rubber wheel tractor and the agricultural working unit during different treatments when recording the pull required for moving unit of the New Holland tractor and each of moldboard plough, harrow disc and land leveller.

During the operations of ploughing, harrowing and land levelling the following measurement were obtained:

A = recording pull with the use of each mouldboard plough, disc harrow and land leveler.

B = rolling resistance for the working unit (tractor + machine).

np = A – B = Net drawbar pull.

3. Determination of the percentage slip of the tractor rear wheels:

The percentage slip (S %) was determined by using the following formula:

$$S\% = \frac{L1 - L2}{L1} \times 100$$

Where:

L1: advance per 10 wheel revolutions with no load, (m).

L2: advance per 10 wheel revolutions with load, (m).

4. Drawbar horsepower ($N_D$):

$$N_D = \frac{P \times V}{3.6} = (kW)$$

Where:

P: Net pull, (kN).

V: forward working speed, km/h.

5. Horsepower consumed by rolling resistance (NR):

$$NR = \frac{R.R. \times V}{3.6} = (kW)$$

Where: R.R.: rolling resistance, kW.

6. Horsepower consumed by slip (Ns):

$$Ns = (P + R.R.) \times \frac{V}{3.6} \times \frac{S}{100 - S} = (kW)$$

Where: S: slip %

7. Horsepower consumed by transmission system ($N_T$):

$$N_T = \frac{N_D}{\eta tra}(1 - \eta trans) = (kW)$$

Where: ηtra: traction efficiency (assumed to be 70%).

ηtrans: transmission efficiency (assumed to be 92%).

8. Total engine Horsepower required for operations ($N_E$):

$$N_E = N_D + NR + Ns + N_T = (kW).$$

## RESULTS AND DICUSSION

This investigation was carried out with the aim of comparative study on types of tractors suitable for agricultural conditions in Iraq. To realize this goal, the results have been recorded for tractor power balance and power required under agricultural conditions in Iraq.

**Table (1): The recorded pull, the rolling resistance, the net drawbar pull and the drawbar Pull Horsepower for different types of tractors during ploughing operation.**

| Items / Tractors | Rep. | Average working speed (km/h) | Recorded pull (A) (kN) | Rolling resistance (B) (kN) | Net drawbar pull (A-B) (kN) | Drawbar pull horsepower (kW) |
|---|---|---|---|---|---|---|
| Tumosan 105 HP | R1 | 5.38 | 13.14 | 4.66 | 8.48 | 12.67 |
| | R2 | 5.46 | 12.78 | 4.66 | 8.12 | 12.31 |
| | R3 | 5.43 | 13.78 | 4.66 | 9.12 | 13.76 |
| | Mean | 5.42 | 13.23 | 4.66 | 8.57 | 12.91 |
| New Holland 80 HP | R1 | 5.10 | 11.41 | 4.26 | 7.15 | 10.12 |
| | R2 | 5.11 | 13.94 | 4.26 | 9.68 | 13.32 |
| | R3 | 5.01 | 11.70 | 4.26 | 7.44 | 10.35 |
| | Mean | 5.07 | 12.35 | 4.26 | 8.09 | 11.26 |
| Jinma 70 HP | R1 | 4.63 | 11.81 | 4.00 | 7.81 | 10.04 |
| | R2 | 4.61 | 12.58 | 4.00 | 8.58 | 10.99 |
| | R3 | 4.60 | 10.43 | 4.00 | 6.43 | 8.22 |
| | Mean | 4.61 | 11.61 | 4.00 | 7.61 | 9.74 |

*The working width (105 cm) and tillage depth (17-20 cm)

