EFFECT OF THE SOWING SPEED AND DEPTH ON SOME ECONOMICAL, TECHNICAL INDICATORS AND ENERGY REQUIREMENTS FOR MACHINERY UNIT

Kasim Mosa Madlol *

ABSTRACT

The experiment was conducted in fields of Agricultural College - University of Baghdad in 2009 in silt - clayey soil in order to study the effect of sowing speeds on some economical, technical performance indicators and energy requirements for machinery unit under variable levels of sowing depths. The tractor "New Holland" and the grain drill“Stegested” were used machinery unit. Threesowingspeed (6.28, 7.61, and 11.43) km / h represented the main plots and three sowing depths (3, 6, and 9) cm represented the sub-plots. Some technical performance indicators for machinery unit were studied which include: percentage of slippage, effective field capacity, field efficiency and fuel consumption per unit area, as well as calculating the total operation costs and energy requirements for the machinery unit. The Experiment was carried out by using split - plot with complete randomized block design in three replicates. The results showed that the third speed of sowing 11.43 km / h was superior among other sowing speeds in recording higher rate of effective field capacity of 1.08 ha / h and lower rate of fuel consumption per unit area of 8.11 L / ha and lower rate of total operation costs for machinery unit of 13594 ID / ha (10.875 US$ / ha) with lower rate of energy requirements for machinery unit of 29.40 kW. h / ha while the percentage of slip was within the permissible limits of 10.98%. The first depth of sowing of 3 cm was superior among other sowing depths in recording lower rate of slippage percentage of 4.64% and higher rate of effective field capacity (0.87 ha / h) and higher rate of field efficiency (71.72 %) with lower rate of fuel consumption per unit area of 8.38 L / ha and lower rate of total operation costs for machinery unit of 16721 ID / ha (13.376 US$ / ha) with lower rate of energy requirements for machinery unit of 30.34 kW. h / ha.

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As for the interaction between sowingspeed and sowing depth, it was significant for all parameters whereas the third speed of sowing of 11.43 km / h with the first depth of sowing (3 cm) was superior in recording higher rate of effective field capacity (1.16ha / h) and lower rate of fuel consumption per unit area (6.32L / ha) and lower rate of total operation costs for machinery unit of 12022 ID / ha (9.617 US$ / ha) with lower rate of energy requirements for machinery unit (23.05 kW. h / ha) while the percentage of slip was within the permissible limits of 6.59%.

