Plant Archives Volume 20 No. 2, 2020 pp. 9421-9424 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

STUDY OF THE PERFORMANCE OF LOCALLY MANUFACTURED ROTAVATOR FOR WEED CONTROL

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Abstract

This research executed at the field of Al-Mussaib technical institute dating 2019, to study the performance of locally manufactured rotavator for weed control by using the implement was self-powered and driven by a person with three rotating speeds for the weapon shaft and various tillage depths in clay loam soil. The research was studied two factors:- included tillage depths (12, 15 and 17 cm) and three rotational speeds for the weapon shaft (165, 190, 220 rpm); The studied traits were studied including practical productivity, soil volume disturbed, field efficiency and weed erasing efficiency. The research was performed by applying the factorial experiment according to a completely randomized design with four replications. The results showed the following: increase tillage depth from 12 to 15 and 17 cm caused an increase in soil volume disturbed, weed erasing efficiency and field efficiency and decrease in the practical productivity. Increasing the rotational speeds for the weapon shaft from 165 to 185 and 200 caused an increase in practical productivity, soil volume disturbed, field efficiency and decrease in the weed erasing efficiency.

Key words: weed control, practical productivity, soil volume disturbed, field efficiency and weed erasing efficiency.

Introduction

Rotavator is tillage implement; it is dual-purpose equipment which is used in soil bed preparation and weed control in an arable field. It has a huge efficiency for flipping mixing to topsoil preparing the seed bed directly and also it has more mixing capacity seven times than a plow that reported by (Abouziena, 2008). The rotator will produce a perfect seedbed in fewer passes; it also has a feature that can be easily adjusted for various working depths indicated by (Al-Tenbi, 2018). Using a rotary plow to eliminate weeds promotes plant growth as a result of increased soil aeration, root length and better equipment production. With all mechanical weeding implements, operator skill, experience and knowledge are necessary for success. The practical productivity of the mechanical unit depends on several factors, the most important of which is the working width of the machine and the speed of it that performs the agricultural process and lost time in addition to the remains of plants in the field such as indicated by (Kankal, 2016). Studies show that the speed of plowing is of great importance in increasing the actual productivity of the mechanical unit as the practical speed of the tractor is directly proportional to the practical productivity of the mechanical unit such as indicated by (Kolo, 2012). The increase in the rotating speed machine led to an increasing the distance from one stroke to the other of the plow weapons because the practical speed of the mechanical unit is considered an important factor in determining the distance between one stroke and the other of the plow weapons and the increase in the rotational speed of the rotor plow increases the length of the stroke between the weapon and soil. Researcher (Pal, 2016) pointed out that any increase in the depth of tillage, it increases the soil volume disturbed due to the increase in the section of the soil that was flipped by the plow and thus the depth of tillage has a significant effect on the soil volume disturbed such as pointed by (Tenu, 2009). Weeds have strong competition with all crops for light, nutrients and moisture which adversely affect the production of the crop. Mechanical cultivators are major proven units for weed control have been successfully used to eliminate from weeds and it works on the correct use of nutrient elements in the soil by the plant, Therefore, a constant effort is needed to

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keep the weed under control. The aim of manufacturing this machine is to eliminate weed-type (perennial weeds), In addition to doing soil tillage at the same time.

Materials and Methods

The study was conducted in the field of Al-Mussaib technical institute in 2019. The soil moisture was 19 %. The research executed by using the factorial experiment design with (CRD) with four replications to study factors:

1- Rotational speed of weapons shaft: Including 165, 190, 220 rpm by using by single-cylinder internal combustion engine, it has a horse power of 16 hp to rotate the weapons shaft. As the engine was installed on a frame from iron, the engine equipped with gearbox, this gearbox to control the speeds of rotation of weapons shaft.

2- Tillage depths: Including 12, 15 and 17 cm by using locally manufactured rotovator, which was designed by us and manufactured in a local workshop which owned to engineering techniques of agricultural machinery and equipment of the technical collage Al-Mussaib, according to the engineering plans we have been provided them. Plow with dimensions 90 × 35 cm and it is the draw type, this plow characterized an independent internal combustion engine with a number of revolutions 3600 rev. A number of weapons were 16 and the, weight of plow 450 kg.

Indicators Studied

1- Practical productivity: The practical width was measured by measuring tape for each treatment separately. The practical productivity can be calculated from the following equation such as indicated by (Sedeeq, 2013):

$$P_p = 0.1 * W_p * V_p * C_t \text{ .... (1)}$$

P_p = practical productivity (ha.hr^{-1})

W_p = actual plow width (m)

V_p = practical speed (km.hr^{-1})

C_p = time utilization coefficient about (0.80)

2- Soil volume disturbed: It's the volume of the soil that was raised by the plow during the fixed time, can be calculated from the following equation such as indicated by (Bukhari, 1988):

$$S.V.D = D_p * P_p * 100 \text{ ..... (2)}$$

S.V.D = soil volume disturbed (m^3.hr^{-1})

D_p = actual tillage depths (cm)

P_p = practical productivity (ha.hr^{-1})

3- Field efficiency: Field efficiency represents the ratio of the effective field capacity to theoretical field capacity and can be affected by time lost in the field and the full width of the machine. It could be calculated from the following equation (Ragesh, 2018):

$$FE = \frac{EFC}{TFC} * 100 \text{ .... (3)}$$

FE = field efficiency %

EFC = effective field capacity (ha.hr^{-1})

TFC = theoretical field capacity (ha.hr^{-1})

