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Characteristics of Some Standards Performance of Agricultural Tractor: Review

Hussein Abbas Jebur [1*], Samir B.Salman Al-Badri [2] and Khalid Zemam Amer [3]

[1]College of Agricultural engineering sciences, University of Baghdad, dr.hussain@coagri.uobaghdad.edu.iq, Baghdad, Iraq.

[2]College of Agricultural engineering sciences, University of Baghdad, samir.albadri@coagri.uobaghdad.edu.iq, Baghdad, Iraq.

[3]University of Mustansiriyah, khalid_zeemam@yahoo.com, Baghdad, Iraq.

***Corresponding author email:** dr.hussain@coagri.uobaghdad.edu.iq, mobile: 07719705977

بعض خصائص الاداء القياسية للجرار الزراعي: مقال علمي

حسين عباس جبر[1*]، سامر بدري سلمان[2]، خالد زمام عامر[3]

1 كلية علوم الهندسة الزراعية، جامعة بغداد، dr.hussain@coagri.uobaghdad.edu.iq ، بغداد، العراق

2 كلية علوم الهندسة الزراعية ، جامعة بغداد، samir.albadri@coagri.uobaghdad.edu.iq ، بغداد ، العراق

3 الجامعة المستنصرية، khalid_zeemam@yahoo.com ، بغداد ، العراق

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ABSTRACT

Agriculture is considered in all parts of the world, especially in developed countries, the main source of livelihood and progress, and it has become wrong or illogical to increase agricultural production either horizontally through reclamation of new non-arable lands or vertically using advanced agricultural methods if agriculture relied on primitive methods. The agricultural mechanization field is concerned with, first and foremost, the comprehensive and integral development of humans and their communities as provided by understandable, scientific, practical and economical means and methods in order to develop and advance their countries and standard of living, as well as the operations training and preparation of human cadres technically and administratively to get filled. The basis of the work of the tractor in the field is to manage and operate agricultural machinery through one of the sources of exploiting the capacity in it. The most used of these sources is the tension bar, and the tension bar is the least efficient of these sources due to its dependence on the interaction between the wheel and the soil. The study of standard performance parameters of agricultural tractor, is reviewed herewith, which may help to the researchers in planning their experiments abut performance mechanics more useful and in right direction to get more accurate results. Traction performance 0.5 for belts and 0.4 for tires, the percentages of difference ranged between 10% and 17% for tire pressure. Tractor performance audits aim to provide information, data and readings to researchers and stakeholders in tractor mechanics for years to come.

Key words: tractor, performance, agriculture, mechanics.

الخلاصة

تعتبر الزراعة في جميع أنحاء العالم، وخاصة في الدول المتقدمة، المصدر الرئيسي للمعيشة والتقدم، وأصبح من الخطأ أو غير المنطقي زيادة الإنتاج الزراعي إما أفقياً من خلال استصلاح الأراضي الجديدة غير الصالحة للزراعة أو رأسياً باستخدام الأساليب الزراعية المتقدمة إذا اعتمدت الزراعة على الأساليب البدائية. يهتم مجال الميكنة الزراعية، أولاً وقبل كل شيء بالتنمية الشاملة والمتكاملة للبشر ومجتمعاتهم على النحو الذي توفره وسائل وأساليب مفهومة وعلمية وعملية واقتصادية من أجل تطوير بلادهم والارتقاء بمستوى معيشتهم. حيث تقوم بعمليات التدريب وإعداد الكوادر البشرية فنيا وإداريا لشغلها. أساس عمل الجرار في الميدان هو إدارة وتشغيل الآلات الزراعية من خلال أحد مصادر استغلال القدرة فيها. أكثر هذه المصادر استخدامًا هو شريط التوتر، وقضيب التوتر هو الأقل كفاءة من بين هذه المصادر نظرًا لاعتماده على التفاعل بين العجلة والتربة. تتم مراجعة دراسة معايير الأداء المعيارية للجرار الزراعي، والتي قد تساعد الباحثين في تخطيط تجاربهم مع ميكانيكا الأداء أكثر فائدة وفي الاتجاه الصحيح للحصول على نتائج أكثر دقة. أداء الجر 0.5 للأحزمة و 0.4 للإطارات، تراوحت نسب الفرق بين 10٪ و 17٪ لضغط الإطارات. تهدف عمليات تدقيق أداء الجرارات إلى توفير المعلومات والبيانات والقراءات للباحثين وأصحاب المصلحة في ميكانيكا الجرارات لسنوات قادمة.