INTRODUCTION

Nourishing the rapidly growing world population calls for a rapid increase in food by increasing agricultural production. An increase in agricultural production is not only of interest from the point of view of nourishment of the world population, but is also the central problem of the whole national economic development in the majority of emergent countries. The efforts towards a rapid extension of agricultural production, especially cereal production, by increasing the areas of cereal crop and the development of cereal production (Glanze 1972). New lands in agriculture do not fill the large and growing need for food, because of decreasing through the expansion of cities, roads, picnic areas, therefore, care must be taken to develop agricultural production in currently used land by mechanization of agricultural operations and using the modern techniques in agriculture (Ahmed and Munther, 1987). Mechanical sowing is an important process which is done after tillage and harrowing, that it is providing a saving in the time and labor, accuracy of the required work, lowering of wasted seeds and ease of crop service operations in comparison with hand sowing as well as exposing the worker in the hand sowing to toxins as a result of inhalation of air or touch by hand because of dusting seeds, in addition losing amount of seeds by birds and ants (Abdulrahman, 1992 and Awady et al. 2006). The use of imported grain drills can reduce a big rate in the lost grain as it can increase crop yields if used in land which is well prepared in terms of deeper plowing, leveling and harrowing required in the region (Al-Rajabow, 2002). In view of the short time period for sowing, it is necessary to resort to the optimal use of grain drills and the maximum
capacity by increasing the sowing speed to the maximum extent possible within the permissible limits of the slip, taking into consideration the capacity of available tractor and the grain drill efficiency for accurate work at high speeds (Abu Sabaa and Karim, 1980). Mohammed (2005)) found that increase of the speed of the sowing from 3.51 to 6.21 then to 8.76 km / h led to a significant increase in the percentage of slippage from 6.23 to 9.44 and then to 11.48%. Al-Mkhiol (2005) has noted that the percentage of slippage had increased from 3.24 to 4.13 then to 4.89 % when speed of sowing had increased from 4.39 to 6.42 then to 8.81 km / h and the two were because increasing of practical speed leads to increase traction force required to pull the grain drill. Therefore, slippage will increase. Al-Khafaji (2006) showed that there are apparent increases in the effective field capacity of grain drill in two ratios of increase from 40 to 120% when increasing speed of sowing from 5 to 11 km / h and then decrease the required time to complete agricultural process. Madlol (2010) found that the speed has a significant effect in the equipment field efficiency where it was lowered from 68.22 to 67.25 then to 65.81% when the practical speed increased from 3.27 to 5.00 then to 6.72 km / h, indicating that the reason is reducing of time exploitation coefficient. Kassar (2011) noted significant effect of sowing speed in fuel consumption values where by increasing of sowing speed from 6.8 to 9.26 and then to 11.17 km / h the values of fuel consumption decreased from 7.164 to 5.972 then to 5.360 L / ha. Also Al-Khafaji (2006) found a significant decrease in fuel requirements per unit area when increasing the practical speed of sowing as well. Aday et al. (2008) concluded that higher tractor forward speed may have given the least amount of fuel consumed per unit area and all of them had showed that the reason is that the high speed leads to a short in period of time to complete the unit area as well as losing the tractor ability optimally in the slow speeds. Al-Sharefy (2003) noted that there is a decrease in the rates of total operation costs of machinery unit in two ratios of decrease from 75 to 47%, during increasing of practical speed rate from 2.052 to 4.643 then to 5.459 km / h due to increasing of practical speed and increase of practical productivity, therefore the total costs decreased as a result of the reverse relationship between the two. Increase of speed is at the expense
of specification which should be achieved in the operation of sowing because of rolling seeds and vibrating depth and poor penetration of furrow opener for soil (Abu Sabaa and Karim, 1980). The decline in production of grain crops, due to lack of using the crop management of appropriate sowing depth which affects clearly germination and emergence and field establishment, which is the outcome of germination, administration and the environment (Anderson and Garling, 2000). The sowing depth is an important factor in crop's management affecting productivity. It depends on the soil type, moisture degree, the seed size, irrigation system and class of crop (Al-Izzi, 2004). Accordingly, the sowing depth is the basis to ensure the homogeneity, faster germination and the establishment for good emergence (Jadou and Haider, 2012). Al-Sulaivany (2005) found that increasing the sowing depth from 3 to 5 and then to 7 cm led to increased slippage from 7.85 to 8.08 and then to 10.29%. She attributed the traction force increases to increasing the depth and slippage. Jasim and Madlal (2011) noted that the equipment practical productivity has decreased from 0.649 to 0.617 then to 0.569 ha/h when the depth increased from 5 to 10 then to 15 cm. He attributed the reason that increasing depth will lead to increased slip and thus lees, practical speed so the practical productivity will decrease too. Zedan (2006) and Madlal and Abdulrazzak (2012) concluded that less depth gave the highest field efficiency and explained the increasing depth accompanied by a decrease in practical speed, thus practical productivity will decrease, therefore field efficiency too. Desbilles (2005) showed that the planting depth has largest impact on the traction force requirements, which effects increasing fuel consumption per unit area. Al-Aridhee (2011) found that fuel consumption may fit directly proportional with increasing depth, and attributed that to the increased depth requiring, more work and more fuel consumption. Al-Janobi (2000) noted that the total cost for machinery unit increased by increasing depth, as well. Jabour (2010) concluded that increasing depth from 13 to 21 cm led to an increase in the total costs and the reason is decreasing the practical productivity, thereby increasing the total costs. Al-Sabbaghet al. (2012) found that increasing the operation depth from 10 to 20 cm led to an increase in machinery unit energy requirements from 158.596 to 214.624
Increasing the depth was accompanied by an increase in fuel consumption as a result of increasing the slippage thereby increasing of energy requirements for the machinery unit. Using different types of grain drills in different ground speeds of sowing and numerous sowing depths is one of the indirect causes that lead to a reduction of germination ratio and thus the lack in production and low profits compared to the cost of production. Therefore, many farmers use spinning disc bulk chemical fertilizer distributor (Centrifugal Broadcasters) in the sowing operation for its numerous advantages without taking into account the economic losses caused by increasing the amount of seed out of the allowable rate. For that, it helps to indicate the best combination between the sowing speed and depth that gives the best technical, economic indicators and energy requirements of the machinery unit (tractor + grain drill) in this study.