**Table (2): The recorded pull, the rolling resistance, the net drawbar pull and the drawbar Pull Horsepower for different types of tractors during harrowing operation.**

| Items / Tractors | Rep. | Average working speed (km/h) | Recorded pull (A) (kN) | Rolling resistance (B) (kN) | Net drawbar pull (A-B) (kN) | Drawbar pull horsepower (kW) |
|---|---|---|---|---|---|---|
| Tumosan (105 HP) | R1 | 5.60 | 9.61 | 3.11 | 6.50 | 10.11 |
| | R2 | 5.68 | 9.78 | 3.11 | 6.67 | 10.52 |
| | R3 | 5.56 | 9.32 | 3.11 | 6.21 | 9.59 |
| | Mean | 5.61 | 9.57 | 3.11 | 6.46 | 10.07 |
| New Holland (80 HP) | R1 | 5.40 | 8.73 | 2.83 | 5.90 | 8.85 |
| | R2 | 5.43 | 9.03 | 2.83 | 6.20 | 9.35 |
| | R3 | 5.35 | 8.66 | 2.83 | 5.83 | 8.66 |
| | Mean | 5.39 | 8.81 | 2.83 | 5.98 | 8.95 |
| Jinma (70 HP) | R1 | 4.93 | 8.60 | 3.05 | 5.55 | 7.60 |
| | R2 | 4.98 | 9.10 | 3.05 | 6.05 | 8.37 |
| | R3 | 4.82 | 8.25 | 3.05 | 5.20 | 6.96 |
| | Mean | 4.91 | 8.65 | 3.05 | 5.60 | 7.64 |

*The working width (160 cm) and harrowing depth (10-12 cm)

**Table (3): The recorded pull, the rolling resistance, the net drawbar pull and the drawbar Pull Horsepower for different types of tractors during levelling operation.**

| Items / Tractors | Rep. | Average working speed (km/h) | Recorded pull (A) (kN) | Rolling resistance (B) (kN) | Net drawbar pull (A-B) (kN) | Drawbar pull horsepower (kW) |
|---|---|---|---|---|---|---|
| Tumosan 105 HP | R1 | 5.24 | 8.29 | 2.52 | 5.77 | 8.40 |
| | R2 | 5.34 | 8.55 | 2.52 | 6.03 | 8.94 |
| | R3 | 5.35 | 8.92 | 2.52 | 6.40 | 9.51 |
| | Mean | 5.31 | 8.59 | 2.52 | 6.07 | 8.95 |
| New Holland 80 HP | R1 | 5.32 | 7.53 | 2.57 | 4.96 | 7.32 |
| | R2 | 5.25 | 7.60 | 2.57 | 5.03 | 7.33 |
| | R3 | 5.29 | 7.17 | 2.57 | 4.60 | 6.75 |
| | Mean | 5.28 | 7.43 | 2.57 | 4.86 | 7.13 |
| Jinma 70 HP | R1 | 5.01 | 7.80 | 3.10 | 4.70 | 6.54 |
| | R2 | 5.03 | 6.45 | 3.10 | 3.35 | 4.68 |
| | R3 | 5.11 | 7.12 | 3.10 | 4.02 | 5.70 |
| | Mean | 5.05 | 7.12 | 3.10 | 4.02 | 5.64 |

*The working width (220 cm) and leveling depth (5-7 cm)

**Table (4): Power balance for the different types of tractors during ploughing operation.**

| Items / Tractors | Rep. | Drawbar pull horsepower (kW) | Horsepower consumed spent in rolling resistance (kW) | Horsepower consumed spent in slip (kW) | Horsepower consumed spent in transmissions system (kW) | Total horsepower required (kW) | Percentage of total losses horsepower per required power (kW) |
|---|---|---|---|---|---|---|---|
| Tumosan (105 HP) | R1 | 12.67 | 6.96 | 1.19 | 1.44 | 22.26 | 43.08 |
| | R2 | 12.31 | 7.07 | 1.38 | 1.40 | 22.16 | 44.54 |
| | R3 | 13.76 | 7.03 | 1.71 | 1.57 | 24.07 | 42.83 |
| | Mean | 12.91 | 7.02 | 1.42 | 1.47 | 22.82 | 34.48 |
| New Holland (80 HP) | R1 | 10.12 | 6.03 | 1.25 | 1.15 | 18.55 | 45.44 |
| | R2 | 13.32 | 6.05 | 1.51 | 1.52 | 22.40 | 40.54 |
| | R3 | 10.35 | 5.93 | 1.59 | 1.18 | 19.05 | 40.53 |
| | Mean | 11.26 | 6.00 | 1.44 | 1.28 | 19.98 | 42.17 |
| Jinma (70 HP) | R1 | 10.04 | 5.14 | 2.33 | 1.14 | 18.65 | 46.17 |
| | R2 | 10.99 | 5.12 | 2.58 | 1.25 | 19.94 | 44.88 |
| | R3 | 8.22 | 5.11 | 2.17 | 0.94 | 16.44 | 50.00 |
| | Mean | 9.74 | 5.12 | 2.36 | 1.11 | 18.33 | 47.07 |