الكلمات المفتاحية :جرار ، أداء ، زراعة ، ميكانيكا.

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Introduction:

Agricultural tractors are a source of power in the farm. There are many types of tractors and they are different from a practical point of view in conducting different agricultural operations. According to these operations, the efficiency of the used tractors is determined, and those operations performed by the agricultural tractor can be determined, which depends on the engineering characteristics of the agricultural tractor, for example, the type wheels and engineering dimensions of the tractor, as well as the nature of the field land through soil texture and field dimensions, in addition to the type of agricultural equipment that is attached to the agricultural tractor **[1, 2 and3]**. This pushes states to increase the use of agricultural mechanization units to provide human capital and improve the quality of agricultural goods, although the trend did not appear until the twenty-first century. Drawbar work is known through pull force and speed **[4]**. As a result, the tractor is unable to transfer all of the energy in the fuel into useful work at the drawbar. The majority of potential energy is lost in the conversion of chemical energy to mechanical energy, as well as losses from the engine, drivetrain, and finally the tractive device **[5]** and **[6]**. According to research, the tractive mechanism expends around "20 percent to 55 percent" of the available tractor energy. **[7, 2 and 8]**. Tractor traction efficiency includes increasing the engine and propulsion system's fuel economy, correct attachment of traction devices, determining the best travel speed for a particular implement System. **[9]** it was found that the fuel consumption depends on the forward speed of the tractor, because the high speed gives a short period of time based on the unit area, in addition to reducing and losing the power of the tractor at slow speeds. The speed of the agricultural process, plowing or loosening, has a not small effect on the pulling force, so that increasing the speed of the agricultural process works to increase the traction force, and accordingly, the increase in the initial speed recorded less drag, and the reason is due to the increase in the speed of plowing, which led to an increase in the speed of soil particles and an increase in the energy of soil particles to increase the speed **[10, 11 and 12]**. At a lower slip rate of 10–20 percent, high tractive efficiency was achieved. Pull ratios of 0.40–0.50 resulted in higher tractive efficiency. According to **[13]** agricultural tractors utilize, around 20% of the overall energy necessary for a farm. In summary, improving the function of the agricultural tug works to reduce power loss. **[14 and 15]**, The Forward Velocity, consumption of fuel and Drawbar were all measured during the drawbar test. The interest in the speed of the tractor, the depths of the plow, and the performance standards of the tractor was the main objective of conducting this scientific and practical study for the researcher and the farmer.

Materials and Methods

- **Experiment**
- Yellow maize (Zea mays L). The nerve that sustains life for many human societies. Increasing grain yield is a major goal for plant breeders in general and yellow corn in particular. We are in constant search for genetic materials with superior field performance, on the spread of its cultivation to alleviate the global food crisis, in addition to the benefit of the yellow corn crop

as food for humans, it is also used as a fodder crop, as its grain is used as a concentrated diet for poultry, sheep and cows, so it requires improving the yellow corn productivity by increasing biodiversity in its cultivation and focusing on traditional varieties that have characteristics appropriate to improve its quality . [16 and 17]

- **The Agricultural Tractor**

The main function of the agricultural tractor is traction. So, a tractor is basically a traction machine. Other portable equipment such as locomotives and vehicles such as road trucks and even cars, which are basically vehicles for transporting loads, also involve traction. A tractor is also a type of machine that involves operating under what are known as off-road conditions. Others in this category include earthmoving machines **[18]**.