**MATERIALS AND METHODS**

The field experiment was carried out in one of the fields of the Agricultural College - Baghdad University in 2009. Field soil classified as a sedimentary - silt clay loam, whose physical and chemical characteristics are shown in Table (1).

Table (1): Some chemical and physical characteristics for the studied field soil

<table>
<thead>
<tr>
<th>Particle-Size Distribution</th>
<th>Soil class</th>
<th>Bulk density (g/cm³)</th>
<th>Total porosity (%)</th>
<th>Soil-moisture Content (%)</th>
<th>Electrical conductivity (EC) mmhos/cm.</th>
<th>Soil (pH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand %</td>
<td>Silt %</td>
<td>clay %</td>
<td>1.54</td>
<td>42.08</td>
<td>16.75</td>
<td>12.5</td>
</tr>
</tbody>
</table>

The tractor used was “New Holland” brand name (80-66S), Italian-made, two - wheel drive, model 2000 at a nominal power of 80 hp (60 kW) under 2000 rpm forengine. Grain drill brand name “Stegsted”, Danish-made, 3-point linkage mounted. Design width 170 cm (the number of furrow opener 17 and the spacing between furrow openers 10 cm), double disc - type, placed on a frame has ability to rise and fall by an arm in order to control depth after placing wooden blocks under grain drill
tires. Studded roller-feeding mechanism which rotates just below the seed box and draws seed from the bottom of the box into hoppers at the tops of the seed tubes. The feeding mechanism received movement from ground wheel of grain drill. Capacity of grain drill hopper 400 kg, where put in it seeds of wheat under class “Abu Gharib”. Two factors were studied in this research affecting technical performance indicators, total operating costs and energy requirements of the machinery unit, (1) the sowing speed was selected as (6.28, 7.61, 11.43) km / h respectively which represented the main plots, and (2) the sowing depth with three levels (3, 6, 9) cm respectively which represented the sub-plots. The experiment was conducted after plowing the field by sweep plow and harrowing by spring-tooth cultivator – harrow, and then the field was segmented within experimental design. The experiment was designed according to (Split-Plot-Design) under (Randomized Complete Block Design) with three replicates. So the number of experimental units (replicates) was 27 (3 × 3 × 3). The data were collected and analyzed according to experimental design and differences between treatments were tested by Least Squares Differences (LSD) at probability level 5% (Al-Rawi and Abdulaziz, 1980). Then the following indicators were studied as follows:

- **The slippage (%)**
The slippage percentage was calculated by using the following equation:

- (Awady, 1987) and (Al-Janobi and Zeineldin, 1997)

\[
SP = \left(\frac{V_T - V_P}{V_T}\right) \times 100
\]

Where:

- \(SP\) = slippage percentage (%);
- \(V_T\) = theoretical speed (km/h);
- \(V_P\) = practical speed (km / h).

- **Effective field capacity (practical productivity) (ha / h)**
The effective field capacity was calculated by using the following equation:

- (Elmo, 1981) and (Kepner et al. 1982) and (Awady, 2002)

\[
EFC = 0.1 \times V_P \times W_P \times E_f
\]

Where:

- \(EFC\) = effective field capacity (ha / h);
- \(W_P\) = rated width of grain drill.
Field efficiency (%) 
The Field efficiency was calculated by using the following equation: - (Hanna, 2002)

\[
FE = \frac{EFC}{TFC} \times 100 \quad \text{---} \quad \% 
\]

Where:
FE = field efficiency (%); TFC = theoretical field capacity (ha / h).

Fuel consumption (L / ha) 
The fuel consumption for the traveled distance in the treatment (30) m was measured by using a glass cylinder tool 1000 ml – capacity, then the fuel consumption per unit area (ha) was calculated by using the following equation: - (Khalilian et al. 1988)

\[
Fu.C = \frac{Qd \times 10000}{W_p \times D \times 1000} = 10\frac{Qd}{W_p \times D} \quad \text{L / ha} 
\]

Where:
Fu.C = fuel consumption per unit area (L / ha); Qd = fuel consumed during the treatment (ml); D = traveled distance during the treatment (m).

