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The Effect of Different Furrow Depths and Speeds of Machinery Units Using A Locally Assembled Combine Implement on Planting Maize

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ABSTRACT

Using a combine implement for open furrows, seeds planting and fertilization is very important implement to conduct more than one process or operation in one field pass at the same time where the combine equipment open suitable furrow to grow any crop and also considered as special tillage implement. The combine implements save time, cost and potential, and decrease traffics and, labors and improve soil physicals properties and plant yields. The experiment was conducted to evaluate the effect of different furrow depths and speeds of machinery unit using a locally assembled combine equipment on planting maize. The tractor which was used in this study is New Holland TD80. Two machinery speeds included 7.44 and 9.53 km/hr which represent main plot and two Furrow depths included 5-15 and 15-25 cm which represent sub plot were used in this study. Field efficiency, Leaf area, 300 seed weight, and maize yield were measured in this experiment. Split plot design under Randomized Complete block design with three replication was used in this study. Least significant differences (L.S.D) under 0.05 level was used to compare the mean of treatment. The results can be summarized as Follow; 9.53 km/hr speed gave lower Field efficiency stood (63.45)% and higher maize yield stood (9.65) t/h. 5 - 15 cm furrow depth gave higher Field efficiency stood (66.69)% and greater Leaf area stood (0.53) m² while 15-25 cm furrow depth gave higher maize yield stood (5.53) t/h. The interaction between the speed and furrow depth, has impacted significantly on all plant properties except 300 seed weight. Using the locally assembling combine implement for planting corn, fertilizing and open furrows is successfully done.

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1. Introduction

Increasing the demand for food from the things that require a rapid increase in agricultural production, which become a problem for the national economy development of most developing countries, (Madloul, et al, 2013). The suitable use of agricultural mechanization fully in the performance of agricultural operations, in addition to the mechanical seeding process has achieved a major breakthrough in the agricultural production process and through the application of multi-tillage systems operations, as well as pulverization process and the soil leveling (Abu Sabaa and Karim, 1980).

Combine equipment for open furrows, planting and fertilization is very important equipment used to carry out more than one process at the same time where the combine equipment open suitable furrow to grow any crop and also considered as special tillage implement. An experiment was conducted at University of Iowa to plant maize by furrows and led to an increase in total production (Frank et al, 2012). The leaf plant maize area is essential for being a factory which able to capture the light and take advantage of it for the manufacture of basic materials in the plant life and crop production (Watson, 1952).

Machinery unit operation speed is one of factors that can affect soil, regardless of how it's done. So that, these operations be appropriate they can have a positive impact on

the soil properties and moderate the pressure on the soil. Otherwise inappropriate operation speeds will provide conditions in the soil which are providing the groundwork for the destruction of soil structure, loss of nutrients and environmental pollution.

To assure normal plant growth, the soil must be prepared in such conditions that roots can have enough air, water, and nutrients. Soil tillage is among the important factors affecting soil physical and mechanical properties (Mustafa and Nihat, 2007). Soil physical properties change not only because of constructional properties of soil tillage implements, but also because of their operational variables, such as operating speed. Jiantuo et al, (2010) reported that the designing implement which used for maize cultivation on furrow gave higher practical productivity, as well as reduce the time. Coates, (2002) mentioned that the field practical productivity is affected by several factors such as speeds and other field processing.

Corn is one of the cultivated crops for grain and fodder with tremendous yield potential grown round the year under irrigated condition. In many parts of the world, maize is the most important food stuff and particular, provides the daily bread for the indigenous population of rural area. Corn has become a widely grown feed particularly as a second crop after wheat or barley.

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The corn production in Iraq is about 1066800 ton ha⁻¹ of grain corn from 1809200 ha (Ministry of Agriculture, 2012). According to the importance of using the locally assembled combine equipment in production of maize crop under different machinery speeds, this study was conducted.

2. Materials and Methods

The experiment was conducted to evaluate the possibility of planting maize by using locally assembled combine equipment under two machinery speeds. Two machinery speeds included 7.44 and 9.53 km/hr which represent main plot and two furrow depths included 5-15 and 15-25 cm which represent sub plot were used in this study. Field efficiency, leaf area, 300 seed weight, and maize yield were measured in this experiment. Split plot design and randomized complete block design with three replication was used in this study. Least significant differences (L.S.D) under 0.05 level was used to compare the mean of treatment.

A New Holland TD80 tractor was used in the study (Fig. 1).



Figure 1. New Holland TD80 tractor.

