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Strip Till-Planting Method for Coserving Power and Costs Through Faba Bean Planting

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ABSTRACT

The main objective of this study is to investigate the effect of using strip till-planting method as the minimum tillage system for reducing power and cost requirements of faba bean seedbed preparation and planting under Egyptian conditions. Field experiments were conducted in a clay soil. A split-spit-plot statistical experimental design with three replicates was conducted. Three tillage and planting systems were studied under various levels of planting depths and planting speeds. Measurements were taken for soil mean weight diameter, planting depth, planting speed, fuel consumption and the percentage of seed germination. Results indicated that the soil mean weight diameter were 19.63, 16.79 and 12.52 mm for traditional system (TS), mechanized system (MS) and strip till-planting system (STP), respectively. The strip till-planting system (STP) resulted in the lowest values for the energy requirements and total costs compared with the other two systems. The percentage of seed germination decreased as the planting speed increased for mechanized (MS) and strip till-planting (STP) systems. However, there is no appreciable change in the seed germination when the speed increased for traditional system (TS). From the results of this study, it could be concluded that the strip till-planting system (STP) conserved the power requirements for seedbed preparation and planting faba bean by 40% and 46% compared with the traditional (TS) and mechanized (MS) systems, respectively. It also reduced the total costs by 56% and 69%, respectively.

Keywords: Faba bean; Strip till-planting; Energy; Cost; Seed germination.

INTRODUCTION

High cost of energy in agricultural production in the last decades encouraged scientists to research in conserving energy in crop production through efficient tillage and planting operations. Efforts have been made in finding ways to increase the output of tillage and planting equipment by decreasing the energy and costs requirements. Strip till-planting system is considered one of these efforts for a variety of reasons including improving soil fertility and reducing energy inputs. However, adopting this system may require changes in equipment and management strategy (Jessica *et al*. 2020). The primary objective of the strip till-planting system is to provide very little tillage that is necessary for crop's needs. The other advantages of this system include permit earlier planting thus increasing yields potential and reducing fuel consumption and costs used in tillage and planting operations. Moreover, this method has been found acceptable for reducing the energy and costs requirements in the production of several crops such as corn (Afify *et al*. 1999, Farmaha *et al*. 2011, Derek *et al* 2019 and Jessica *et al*. 2020) and cereal crops (Morrison 2002, Rehm *et al* 2004 and Duiker *et al*. 2006).

Faba bean is the major food legume crop in Egypt, and its dry grain provides the main source of protein for most of the population. It also plays a key role in the biological nitrogen fixation process by improving soil properties and increasing fertility. This is due to it is leaving about 65-70 units of nitrogen for hectare after harvest benefiting the next crop (ARC, 2014). The total cultivated area of faba bean crop in Egypt was about 100,000 hectares (420,000 fedans) in 2005 and this area decreased to 370,000 hectares (88,000 fedans) (CAPMS, 2017). Consequently, the mean productivity of grain is also decreased from 413,000 tons to 142,000 tons

In Egypt, many researches have been done to investigate the effect of seedbed and planting methods on faba bean production using conventional methods. However, there are very little researches concentrated in using conservation tillage method for producing faba bean. Ward (2001) studied the effect of integration between seedbed preparation method and weed control method to maximize the yield of faba bean. He found that the lowest values of power requirement and total cost were obtained using no-tillage seedbed preparation system. Also chiseling twice followed by harrowing as a seedbed preparation system resulted in highest values of yield compared with the other systems used under this study. El-Raie *et al*. (2003) found that when using tillage and planting system consists of rotary plow followed by seed drill, the values of energy requirements and total costs for mung bean crop were 0.07 (kWh kg^{-1}) and 0.07 (LE kg^{-1}), respectively. However, the highest yield 1044.38 (kg fed^{-1}) was obtained using a system consists of moldboard plow followed by land leveler and seed drill.