Total operation costs (ID / ha) 
The total operation costs of the machinery unit (tractor + grain drill) was calculated according to ASAE (2000), which included: fixed costs (depreciation, interest on investment, taxes, insurance and shelter), Variable costs include (fuel, oils, maintenance, repairs and labours), Administrative costs and tractor's total cost. As for grain drill, the same preceding items were applied to calculate the operating costs, except variable costs which were calculated by multiplying the fixed costs value of grain drill times 80% because it does not have a power source (engine) (Al-Tahan et al. 1991). Declining - Balance Depreciation was the method adopted to calculate the depreciation for the tractor and grain drill (Hunt, 2001) and (Issct, 2004).
Energy requirements (kW. h / ha)

Engine power was calculated by using the following equation: -(Embaby, 1985)

\[ EP = 3.16 \frac{FC}{kW} \]

Where:

\( EP \) = engine power (kW); \( FC \) = fuel consumption (L / h)

Then the energy requirement of the machinery unit was calculated by using the following equation: -(Embaby, 1985)

\[ ER = \frac{EP}{EFC} \frac{kW. h}{ha} \]

Where:

\( ER \) = energy requirements (kW. h / ha); \( EFC \) = effective field capacity (ha / h).

RESULTS AND DISCUSSION

The percentage of slippage

Table (2): Effect of the sowing speed and depth on the percentage of slippage (%)

<table>
<thead>
<tr>
<th>The sowing speed (km / h)</th>
<th>The sowing depth(cm)</th>
<th>Average sowing speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>6.28</td>
<td>2.57</td>
<td>9.06</td>
</tr>
<tr>
<td>7.61</td>
<td>4.76</td>
<td>10.82</td>
</tr>
<tr>
<td>11.43</td>
<td>6.59</td>
<td>12.11</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td>2.04</td>
<td>1.08</td>
</tr>
<tr>
<td>Average sowing depth</td>
<td>4.64</td>
<td>10.66</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td>1.08</td>
<td></td>
</tr>
</tbody>
</table>

Table (2) shows the effect of sowing speed and sowing depth and their overlaps on the percentage of slippage. As seen from the table, increasing the sowing speed from 6.28 to 7.61 and then to 11.43 km / h led to increase the slippage percentage from 7.77% to 9.53% and then to 10.98%, respectively. This may be due to the increased practical speed leading to increase traction resistance force and reduce the chance of the
driving wheel coherence of the tractor with the ground, therefore the slip increased. These results are consistent with the ones obtained by Mohammed (2005) and Al-Mkhiol (2005). Also the results in the same table show that increasing the sowing depth from 3 to 6 and then to 9 cm caused an increase in the percentage of slipping from 4.64% to 10.66% and to 12.97%, respectively. The reason is that the increase of depth has led to increased loading on the furrow openers and it’s penetrate in the ground, which cause an increase in the traction resistance force therefore the slip increases. These results are consistent with those obtained by Al-Sulaivany (2005). The interaction between the sowing speed and the sowing depth was significant on the percentage of slip, whereas the dual overlap between the sowing speed 6.28 km / h and the sowing depth 3 cm led to obtain the lowest percentage of slip was 2.57%, while the highest percentage of slip was 14.23% resulting from the overlap of the sowing speed 11.43 km / h with the sowing depth 9 cm.

- Effective field capacity (practical productivity)
The effect of the sowing speed and the sowing depth and their overlaps on the effective field capacity is given in table (3). As seen from the table, the increase of the sowing speed from 6.28 to 7.61 and then to 11.43 km / h increased effective field capacity from 0.61 to 0.73 then to 1.08 ha / h, respectively. The reason may be attributed to the fact that speed is one of the factors involved in the calculation of productivity. These results are consistent with the results obtained by Al-Khafaji (2006). The same table shows that increasing the sowing depth from 3 to 6 cm the practical productivity has decreased from 0.87 to 0.78 ha / h. The reason is that increasing depth will be followed by increasing penetration of the furrow openers in the soil leading to increase the traction resistance force and thus, practical speed will decrease, which is one of the factors of practical productivity. These results are consistent with those obtained by Jasim and Madloul (2011) and Abu Sabaa and Karim (1980), while increasing the sowing depth from 6 to 9 cm did not have any significant effect in the practical productivity. The interaction between the sowing speed and the sowing depth was significant in the practical productivity. Interaction of the sowing speed 11.43 km / h with the sowing
depth 3 cm was superior in obtaining highest value of productivity rate amounting to 1.16 ha / h. While the lowest field capacity rate was 0.58 ha / h which was resulting from overlap of the sowing speed 6.28 km / h with the sowing depth 9 cm.