**Table (5): Power balance for the different types of tractors during harrowing operation.**

| Items / Tractors | Rep. | Drawbar pull horsepower (kW) | Horsepower consumed spent in rolling resistance (kW) | Horsepower consumed spent in slip (kW) | Horsepower consumed spent in transmissions system (kW) | Total horsepower required (kW) | Percentage of total losses horsepower per required power (kW) |
|---|---|---|---|---|---|---|---|
| Tumosan (105 HP) | R1 | 10.11 | 4.84 | 0.31 | 0.74 | 16.00 | 36.81 |
| | R2 | 10.52 | 4.91 | 0.44 | 0.76 | 16.63 | 36.74 |
| | R3 | 9.59 | 4.80 | 0.35 | 0.71 | 15.45 | 37.93 |
| | Mean | 10.07 | 4.85 | 0.36 | 0.74 | 15.99 | 37.16 |
| New Holland (80 HP) | R1 | 8.85 | 4.24 | 0.24 | 0.67 | 14.00 | 36.79 |
| | R2 | 9.35 | 4.27 | 0.17 | 0.70 | 14.49 | 35.47 |
| | R3 | 8.66 | 4.20 | 0.36 | 0.66 | 13.88 | 37.61 |
| | Mean | 8.95 | 4.23 | 0.26 | 0.67 | 14.11 | 36.62 |
| Jinma (70 HP) | R1 | 7.60 | 4.17 | 1.06 | 0.63 | 13.46 | 43.54 |
| | R2 | 8.37 | 4.21 | 0.93 | 0.69 | 14.20 | 41.06 |
| | R3 | 6.96 | 4.08 | 1.11 | 0.59 | 12.74 | 45.37 |
| | Mean | 7.64 | 4.15 | 1.05 | 0.64 | 13.48 | 43.32 |

**Table (6): Power balance for the different types of tractors during levelling operation.**

| Items / Tractors | Rep. | Drawbar pull horsepower (kW) | Horsepower consumed spent in rolling resistance (kW) | Horsepower consumed spent in slip (kW) | Horsepower consumed spent in transmissions system (kW) | Total horsepower required (kW) | Percentage of total losses horsepower per required power (kW) |
|---|---|---|---|---|---|---|---|
| Tumosan (105 HP) | R1 | 8.40 | 3.72 | 0.18 | 0.65 | 12.95 | 34.79 |
| | R2 | 8.94 | 3.67 | 0.35 | 0.68 | 13.64 | 34.84 |
| | R3 | 9.51 | 3.70 | 0.27 | 0.73 | 14.10 | 33.33 |
| | Mean | 8.95 | 3.70 | 0.26 | 0.69 | 13.55 | 34.32 |
| New Holland (80 HP) | R1 | 7.32 | 3.74 | 0.54 | 0.56 | 12.16 | 40.13 |
| | R2 | 7.33 | 3.81 | 0.34 | 0.57 | 12.04 | 38.75 |
| | R3 | 6.75 | 3.82 | 0.30 | 0.52 | 11.39 | 40.41 |
| | Mean | 7.13 | 3.79 | 0.39 | 0.55 | 11.86 | 39.76 |
| Jinma (70 HP) | R1 | 6.54 | 4.31 | 0.73 | 0.53 | 12.11 | 45.99 |
| | R2 | 4.68 | 4.33 | 0.57 | 0.38 | 9.96 | 53.01 |
| | R3 | 5.70 | 4.40 | 0.47 | 0.46 | 11.03 | 48.32 |
| | Mean | 5.64 | 4.34 | 0.59 | 0.46 | 11.03 | 49.10 |