From this equation we could calculate the effective field capacity:

$$EFC = 0.1 * W_p * V_p * F_e \text{ .... (4)}$$

4- Weed erasing efficiency: The weed erasing efficiency intended is the number of weeds that already removed in the 20 m. of the row, calculated directly after cultivation by the following equation such as indicated by (Salim, 2012):

$$W_E = \left(1 - \frac{N_1}{N}\right) * 100 \text{ ...... (5)}$$

W_E = weed erasing efficiency (%)

N_1 = number of stay weeds directly after cultivation

N = total number of weeds

Results and Discussion

The results in table 1 showed that there were significantly different of the effect of tillage depths by using L.S.D at the 0.05 level. Where the superiority tillage depth 12 cm achieved the highest value of practical productivity 0.444 ha.hr^{-1}, also the rotational speeds of the weapons shaft 220 rpm achieved the highest value of practical productivity which was 0.462 ha.hr^{-1}. As shown in table 1 that the interaction between tillage depth 12 cm and the rotational speeds of the weapons shaft 220 rpm registered the highest value of the practical productivity which was 0.494 ha.hr^{-1}, while tillage depth 17 cm and the rotational speeds of the weapons shaft 165 rpm

Table 1: Effect of rotational speeds of the weapons shaft and tillage depth on the practical productivity (ha.hr^{-1}).

Tillage depths (cm)	The rotationalspeeds of the weaponsshaft (rpm)			Average
	165	190	220	
12	0.386	0.453	0.494	0.444
15	0.359	0.428	0.471	0.419
17	0.313	0.374	0.422	0.370
L.S.D		0.028		0.017
Average	0.353	0.418	0.462	
L.S.D		0.012		

registered the lowest value of practical productivity which was 0.313 ha.hr^{-1}. These results may be due to the direct relationship between the rotational speeds of the weapons shaft and practical productivity which led to increase the practical productivity this is consistent with what the results found by researcher (Kankal, 2016).

The results in table 2 showed that there were significantly different of the effect tillage depths by using L.S.D at the 0.05 level where the superiority tillage depth 17 cm achieved the highest value of the soil volume disturbed 338.46 m^3.hr^{-1}, also the rotational speeds of the weapons shaft 220 rpm achieved the highest value of the soil volume disturbed which was 311.16 m^3.hr^{-1}. As shown in table 2 that the interaction between tillage depth 17 cm and the rotational speeds of the weapons shaft 220 rpm registered the highest value of the soil volume disturbed which was 359.65 m^3.hr^{-1}, while the interaction between tillage depth 12 cm and the rotational speeds of the weapons shaft 165 rpm registered the lowest value of the soil volume disturbed which was 221.74 m^3.hr^{-1}. The reason maybe the tillage speed is directly proportional with soil volume disturbed this is consistent with what the researchers indicated (Mandal, 2015, Sajid, 2017).

Table 2: Effect of rotational speeds of the weapons shaft and tillage depth on the soil volume disturbed (m^3.hr^{-1}).

Tillage depths (cm)	The rotationalspeeds of the weaponsshaft (rpm)			Average
	165	190	220	
12	221.74	250.89	267.24	246.62
15	275..23	296.47	306.59	292.76
17	319.62	336.12	359.65	338.46
L.S.D	11.41			7.37
Average	272.20	294.49	311.16	
L.S.D	6.18			

Table 3: Effect of rotational speeds of the weapons shaft and tillage depth on the field efficiency (%).

Tillage depths (cm)	The rotationalspeeds of the weaponsshaft (rpm)			Average
	165	190	220	
12	74.59	78.13	84.03	78.92
15	86.34	89.62	92.15	89.37
17	91.27	94.71	97.48	94.49
L.S.D	2.59			1.47
Average	84.07	87.49	91.22	
L.S.D	1.13			

Table 4: Effect of rotational speeds of the weapons shaft and tillage depth on the weed erasing efficiency (%).

Tillage depths (cm)	The rotationalspeeds of the weaponsshaft (rpm)			Average
	165	190	220	
12	78	71	64	71
15	85	82	76	81
17	94	88	84	88.7
L.S.D	2.26			1.39
Average	85.7	80	74.7	
L.S.D	1.04			

The results in table 3 showed that there are significantly different effects of the till age depths by using L.S.D at the 0.05 level. Where the superiority tillage depth 17 cm achieved the highest value of field efficiency 94.49%, also the rotational speeds of the weapons shaft 220 rpm achieved the highest value of field efficiency which was 91.22 %. As shown in table 3 that the interaction betweentillage depth 17 cm and the rotational speeds of the weapons shaft 220 rpm registered the highest value of the field efficiency which was 97.48 %, while the interaction between tillage depth 12 cm and the rotational speeds of the weapons shaft 165 rpm registered the lowest value of field efficiency which was 74.59 %. These results may be due to that the practical speed is one of the variables of the equation for obtaining practical productivity, which is one of the most important factors that have an impact in determining the value of field efficiency this is consistent with the results found by the researchers (Kumar, 2017, Maheshwari, 2018).

The results in table 4 showed that there are significantly different effect tillage depths by using L.S.D at the 0.05 level. Where the superiority tillage depth 17 cm achieved the highest value of weed achieved the highest value of weed erasing efficiency which was 85.7 %. As shown in table 4 that the interaction betweentillage depth 17 cm and the rotational speeds of the weapons shaft 165 rpm registered the highest value of the weed erasing efficiency which was 94 %, while the interaction betweentillage depth 12 cm and the rotational speeds of the weapons shaft 220 rpm registered the lowest value of weed erasing efficiency which was 64 %. These results may be due to the effect of actual width with increasing tillage depth, which has an important role in erasing the largest quantity of weeds in the area covered this is consistent with what the results found by researchers (Rahman, 2000, Shiru, 2011).

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