Table (3): Effect of the sowing speed and depth on the effective field capacity (ha / h)

<table>
<thead>
<tr>
<th>The sowing speed (km / h)</th>
<th>The sowing depth (cm)</th>
<th>Average sowing speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>6.28</td>
<td>0.67</td>
<td>0.58</td>
</tr>
<tr>
<td>7.61</td>
<td>0.76</td>
<td>0.71</td>
</tr>
<tr>
<td>11.43</td>
<td>1.16</td>
<td>1.05</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td></td>
<td>0.04</td>
</tr>
<tr>
<td>Average sowing depth</td>
<td>0.87</td>
<td>0.78</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td></td>
<td>0.02</td>
</tr>
</tbody>
</table>

- Field efficiency

Table (4): Effect of the sowing speed and depth on the field efficiency (%)

<table>
<thead>
<tr>
<th>The sowing speed (km / h)</th>
<th>The sowing depth (cm)</th>
<th>Average sowing speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>6.28</td>
<td>75.66</td>
<td>65.17</td>
</tr>
<tr>
<td>7.61</td>
<td>70.03</td>
<td>65.29</td>
</tr>
<tr>
<td>11.43</td>
<td>69.46</td>
<td>62.98</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td></td>
<td>2.96</td>
</tr>
<tr>
<td>Average sowing depth</td>
<td>71.72</td>
<td>64.48</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td></td>
<td>1.47</td>
</tr>
</tbody>
</table>

Table (4) shows the effect of the sowing speed and the sowing depth and their overlaps on the field efficiency. The table shows that when the sowing speed increasing from 6.28 to 7.61 and then to 11.43 km / h the field efficiency decreased from 68.60 to 66.82 then to 64.71%, respectively. The reason may be that increasing practical speed leads to reduce the
time exploitation coefficient, the results agree with those reached by Madlol (2010). As the table shows, when the sowing depth increased from 3 to 6 cm, the field efficiency decreased from 71.72 to 64.48%. The reason, that increasing depth leads to increase the deepening of the furrow openers which leads to increase the slippage percentage and thus the practical front speed will decrease, which is one factors of field efficiency and thus the field efficiency is reduced. These results are consistent with the findings by Zedan (2006) and Madlol and Abdulrazzak (2012), while increasing the sowing depth from 6 to 9 cm did not have any significant effect on the field efficiency. The interaction between the sowing speed and the sowing depth was significant in the field efficiency. Interaction of the sowing speed 6.28 km / h with the sowing depth 3 cm gave higher field efficiency amounting to 75.66%, while the overlap of the sowing speed 11.43 km / h with the sowing depth 9 cm gave lower field efficiency amounting to 61.68%.

- Fuel consumption

Table (5): Effect of the sowing speed and depth on the fuel consumption (L/ha)