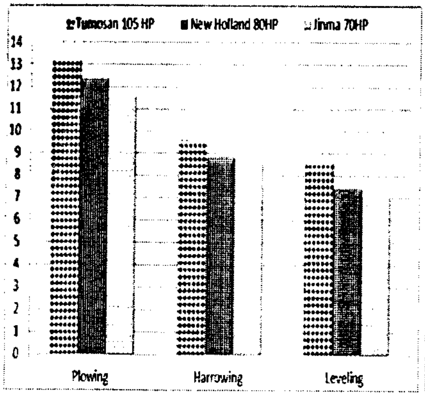


Fig. (1) Recorded pull (kN) Interaction between tractors and operation

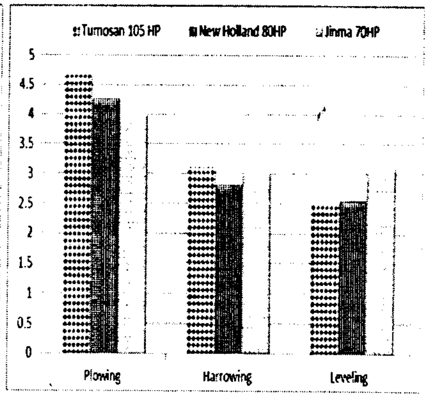


Fig. (2) Rolling resistance (kN) Inter. between tractors and operation.

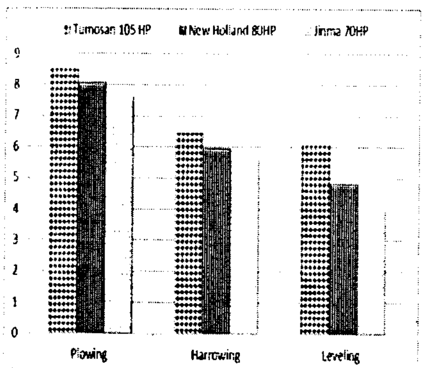


Fig. (3) Net drawbar pull (kN) Inter. between tractors and operation.

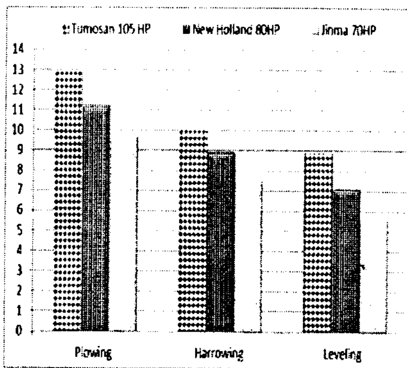


Fig. (4) Drawbar pull horsepower (kW) Inter. between tractors % oper.

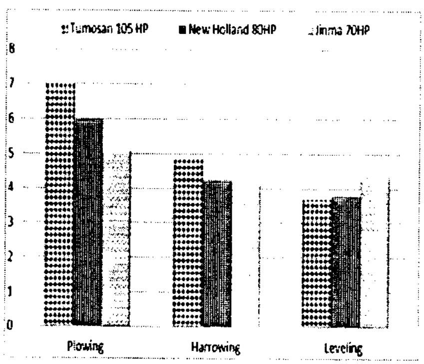


Fig.(5) Rolling resistance horsepower (kW) Inter. between tractors and oper.