- **Agricultural tractor mechanics**

. Actual performance is considered lower. This is due to losses that occur when the surface of the wheel contacts the ground. We can define **tractor components or components** in terms of general mechanical engineering without having to know their detailed shape. Thus, the engine can be represented as the power source in terms of torque and speed without the need to specify its thermodynamic or electrical type, or its operating principle as internal and external combustion engines, or according to the two- or four-stroke operating stroke, or according to the fuel source, diesel or gasoline engines. The transmission system can be considered in terms of transmission ratio without specifying its shape or the principle of mechanical operation such as gears, chains or rubber belts **[17]**. The agricultural engineer must have more than one conception of the working mechanism of the tractor so that the tractor is considered as a unit and clearly works for all agricultural operations. An agronomist must be familiar with the basic laws of mathematics and physics that explain the dynamic and the kinetic response to these forces **[19 and 20]**.

Results and Discussion

Traction:

The concept of traction involves the interaction of contacts with the soil. Through the formulation of design performance equations, theoretical and practical investigations and field tests are used to describe the general nature of these interactions in the design considerations of traction systems. According to **[21]**, performance equations were created utilizing both theoretical and empirical methodologies. The theoretical approach does not give the designer easy-to-use solutions due to the difficulties of understanding the interactions of the traction device with the soil, but it does provide a general performance response for vehicles with the soil.

Traction Performance:

The following figure shows a series of test curve numbers for traction operations for different soil types, tire size and pressure. Figure (1) explains the traction diagrams. We note that the traction efficiency curve has the highest peak value, within the net traction range. Reduced tractor transmission is also shown, as well as the net traction ratio, which is normally limited by

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an engineer? The NTR of 0.5 for belts and 0.4 for tires is where traction efficiency peaks. [22 and 23].

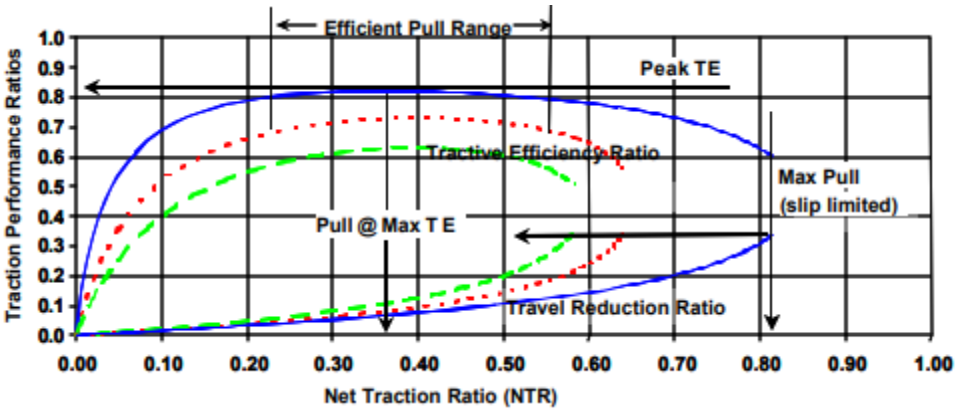

Figure 1. Explains the traction diagrams [21].

Effect of Soil:

The graph depicts the performance of the 20.8R42 twin tires on three different traction surfaces. The highest traction efficiency drops soil becomes softer, although the highest that can occur in different types of soil. As the soil becomes less firm, the maximum NTR decreases (lower net traction at the same slip reduction) [21].

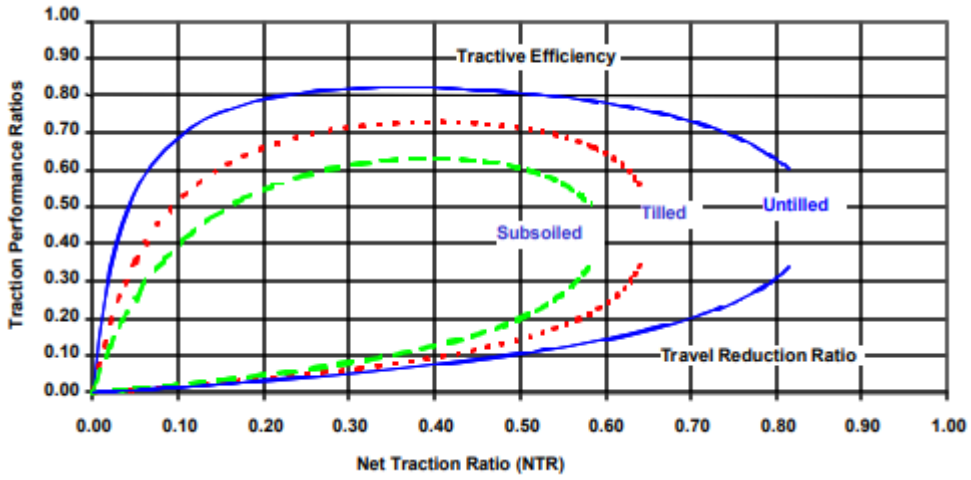

Figure 2. Performance of dual tires on three surfaces [21].