The power requirements using till-planting method were reduced by about 64% compared to conventional method for sorghum crop (Burt *et al*., 1994). Licht *et al*. (2005) reported that the strip-tillage system is perceived as having lower soil temperatures, wetter soil conditions, and greater surface penetration resistance compared with

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conventional and other conservation tillage systems. Also strip-tillage can contribute effectively to improve plant emergence, similar to chisel plowing and conserve soil moisture effectively compared with no-tillage. The strip-till adoption in corn has increased as a sustainable means to improve soil conditions and yield (Derek *et al*., 2019). However, the response of soybean to strip-till has been less consistent. They added that for corn, strip-till yielded 0.8 (Mg ha^{-1}) greater than no-till and banded fertilizer yielded 0.7 (Mg ha^{-1}) higher than surface-applied fertilizer. While, soybean yields in strip-till for soybean, yields in strip-till were generally equivalent to no-till and yield benefits associated with strip-till were dependent on other management factors. Farmaha *et al*. (2011) found that strip-till treatments had greater yield than no-till treatments for soybean crop yield. However, Janovicek *et al*. (2006), found no response to strip till for the same crop. Studies comparing strip-till, conventional till, and no-till found that strip-till and conventional till for corn increased corn grain yield compared to no-till (Vetsch *et al*, 2007). Lee *et al*., (2003) concluded a strip tillage technique by the power tiller blade with a down-cut process for a dryland direct rice seeder. They found that the rotor shaft with four rotary blades had the lowest torque variation and torque requirement and ratio of soil breaking was 24.4%.

Therefore, the objective of this work is to study the effect of using till-planting method as the minimum tillage system for conserving energy and cost requirements of faba bean seedbed preparation and planting under Egyptian conditions.

MATERIALS AND METHODS

Experimental procedures

A field experiment was carried out at the Agricultural Research and Experimental Station of the Faculty of Agriculture at Moshtohor, Benha University. Three tillage and planting systems were used: 1) Traditional system (TS), consists of chisel plow two times followed by land leveler, ridging and manual planting, 2) Mechanized system (MS), consists of chisel plow two times followed by laser leveling and mechanical planting and 3) Strip till-planting system (STP). Experiments were conducted using mounted 7-blades (sweep share) chisel plow with working width of 1.75 m, a local land leveler with 3.5 m width was used for leveling soil, a trailed land leveler with the working width of 2.4 m was used for laser leveling, a local 4-rows ridger with working width of 2.4 m was used for ridging, a Gassbardo Italy, 4-row planter was used for planting, and a strip till-planting machine. The strip till-planting machine (Figure 1) which has been modified by Afify *et al.* (1999) consists of the following parts: 1) A pair of smooth rolling coulter to limit the row cultivation to a strip of 150 mm width, 2) A sweep share to till soil strip, 3) A packer wheel with blades to pulverize soil strip and 4) A single disc opener with closing system to place and cover the seed and also to pack the furrow. All the tillage and planting equipment was trailed or mounted using Universal tractor (800 Model, 2-Wheel drive type, 4-Cycle, 4-Cylinder, Direct injection, Water cooled, 77-80 HP at 1900 rpm). For the traditional system (TS) and mechanized system (MS), the primary and secondary tillage operations were conducted at 5 kmh^{-1} speed under 15 cm operating depth. The manual planting was conducted at two depths (3 and 5 cm). However, the planter and the till-planting machine were used at three forward speeds (3, 5 and 8 km h^{-1}) and at two planting depths (3 and 5 cm).