A combine equipment which Manufactured and assembled at the department of agricultural machines and equipment workshop, College of Agriculture, University of Baghdad, used for opening furrow, planting and fertilizing. The combine equipment consists of three implements included open furrow, planting and fertilization implements, which achieve the three operations at once, figure 2, 3 and 4.

2.1. Components of the combine implements:

The combine implement consists of three main implements as follows:

1- Ridge (furrow opener) implement, consist of:

A-Shank

B-Two moldboards

C- Frog

D- ridge edge (share)

2-Planting (seeding) implement, consist of:

A-Seed tank

B-Seed feeding mechanism

C-Seed fall tube

D-Seed Furrow opener

E- Seed mixer

3-Fertilizer implement, consist of:

A-Fertilizer tank

B-Fertilizer feed mechanism

C-Fertilizer fall tube

D- Fertilizer Furrow opener

E- Fertilizer mixer

4-Main Frame with three hitching points

5-Movement rear wheel

6- Depth determination wheels

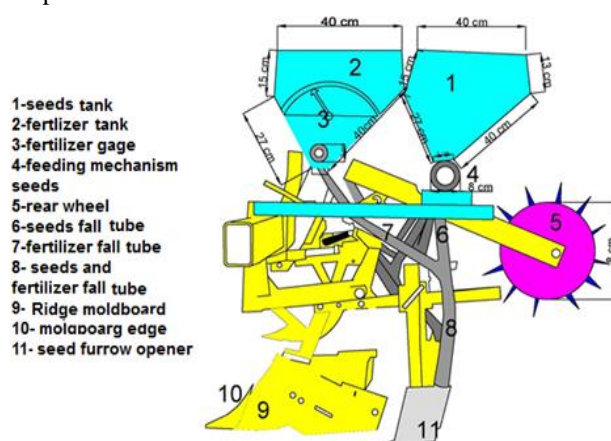


Figure 2. Combine implement parts.

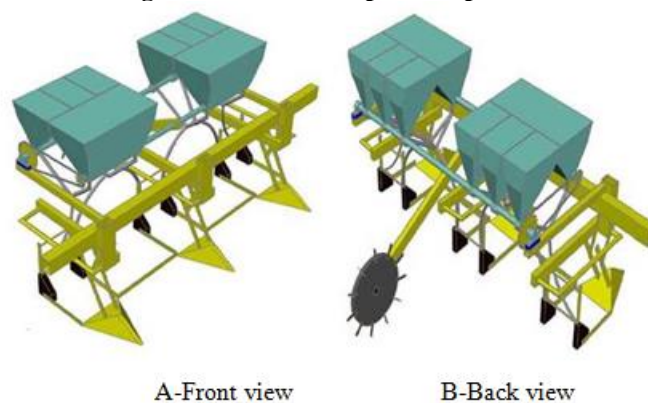


Figure 3. Front and back view for the combine implement.



Figure 4. Combine implement pictures during operation.

2.2. Studied properties

2.2.1. Field efficiency, %

Field efficiency was measured using the following equation which proposed by (Hunt, 1980)

$$Fe = \frac{Pp}{Pt} \times 100$$

Whereas:

Fe = Field Efficiency, %

Pp = Practical productivity, hac/h

Pt = Theoretical productivity, hac/h

2.2.2. Leaf area (m²)

Leaf area (m²) was measured by using by equation which proposed by Elsahooeke , (1990).

2.2.3. Weight of 300 seeds

Weight of 300 seeds corrected on the basis of moisture 15.5 % after measuring the moisture content in the grain for each repeater by using Grain Moisture Tester device.

2. 2. 4. Plant production (t / ha)

Plant production was measured through choosing ten plants randomly from the two centrists' lines for each repeater. The yield has been calculated by multiplying the production per plant rate g time (*) plant density and justice weight on the basis of moisture 15.5 % of all qualities of weight-related , according to equation proposed by Elsahooeke , (1990) .

3. Results and discussion

3.1. Field efficiency (%)

Table 1 shows the effect of machinery speed and furrow depths on the field efficiency. 7.44 km / h machinery speed showed the superiority in the field efficiency stood 67.23% compared with 9.53 km/h speed which got 63.01% the reason for that may be due to the decrease in the slippage percentage which led to increase in field productivity which is one of the variables in field efficiency equation. 5-15 cm furrow depth got higher field efficiency stood 63.45% comparing with 15-25 cm and the reason for that also due to the decrease in the slippage percentage which led to increase field productivity. The overlap between 7.44 km / h speed and 5-15 cm depth obtained the highest field efficiency amounted to 69.92 % , and the lowest field efficiency achieved 62.57 % for the overlap of Speed 9.53 km / h with a depth of 15-25 cm.