Effect of Tire Pressure:

Tires that have been over-inflated due to their higher payload when compared to properly inflated tires. The traction efficiency and the top limit of the net traction ratio are both reduced. While maximum traction is reduced by around 4%, That instance, with net traction of 0.5, a difference of more than 10% in drawbar pull and much greater slip would result in a difference of approximately17% in drawbar pull and significantly higher slip [24 and25].

Effects of Tire Size:

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In the same slip the larger diameter 520 / 85R46 tire offers much superior energy efficiency. Both provide identical maximum power traction, implying that there is no difference in performance between the two tires **[26 and 27]**.

Tire Size, Air Pressure, and Load Relationship:

The load and torque for each tire are determined by tire associations through the tire company **[28 and 29]**, published the information related to the tires. We can see from figure (3) that it is possible to minimize the size of the rubber tires for a specific tractor using this information. For vertical load and torque, this tire will be properly sized. It's possible that it's too little **[30 and 31]**. simplified the tractor force and forward speed to get the best tire. The force that the tires can transfer is not maximized when binary tires are used. Because each tractor's use will vary depending on the soil conditions, the rubber tire manufacturer will offer a variety of sizes, treads, and layer ratings.

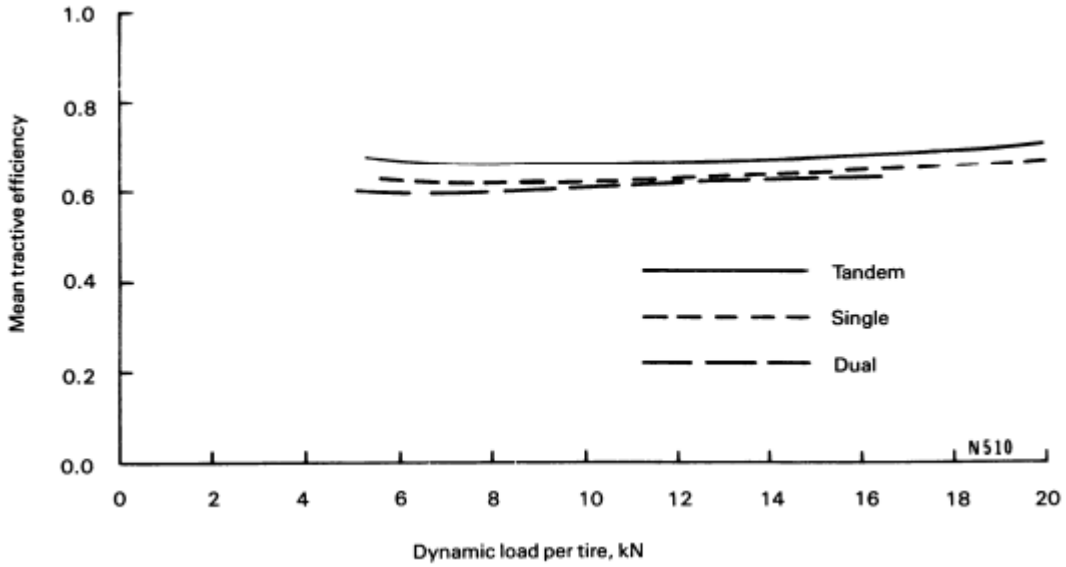

Figure 3. Traction efficiency of the versus load **[28]**.

Tractive efficiency and power losses **[32]**:

We see from the figure the relationship between tractor speed, traction efficiency, and power loss for moldboard plows, disc plows, and disc harrow operations using different blowing pressures Figure (4). In general, it is observed from the power loss increases with increasing speed for both devices, the efficiency decreases with increasing speed.