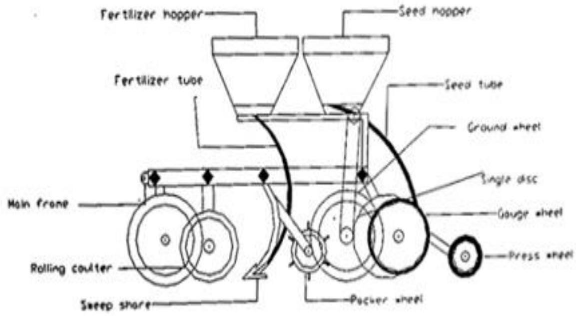

Figure 1. Schematic diagram of the strip till-planting machine

A split-spit-plot experimental design was used with three replicates. Fifty-four tests were conducted using three tillage systems under two planting depths and three planting speeds. An area of about 3 fedans was divided into 54 plots. Therefore, the area for each plot becomes 280 m^2 (80 m length and 3.5 m width). The field soil was a clay soil having 51% clay, 28% .silt, and 21% sand. The variety of faba bean used was Giza 643 (medium size). The planter and strip till-planting machine were calibrated under laboratory condition and the adjusted seeding rates of 52.2 and 53.3 kg fed^{-1} to conformed seed spacing of 7.5 and 7.4 respectively. On the day of seeding, three soil samples were collected from each plot for determining the soil moisture content, soil bulk density and soil mean weight diameter.

Measurements

1- Soil moisture content determined according to the standard methodology of ASTM (2017). The average value of soil moisture content under experimental conditions was 18% ±1%.

2- Soil bulk density determined according to the standard methodology of ASTM (2017). The average value of soil bulk density under experimental conditions at 15 cm depth was 1.485 kg m^{-3}.

3- Aggregate size distribution of soil particles determined based on the weight of aggregates retained in each sieve class with respect to the total soil sample weight. The size distribution of aggregates was characterized by mean weight diameter (MWD) which was estimated using the following (van Bavel, 1953).

$$MWD = \sum_{i=1}^{n} W_i \times X_i \qquad (1)$$

Where, **(MWD), is the soil mean weight diameter (mm), (W_i), is the proportion of the total dry sample weight (%), (X_i), is the mean diameter of any particular size range of aggregates separated by sieving and equal to (($X_i + X_{i-1}$) / 2) (mm) and (i), is the sieve number.**

4- Fuel consumption of the tractor with different tillage and planting equipment under various levels of variables carried out by filing up the fuel tank before starting each operation then after finishing every operation. Fuel tank to be refilled again using a graduated cylinder. The total quantity of fuel needed to refill the tank was recorded and as fuel consumed in L h^{-1}.

5- Planting depth measured by excavating two meters lengths of seed row for each plot and measuring the vertical distance from the center of the seed to the soil surface.
6- Planting speed measured during tests for each nominal speed. It was calculated by recording the time and the distance of 40 m middle length for each plot.
7- Seed germination collected three times for each plot on 21th day following seeding. Then, the percentage of seed germination was calculated.

Energy requirements

The power requirements of tractor for tillage and planting equipment determined from the data of tractor fuel consumption for each operation (Table 1) using the following equation (Grisso *et al*., 2004).

$$P_T = \frac{Q_i}{Q_s} \qquad (2)$$

Where, **(Q_i), is the estimated fuel consumption for a particular operation (L h^{-1}), (Q_s), is the specific volumetric fuel consumption for the given tractor determined from ASAE (2002) and ranged from 2.36 to 4.1 (L kW^{-1} h^{-1}) and (P_T), is the total tractor power for the particular operation (kW).**

The energy requirements of tillage and planting equipment in (kWh fed^{-1}) calculated from the data of power requirements and from the estimated actual field capacity for each plot of tillage and planting machines and also for strip till-planting machine. The actual field capacity (AFC, fed h^{-1}) was calculated as the ratio of area covered by the tractor to the productive and nonproductive time according to the following equation.

$$AFC = \frac{A}{T} \times 0.36 \qquad (3)$$

Where, **(AFC), is the actual field capacity (fed h^{-1}), (A), is the plot area (m^2) and (T), is the total time required to finish the plot (h).**

On the other hand, the energy requirement for human was estimated according the Goering, (1992). He assumed that an adult human can produce approximately 0.15 (kW h) of energy while working continuously. He also added that the human working as a power unit is equivalent to 0.05 (L h^1) of diesel fuel.