<table>
<thead>
<tr>
<th>The sowing speed (km / h)</th>
<th>The sowing depth (cm)</th>
<th>Average sowing speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>6.28</td>
<td>10.86</td>
<td>13.25</td>
</tr>
<tr>
<td>7.61</td>
<td>7.96</td>
<td>10.00</td>
</tr>
<tr>
<td>11.43</td>
<td>6.32</td>
<td>7.85</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td></td>
<td>6.48</td>
</tr>
<tr>
<td>Average sowing depth</td>
<td>8.38</td>
<td>10.37</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table (5) shows the effect of the sowing speed and the sowing depth and their overlaps on the fuel consumption. As seen from the table, when the sowing speed increased from 6.28 to 7.61 and then to 11.43 km / h, the amount of fuel consumption per unit area decreased from 19.17 to 12.58 and then to 8.11 L / ha, respectively. The reason is that the tractor ability
does not show optimally at slow velocities. Therefore, waste exists in energy. These results are consistent with the ones obtained by Kassar (2011), as well as the high velocities need a short time period to complete unit area according to results of Al-Khafaji (2006) and Aday et al. (2008). Also the results in the same table show that increasing the sowing depth from 3 to 6 and then to 9 cm caused an increase in the fuel consumption from 8.38 to 10.37 and to 21.11L/ha, respectively. The reason is that when increasing the sowing depth, furrow openers resistance will increase and that led to increased load on the tractor. These results are consistent with those obtained by Desbilles (2005) and Al-Aridhee (2011). The interaction between the sowing speed and the sowing depth was significant in the fuel consumption, whereas the dual overlap between the sowing speed 11.43 km/h with the sowing depth 3 cm was superior in obtaining least value of fuel consumption rate amounting to 6.32 L/ha. The highest value of fuel consumption rate was 33.39 L/ha resulting from overlap of the sowing speed 6.28 km/h with the sowing depth 9 cm.

**-Total operation costs**

The effect of the sowing speed and the sowing depth and their overlaps on the total operation costs for machinery unit is tabulated in table (*). As seen from the table, increasing of the sowing speed from 6.28 to 7.61 and then to 11.43 km/h, the total operation costs decreased from 26454 to 20393 then to 13594 ID/ha (ID=0.0008 US$ or US$=1250ID), respectively. The reason may be attributed to the fact that increasing of practical speed led to increase of practical productivity. Therefore the total costs decreased as a result of the reverse relationship between the productivity and total costs. These results are consistent with the results obtained by Al-Sharefy (2003). The same table shows that increasing of the sowing depth from 3 to 6 and then to 9 cm caused an increase in total cost from 16721 to 19151 then to 24570 ID/ha. The reason is that the increase of the sowing depth has led to reduce the productivity and increased fuel consumption, therefore the total economic costs increased. These results are consistent with those obtained by Al-Janobi (2000) and Jabour (2010). The interaction between
the sowing speed and the sowing depth was significant in the total operation costs. Interaction of the sowing speed 11.43 km/h with the sowing depth 3 cm was superior in obtaining lowest value of total operation costs which amounted to 12022 ID/ha. Meanwhile, the highest total costs were 34338 ID/ha, which resulted from overlap of the sowing speed 6.28 km/h with the sowing depth 9 cm.

Table (6): Effect of the sowing speed and depth on the total operation cost (ID*/ha)

<table>
<thead>
<tr>
<th>The sowing speed (km/h)</th>
<th>The sowing depth (cm)</th>
<th>Average sowing speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.28</td>
<td>20701</td>
<td>26454</td>
</tr>
<tr>
<td>7.61</td>
<td>17439</td>
<td>20393</td>
</tr>
<tr>
<td>11.43</td>
<td>12022</td>
<td>13594</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td>3522.3</td>
<td>974.16</td>
</tr>
<tr>
<td>Average sowing depth</td>
<td>16721</td>
<td>24570</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td>974.16</td>
<td>*Iraqi Dinar</td>
</tr>
</tbody>
</table>

-Energy requirements-

Table (7): Effect of the sowing speed and depth on energy requirements (kW.h/ha)

<table>
<thead>
<tr>
<th>The sowing speed (km/h)</th>
<th>The sowing depth (cm)</th>
<th>Average sowing speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.28</td>
<td>39.22</td>
<td>69.18</td>
</tr>
<tr>
<td>7.61</td>
<td>28.76</td>
<td>45.40</td>
</tr>
<tr>
<td>11.43</td>
<td>23.05</td>
<td>29.40</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td>23.42</td>
<td>6.65</td>
</tr>
<tr>
<td>Average sowing depth</td>
<td>30.34</td>
<td>76.21</td>
</tr>
<tr>
<td>L.S.D = 0.05</td>
<td>6.65</td>
<td></td>
</tr>
</tbody>
</table>