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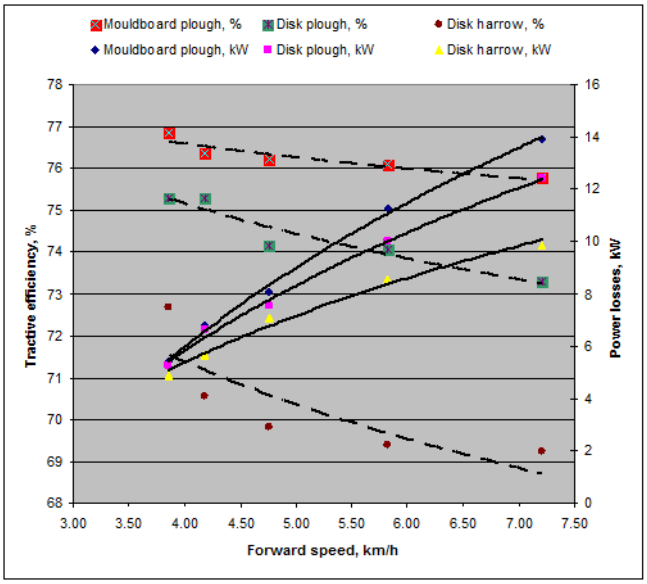

Figure (4) relationship between tractive efficiency and power losses [29].

Tractor Performance Criteria:

The performance criterion that best describes the tractor's use is largely determined by the nature of the tractor's use. Agronomists commonly measure the size of a tractor by the number of plow bottom it can draw. There are some evident flaws with this system. For comparison, a test was carried out using the highest value of the drawbar force. It was found that the soil has a significant effect on the pulling force of the agricultural tractor. Usually, the maximum pulling force is the main criterion for the performance of the tractor. As a result, on the other hand, engineers were more interested in the concept of rated power than tractor buyers and dealers. The asae and SAE tractor test codes, as well as the Nebraska tractor tests, were revised in 1959 to eliminate the calculation of corrected and rated horsepower ratings [25 and 33].

Tractor design:

Since the original tractor testing in Nebraska, tractor design and performance have changed dramatically. Tractor design is heavily focused on agricultural scientific advancements, particularly power systems [34]. Since the improvement of traction, it is apparent that the tractors continue to have an energy-to-mass ratio, which leads to an increase in frontal speed. Tractor power output has increased in recent years. One cause is the inability of farm sizes to expand due to limited land availability and the volatility of export opportunities [35 and 36]. The rise in soil pressure, which impacts both soil conservation and plant growth, is a second rationale for limiting tractor size increases.

Performance of Four-Wheel, and Dual Tires:

Depending on the field conditions, various tire drive systems have been created to increase the tractor's performance. In most cases, the increased wheel trajectory produced by a 4WD tractor's front wheels has equivalent tires that compress the rear tires. Strong soil improves traction as well as lowering rolling resistance. As a result, when working on loose soil, four-wheel drive tractors should have higher net traction coefficient and traction efficiency than two-wheel drive tractors. [34] Discovered that the two-wheel drive's traction efficiency was 56 percent at, while the engine efficiency was 66 percent. [37and 38] Discovered that rolling resistance was lower on the first pass than on the second pass.

Conclusion:

Through the article, it became clear that there are factors and characteristics that affect the performance of the agricultural tractor in terms of balance during work, as well as maintaining the reactions that the tractor + machine is exposed to, and the extent of the tractor's relationship with agricultural machinery. It was also clear from the study that the type of contactors has a clear effect on the performance of the tractor and the efficiency of traction.

The efficiency of the tractor's performance is affected by the contact device and the soil. To improve the efficiency of the tractor's performance, appropriate methods must be used to reduce wheel slip, while resorting to using the maximum possible speed of the tractor as long as this speed will enable the tractor to generate sufficient pulling force to overcome the resistance of the machine pulled by the tractor. Such as plows, crops, trailers and other agricultural machinery.

Agricultural technology adopts modern scientific methods in the use of agricultural machines that are suspended and calculated behind the tractor in order to advance the agricultural reality with the least effort and time.

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Conflict of interests.

There are non-conflicts of interest.

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