Table 1. Fuel consumption of tractor for the three tillage systems at different planting depths and at 5 (km h^{-1}) planting speed

Systems	Planting depth	Fuel consumption for tillage and planting operations, (L fed^{-1})						Total
		First chiseling	Second chiseling	Leveling	Ridging	Planting	Strip till-planting	
TM	3 cm	12.05 ± 0.14	9.23 ± 0.10	6.91 ± 0.07	6.14 ± 0.18	2.25 ± 0.09	0.00	36.58
	5 cm	12.28 ± 0.11	9.46 ± 0.12	6.88 ± 0.11	6.26 ± 0.12	2.85 ± 0.10	0.00	37.73
MS	3 cm	12.55 ± 0.13	9.59 ± 0.15	11.27 ± 0.10	0.00	8.59 ± 0.14	0.00	42.00
	5 cm	12.73 ± 0.09	9.78 ± 0.14	11.48 ± 0.12	0.00	10.77 ± 0.17	0.00	44.76
STP	3 cm	0.00	0.00	0.00	0.00	0.00	26.05 ± 0.11	26.05
	5 cm	0.00	0.00	0.00	0.00	0.00	30.18 ± 0.08	30.18

(±) Standard deviation

Cost of operations

The total cost of operations for the tillage and planting equipment was estimated according to price level of (2017) from the following equation (Awady, 1978).

$$C = \frac{P}{h}\left(\frac{1}{y} + \frac{i}{2} + t + r\right) + (a \times f \times u) + \frac{M}{144} + \frac{P_1}{h_1}\left(\frac{1}{y} + \frac{i}{2} + t + r\right) + (a \times f \times u) + \frac{M_1}{144} \qquad (4)$$

Where, **(C), is the total hourly cost (LE h^{-1}); (P and P_1), are the price of tractor and machine, respectively; (h and h_1) are the estimated yearly operating hours 1000 and 750 h for tractor and machine, respectively; (i), is the interest rate (10 %); (y), is the life expectancy of machine (10 year); (t), is the taxes and overhead rates (3%); (r), is the maintenance and repairs ratio (10%); (a), is the ratio of rated power and lubrication related to fuel cost (1.2); (*f*), is the fuel consumption in (L h^{-1}); (u), is the price of diesel fuel per liter (5 LE); (M and M_1), are the monthly salaries (1500 and 1000 LE) and (144), is the estimated working hours per month.**

RESULTS AND DISCUSSION

Soil mean weight diameter for tillage systems

Data in Table (2) represents the aggregate size distribution of soil particles and the soil mean weight diameter produced using three tillage systems. It is clear that, the highest values of the soil mean weight diameter were obtained with the traditional system (TS). However, the lowest values were observed using the mechanized system (MS). The strip till-planting system (STP) produced the middle values of the soil mean weight diameter. The averages of these values were 19.63 mm, 16.79 mm, and 12.52 mm for (TS), (MS), and (SPT) systems, respectively. These results may have been attributed to the following reasons:

- The increase of the average percentage weight of soil clods, which has the mean diameter ranged from 25 mm to bigger than 60 mm for (TS) system by 64% and 20% compared with that for (MS) and (STP) systems, respectively.
- The decrease of the average percentage weight of soil clods, which has the mean diameter smaller than 12.5 mm for (TS) system by 26% and 9% compared with that for (MS) and (STP) systems, respectively.
- There was no appreciable change of the percentage weight of soil clods that diameter ranged from 12.5 to 25 mm between the three systems.
- The laser land leveler used with (MS) system has a very high effect on pulverize the soil compared with the traditional land leveler and packer wheel that used with (TS) and (STP) systems, respectively.

The energy requirements for three tillage systems with planting depths

Data in Table (3) observed the effect of planting depth on the energy requirements for the three tillage systems at 5 (km h^{-1}) planting speed. As expected, the energy requirement increased as the planting depth increased for all systems. The strip till-planting system

(STP) resulted in the lowest values of the energy requirements compared with the other two systems. However, the mechanized system (MS) resulted in the highest values of the energy requirements at the two planting depths. This is due to the increase in the fuel consumption for laser land leveling and planting operations with second system (MS) compared with the traditional land leveling and manual planting for first system (TS). The change in the planting depth from 3 cm to 5 cm at 5 (km h^{-1}) does not produce much change in the energy requirements except for the strip till-planting system; it produces about 20% increase in the energy requirements.