Table (7) shows the effect of the sowing speed and depth and their overlaps in the energy requirements for machinery unit. The table shows that when the sowing speed increased from 6.28 to 7.61 and then to
11.43 km/h, the energy requirements decreased from 69.18 to 45.40 then to 29.40 kW·h/ha, respectively. The reason may be that increasing practical speed tends to reduce the required time to complete the sowing process and reducing the amount of fuel consumed. Thus power requirements for machinery unit decreased. As the table shows, when the sowing depth increased from 3 to 6 and then to 9 cm, the energy requirements have increased from 30.34 to 37.43 then to 76.21 kW·h/ha. The reason is that increasing depth leads to increase the slippage percentage and thus the fuel consumption will increase. So the energy requirements increased. These results are consistent with the findings by Al-Sabbagh et al. (2012). The interaction between the sowing speed and the sowing depth was significant in the energy requirements. Interaction of the sowing speed 11.43 km/h with the sowing depth 3 cm gave the lowest energy requirement which was 23.05 kW·h/ha, while the overlap of the sowing speed 6.28 km/h with the sowing depth 9 cm gave the highest energy requirements for the machinery unit which was 120.45 kW·h/ha.

**CONCLUSION**

From the study conducted, the followings were concluded:

Increasing the sowing speed resulted in an increase in effective field capacity, percentage of slippage and a significant decrease in field efficiency, fuel consumption per unit area, total operation costs and energy requirements for machinery unit. Also, increasing the sowing depth resulted in a significant decrease in effective field capacity, field efficiency and a significant increase in the percentage of slippage, fuel consumption per unit area, total operation costs and energy requirements for the machinery unit. The overlap between the sowing speed and the sowing depth has a very significant effect on all attributes which studied.

**RECOMMENDATIONS**

We recommend using the third speed of sowing (11.43 km/h) with the first depth of sowing (3 cm), which gave a good technical, economic indicators and energy requirements for the machinery unit. We also recommend doing future studies similar to this research with planting different cereal crops at several depths of sowing, taking into account the
grain drill field performance indicators and crop output in order to achieve the best combination between the machine and plant.

REFERENCES


تأثير سرعة وعمق البذار في بعض المؤشرات الفنية والاقتصادية ومنطقات القدرة للوحدة الميكانيكية
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تأثّزسّزع وعمق البذار هما لهما تأثيراً كبيراً على نتائج الزراعة. البحوث وتقريرات مختلفة كثيرة تمت دراسة تأثير سرعة وعمق البذار في بعض مؤشرات الأداء الفنية والاقتصادية ومنطقّات القدرة للوحدة الميكانيكية. تم استخدام الجرّاء "New Holland" كواحدة من هذه الأجهزة. تم استخدام ثلاث سرعات البذار هي 2.28، 6.61، 7.61، 11.41 سم/ساعة (عمر البذار)، وثلاثة أعمق للبذار هي 3، 6، 9 سم، والتي تمثل القطاعات الثانوية. تم دراسة بعض مؤشرات الأداء الفنية والوحدة الميكانيكية وشملت: النموية للأنزلاق، السعة الحقيقية الفعلية، الكفاءة الحقلية، واستهلاك الوقود. كما تم حساب تكاليف التشغيل الكلية وممكنيات القدرة للوحدة الميكانيكية. نفتذت التجربة باستخدام متميزة الألواح المتشقّقة تحت نظام القطاعات العشوائية الكاملة وبثلاثة مكرّرات. أظهرت النتائج أن سرعة البذار الثالثة (11.41 سم/ساعة) كانت تؤثر بشكل أفضل على السعة الحقيقية الفعلية (1.08 هكتار/ساعة، عرض البذار 170 سم) و أقل معدل لاستهلاك الوقود لوحدة المساحة (8.11 لتر/هكتار وأقل معدل لتكاليف التشغيل الكلية للوحدة الميكانيكية (1354 دينار عراقي/هكتار) ونسبة النموية للأنزلاق (4.24 %) و أعلى معدل للسعة الحقيقية الفعلية (0.87 هكتار/ساعة وأعلى معدل للكفاءة الحقلية (21.76 %) مع أقل معدل لاستهلاك الوقود لوحدة المساحة (8.38 لتر/هكتار وأقل معدل لتكاليف التشغيل الكلية للوحدة الميكانيكية (1724 دينار عراقي/هكتار) مع أقل معدل لفترات القدرة للوحدة الميكانيكية (0.34 كيلومتر-ساعة/هكتار). أما بالنسبة للتفاعلات بين سرعة البذار وعمق البذار فقد فورت سرعة البذار الثالثة (11.41 سم/ساعة) مع عمق البذار الأول (3 سم) في تسجيله لأقل معدل للسعة الحقيقية الفعلية (1.16 هكتار/ساعة وأقل معدل لاستهلاك الوقود لوحدة المساحة (0.32 لتر/هكتار وأقل معدل لتكاليف التشغيل الكلية للوحدة الميكانيكية (1202 دينار عراقي/هكتار) مع أقل معدل لفترات القدرة للوحدة الميكانيكية (2.6 كيلومتر-ساعة/هكتار). وأتضح أيضاً أن النسبة المئوية للأنزلاق فقد كانت ضمن الحدود المسموح بها (79.49).
أيضاحات