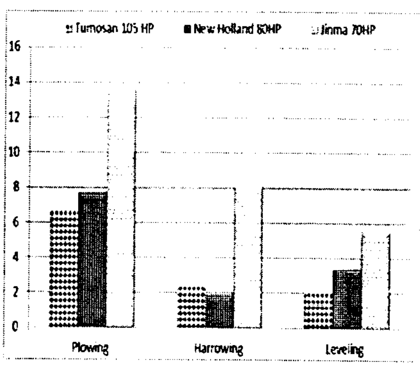


Fig.(6) Slip percentage (%) Interaction between tractors and operation

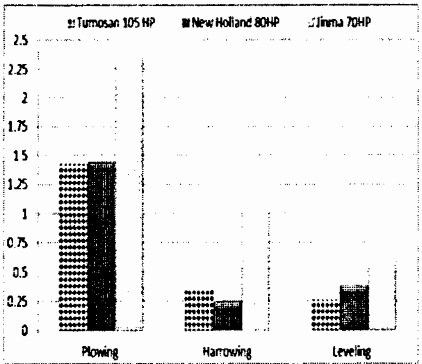


Fig.(7) Slip horsepower (kW) Interaction between tractors and oper.

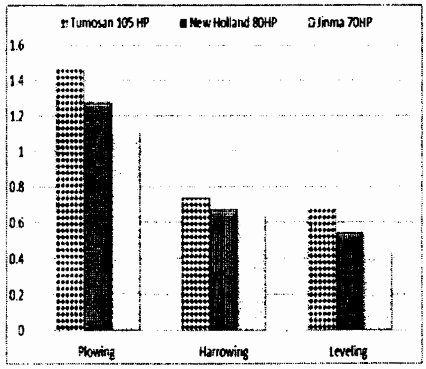


Fig.(8) Trans. system horsepower (kW) Interaction between tractors and oper.

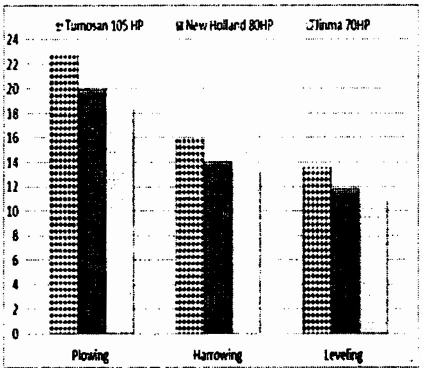


Fig.(9) Total engine horsepower required (kW) Inter. between tractors and oper.

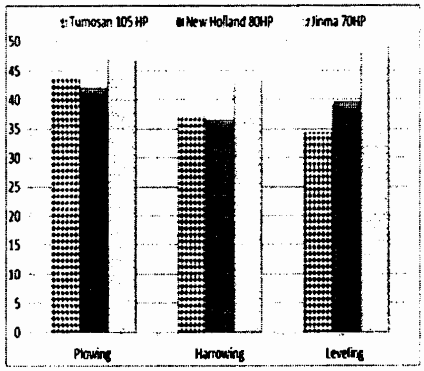


Fig. (10) Horsepower per width unit (kW/m) Inter. between tractors and oper.

According to Tables (1-6) and Fig. (1-10):

1. Recorded pull increases when horsepower of tractor engine increased. Where recorded the maximum recorded pull (13.23 kN) was observed with Tumosan tractor (105 HP) when currying ploughing, it compared with New Holland tractor (80 HP) and Jinma tractor (70 HP) according to Fig. (1)

2. The rolling resistance increases when horsepower of tractor engine increased. Where recorded the highest rolling resistance (4.66 kN)

was observed with Tumosan tractor (105 HP) when currying ploughing, it compared with New Holland tractor (80 HP) and Jinma tractor (70 HP) according to Fig. (2)

3. The net drawbar pull increases when horsepower of tractor engine increased. Where recorded the highest net drawbar pull (8.57 kN) was observed with Tumosan tractor (105 HP) when currying plowing, it compared with New Holland tractor (80 HP) and Jinma tractor (70 HP) according to Fig. (3)

4. The drawbar pull horsepower increases when horsepower of tractor engine increased. Where recorded the highest drawbar pull horsepower (12.91 kW) was observed with Tumosan tractor (105 HP) when currying ploughing, it compared with New Holland tractor (80 HP) and Jinma tractor (70 HP) according to Fig. (4)