Table 1. The effect of the machinery speed and furrow depths on the field of efficiency, %.

| Speed km/h | Depth of furrow (cm) | | Average |
|------------|----------------------|-------|---------|
| | 5-15 | 15-25 | |
| 7.44 | 69.92 | 64.54 | 67.23 |
| 9.53 | 63.45 | 62.57 | 63.01 |
| L.S.D | 1.13 | | 0.64 |
| Average | 66.69 | 63.56 | |
| L.S.D | 0.45 | | |

3.2. Leaf area (m 2).

Table 2. shows the effect of machinery speed and furrow depths on the leaf area. 7.44 km / h machinery speed showed the superiority in the leaf area stood 0.51 cm² compared with 9.53 km/h speed which got 0.43 cm². The reason for that may be due to the increase in soil pulverization which gave good condition for plant growing. 5-15 cm furrow depth got higher leaf area stood 0.42 cm comparing with 15-25 cm. The overlap between 7.44 km / h speed and 5-15 cm depth obtained the highest leaf area amounted to 0.58 cm² ,and the lowest leaf area achieved 0.39 cm² for the overlap of Speed 9.53 km / h with a depth of 15-25 cm.

Table 2. the effect of the machinery speed and furrow depths on the leaf area.

| Speed km/h | Depth of furrow (cm) | | Average |
|------------|----------------------|-------|---------|
| | 5-15 | 15-25 | |
| 7.44 | 0.58 | 0.44 | 0.51 |
| 9.53 | 0.47 | 0.39 | 0.43 |
| L.S.D | 0.04 | | 0.002 |
| Average | 0.53 | 0.42 | |
| L.S.D | 0.007 | | |

3.3. 300 grain weight (g)

Table 3. shows no significant impact of machinery speed and furrow depths and the interference between the machinery speed and furrow depths on weight of 300 grain.

Table 3. The effect of the machinery speed and furrow depths on 300 grain weight, gm.

| Speed km/h | Depth of furrow (cm) | | Average |
|------------|----------------------|---------|---------|
| | 155 | 25 – 15 | |
| 7.44 | 46.83 | 42.59 | 44.71 |
| 9.53 | 49.34 | 43.72 | 45.53 |
| L.S.D | N.S | | N.S |
| Average | 48.09 | 43.16 | |
| L.S.D | N.S | | |

3.4. Corn Yields, ton/hac

Table 4. shows the effect of machinery speed and furrow depths on the corn yield. 9.53 km / h machinery speed showed the superiority in the corn yield stood 10.12 ton/hac compared with 7.44 km/h speed which got 8.48 ton/hac. The reason for that may be due to the increase in soil tillage which gave good condition for plant growing and increase in the leaf area of the plant. 15-25 cm furrow depth got higher corn yield stood 5.53 ton/hac while 5-15 cm furrow depth got 3.78 ton/hac. May be the reason for that due to the availability of irrigation water for the bigger size of the furrow. Where it was found that the impact of interference between the speed and the furrow depths got a significant effect on the corn yields. The overlap between 9.53 km / h speed and 15-25 cm furrow depth got the highest corn yields amounted to 5.91 ton/hac ,and the lowest corn yields achieved 3.34 ton/hac for the overlap of Speed 7.44 km / h with a depth of 5-15 cm.

Table 4. The effect of the machinery speed and furrow depths on the corn yields, ton/hac.

| Speed km/h | Depth of furrow (cm) | | Average |
|------------|----------------------|---------|---------|
| | 5-15 | 25 – 15 | |
| 7.44 | 3.34 | 5.14 | 8.48 |
| 9.53 | 4.21 | 5.91 | 10.12 |
| L.S.D | 3.54 | | 1.02 |
| Average | 3.78 | 5.53 | |
| L.S.D | 2.32 | | |

3. Conclusion and recommendation

Using the locally assembling combine implement for planting corn, fertilizing and open furrows is successfully done. Through the above results it is clear that increased tractor speed led to significant decrease in field efficiency, leaf area, and significant increase in corn yield. Also increase furrow depth led to significant decrease in field efficiency, leaf area, and significant increase in corn yield. Therefore, we recommend using a 9.53 km/ h speed and 15-25cm depth treatment which gave the best plant yield.

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