Table 2. Aggregate size distribution of soil particles and the soil mean weight diameter (MWD) produced using three tillage systems

Systems	Percentage of soil weight (%)					MWD
	<12.5	12.5-25	25-37.5	37.5-60	> 60	mm
Traditional System	49.62	21.19	17.05	6.62	5.52	19.87
(TS)	51.74	20.42	11.83	8.62	7.38	20.95
	48.04	28.46	13.56	5.63	4.32	18.06
Mean	49.80	23.36	14.15	6.96	5.74	19.63
CV	0.04	0.19	0.19	0.22	0.27	0.07
SD	1.86	4.44	2.66	1.52	1.54	1.46
Mechanized System	70.06	20.85	5.50	3.59	0.00	12.09
(MS)	64.95	23.90	5.17	4.26	1.73	13.61
	68.30	23.17	5.28	3.26	0.00	11.85
Mean	67.77	22.64	5.32	3.70	0.58	12.52
CV	0.04	0.07	0.03	0.14	1.72	0.07
SD	2.59	1.59	0.17	0.51	0.99	0.95
Strip Till-Planting System	52.86	25.65	12.35	5.25	4.36	17.33
(STP)	53.25	25.10	11.63	6.15	3.88	17.16
	57.19	22.55	14.40	3.45	2.96	15.88
Mean	54.43	24.43	12.79	4.95	3.73	16.79
CV	0.04	0.07	0.11	0.28	0.19	0.05
SD	2.39	1.65	1.44	1.37	0.71	0.79

Table 3. Energy requirements for three tillage systems at different planting depths under 5 (km h^{-1}) planting speed

Systems	Planting depth	Energy for tillage and planting operations, (kWh fed^{-1})						Total
		First chiseling	Second chiseling	Leveling	Ridging	Planting	Strip till-planting	
TM	d1	7.66 ± 0.17	5.26 ± 0.29	4.39 ± 0.26	3.72 ± 0.27	1.55 ± 0.22	0.00	22.58
	d2	7.56 ± 0.24	5.86 ± 0.16	4.72 ± 0.24	3.87 ± 0.10	1.59 ± 0.06	0.00	23.60
MS	d1	7.48 ± 0.19	5.76 ± 0.11	6.76 ± 0.24	0.00	4.91 ± 0.14	0.00	24.91
	d2	7.57 ± 0.20	5.49 ± 0.18	6.53 ± 0.20	0.00	6.16 ± 0.17	0.00	25.75
STP	d1	0.00	0.00	0.00	0.00	0.00	17.66 ± 0.22	17.66
	d2	0.00	0.00	0.00	0.00	0.00	19.46 ± 0.19	19.46

(±) Standard deviation

The energy requirements for three tillage systems with planting speeds

Table (4) shows the effect of the planting speed on the energy requirements for the three tillage systems at 5 cm planting depth. The energy requirements decreased as the planting speed increased for the three systems. For traditional system (TS), the change in the planting speed from low to high does not produce much change in the energy requirements. This is due to the planting operation was conducted by human. On the other hand, the increase in the planting speed from 3 to 8 (km h^{-1}) resulted in decreasing in the energy requirements by 19% and 36% for (MS) and (STP) systems, respectively. This result may have been attributed to the increase in the actual field capacity for planting operation by 33% and 21% as the planting speed increased from 3 to 8 kmh^{-1} for (MS) and STP) systems, respectively. In a comparison among the three systems, the strip till-planting system at 5 (kmh^{-1}) planting speed reduced the energy requirements by 37% and 44% compared with that for (TS) and (MS) systems, respectively. The energy requirements for the mechanized system (MS) increased by 15%, 13%, and 9% compared with that for the traditional system (TS) at 3, 5, and 8 (kmh^{-1}) planting speeds, respectively. This result due to the increasing in energy requirements for planting and leveling operations with (MS) system compared with that for (TS) system at various levels planting speeds.