5. The rolling resistance horsepower increases when horsepower of tractor engine increased. Where recorded the highest rolling resistance horsepower (7.02 kW) was observed with Tumosan tractor (105 HP) when currying ploughing, it compared with New Holland tractor (80 HP) and Jinma tractor (70 HP) according to Fig. (5)

6. Slip percentage decreases when performance of tractor increased. Where recorded the lowest slip percentage (1.93 %) was observed with New Holland tractor (80 HP) when currying harrowing, it compared with Tumosan tractor (105 HP) and Jinma tractor (70 HP) according to Fig. (6)

7. Slip horsepower decreases when performance of tractor increased. Where recorded the lowest slip horsepower (0.26 kW) was observed with New Holland tractor (80 HP) when currying harrowing, it

compared with Tumosan tractor (105 HP) and Jinma tractor (70 HP) according to Fig. (7)

8. The transmissions system horsepower decreases when performance of tractor increased. Where recorded the lowest transmissions system horsepower (0.46 kW) was observed with Jinma tractor (70 HP) when currying levelling, it compared with Tumosan tractor (105 HP) and New Holland tractor (80 HP) according to Fig. (8)

9. The total engine horsepower required increases when horsepower of tractor engine increased. Where recorded the highest total engine horsepower required (22.83 kW) was observed with Tumosan tractor (105 HP) when currying ploughing, it compared with New Holland tractor (80 HP) and Jinma tractor (70 HP) according to Fig. (9)

10. The percentage of the total losses horsepower per required power decreases when performance of tractor increases. Where recorded the lowest of this this percentage (42.17%) was observed with New Holland tractor (80 HP) when carrying ploughing operation, also recorded the lowest of this percentage (36.62%) of the same tractor when carrying harrowing operation and recorded the lowest of this percentage (34.32%) was observed with Tumosan tractor (105 HP) when carrying levelling operation, according to Fig. (10) and tables (1,2 and 3).

## CONLUSIONS

Therefore it might be suggested from the results of this investigation covering many technical aspects that the engine horsepower required for executing must of the main Iraqi agricultural operations could be New Holland tractor (80 HP) or Tumosan tractor (105 HP) under agricultural conditions in Iraq.

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## الملخص العربي

# ميزان القدرات لبعض أنواع الجرارات المستخدمة في العراق

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الهدف الرئيسي لهذا البحث هو إختيار الجرار الاكثر مناسبة لإتمام تنفيذ العمليات الزراعية الأساسية خلال وقتها التكنولوجي تحت ظروف الإنتاج الزراعي بالعراق. ولهذا الغرض أجريت تجربة حقلية في محطة التجارب الزراعية بكلية الزراعة - جامعة بغداد خلال عام ٢٠١١ لدراسة تقييم متطلبات القدرة والاداء وكفاءة الجرارات الزراعية.

وتم إختيار ثلاث جرارات مختلفة القدرات تتراوح قدراتها من (٧٠- ١٠٥) حصان ميكانيكي في ثلاثة من العمليات الزراعية الأساسية (عملية الحراثة بإستخدام المحراث المطرحي القلاب, وعملية التنعيم بالمشط القرصي, عملية التسوية بإستخدام آلة التسوية). وتم الإختبار للجرارات الثلاثة المستخدمة وإختيار عامل التقييم لهذه الجرارات وهو النسبة مابين إجمالي القدرات المفقودة الى القدرة المطلوبة لتنفيذ العملية تحت ظروف الزراعة في العراق, ممماسبق دراسته يمكن التوصية بإختيار أولاً الجرار نيو هولاند (٨٠ حصان ميكانيكي) في العمليات الزراعية الأساسية (الحرث والتمشيط والتسوية) وثانياً إستخدام الجرار تومسون (١٠٥ حصان) وخاصة في عملية التسوية, ولا يفضل إستخدام الجرار جينما (٧٠ حصان ميكانيكي) وذلك تحت ظروف الزراعة في العراق.


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