في البداية، أقدم شكري وتقديري للسادة المحكمين لما ثبتته من ملاحظات قيمة على بحث هذا والتي أن دلت على شيء. فأنا أعلم على رصانة وسلامة البحث العلمي. وتقاعضهم، مع هذا البحث وأهتمامهم به. وبعد فاتني أود أن أوضح بعض الأمور والتي ثبتها السادة المحكمين على البحث:

- أن مقاسات خط كتابة البحث كانت ضمن توصيات المجلة مع وجود مسافات بين الكلمات. ولكن عند سحب البحث فأنا صحب على نظام وورد مغاي. ولهذا ظهرت كل الأرقام باللغة الهندية ودائم الكتال.
- تم اختصار عنوان البحث وما يضم شموله أركان البحث. استخدمت مذكرة الحالة صنف أبو غريب عند تنفيذ البحث ثم تثبيتها في البحث.
- سعة خزان البذور: 20 كيلوغرام وتثبت فيه البحث (ص. 4).
- نوع جهاز التلقيح هو العجالة المجمعة ذات التغذية الجبرية الخارجية، مثبت (ص. 4).

العرض الشغال التصمييم للمبارة 170 سم، مثبت (ص. 4).
- أختار عم البذور يتم من خلال دراق موجودة ضمن المبارة (معتدل البذرة تقريبًا) تدار بأجده عروب الدراسة أو بالعكس ورفع وخفض هاب مثبت عليه الفجوات الفرصة المزودة وبالتالي خفض ورفع الفجوات بعد وضع كتل خشبية أسفل أطارات المبارة ذات أنغامات معلولة وعلى أرض مستوية.
- أختار سرع البذور النظرية يتم من خلال تسير الوحدة المكنية لمسافة 30 م والتي تم أعمادها كمسافة نظرية لعموم ووحدات التجربة ولكل طابع عينت تغير السرع (بعد السرع الساحبة)، تم حساب السرع النظرية (بعد تسجيل الوقت للألازم لقطع المسافة أعلاه (السرعة = المسافة/الزمن)، بعدد أختار السرع النظرية 7.61 كم/ساعة كسرعة أولى والسرعة 7.28 كم/ساعة كسرعة ثانية أما السرع النظرية الثالثة فكانت 4.12 كم/ساعة ووضعت عثمانية الوقود البالغ 60% ، عند تنفيذ التجربة سارعت الوحدة المكنية لكل سرعات ممتدية ولكن المبارة في حالة عمل و ضمن المعا وإمتيازات مستحيل (12.9 م لبس أول الوقت الألازم لقطع المسافة المبارة) ولم تتم تطبيق معادلة السرعات أعلاه فكانت هي السرعات العملية.
- في محاولة حساب الأنتاجية العملية عبر المسافة /EFe لأعداد الانتباه E من الرمز ر/العدم الانتباه الذي يمثل كفاءة البذور الأحيائية التي أفترضها كنهر (1982) (ص. 31) للبذور EFA maj 20-60% ووسطها 40% أما رمز الكفاءة الحقيقية فهو EFA maj 20-60%، والذي يمثل أثناء Stegsted التجريية.
- تم تقريب الأرقام على مرتين بعد الفارفوة لتتوافق كل أرقام الجداول لأن د في حالة التقرب ثلاث مرات، تظهر مشكلة في جدول الأنتاجية العملية والتي بها بعض الأرقام الصعبة صفر.
- تم ذكر سعر الدولار وقيمته بالدينار العراقي.

مع فائق شكري وتقديري للسادة المحكمين.

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