The percentage of seed germination

Figure (2) shows the effect of the planting speed on the percentage of seed germination for the three tillage systems on the 21st days following seeding. The percentage of seed germination decreased as the planting speed increased for the three tillage systems. This may have been attributed to the increase in soil dispersion at the high speed of operation, which might cause increased soil drying. However, the traditional system (TS) produces the highest values of the percentage of seed germination under different levels of planting speeds. The mechanized system (MS) produced higher seed germination as a compared with the strip till-planting system (STP) at different speeds. This result may be attributed to the increase in the percentage weight of soil clods bigger than 37.5 mm for (STP) by 51 % compared with (MS) (Table 1).

The total cost of operations for tillage systems

Figure (3) shows the effect of the planting speed on the total cost of operations for three tillage systems at 5 cm planting depth. It is clear that, the total costs decreased as the planting speed increased for all systems. The lowest values of the total costs were obtained using strip till-planting system (STP) compared with other two systems. The mechanized system (MS) resulted in the highest values of the total costs. But, the traditional system (TS) obtained the middle values of the total costs. These results may have been attributed to the following reasons:

- The increase in the operation cost of the laser land leveling by 76% compared with that for traditional land leveler.
- The decrease in the average actual field capacity by 11% for (MS) system compared with (TS) system at different planting speeds.
- The increase in the cost of the manual planting by 67% compared with that for the mechanical planting at different planting speeds.

Table 4. Energy requirements for three tillage systems at different planting speeds under 5 cm planting depth

Systems	Planting speed, (kmh^{-1})	Energy for tillage and planting operations, ($kW\ h\ fed^{-1}$)						Total
		First chiseling	Second chiseling	Leveling	Ridging	Planting	Strip till-planting	
TM	3	7.78 ± 0.28	5.86 ± 0.43	4.39 ± 0.36	3.87 ± 0.28	1.53 ± 0.26	0.00	23.43
	5	7.82 ± 0.24	5.73 ± 0.19	4.45 ± 0.36	3.90 ± 0.18	1.51 ± 0.14	0.00	23.41
	8	7.94 ± 0.12	5.92 ± 0.19	4.51 ± 0.28	3.79 ± 0.27	1.48 ± 0.19	0.00	23.64
MS	3	7.24 ± 0.26	5.33 ± 0.17	6.57 ± 0.22	0.00	8.64 ± 0.24	0.00	27.78
	5	7.33 ± 0.12	5.49 ± 0.23	6.82 ± 0.21	0.00	6.79 ± 0.22	0.00	26.43
	8	7.28 ± 0.11	5.41 ± 0.19	6.93 ± 0.28	0.00	5.07 ± 0.18	0.00	25.69
STP	3	0.00	0.00	0.00	0.00	0.00	17.86 ± 0.20	17.86
	5	0.00	0.00	0.00	0.00	0.00	14.75 ± 0.19	14.75
	8	0.00	0.00	0.00	0.00	0.00	11.53 ± 0.17	11.53

(±) Standard deviation

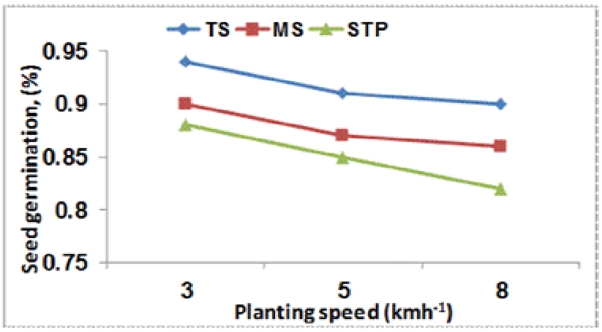

Figure 2. Percentage of seed germination for the three tillage systems at different levels of planting speeds

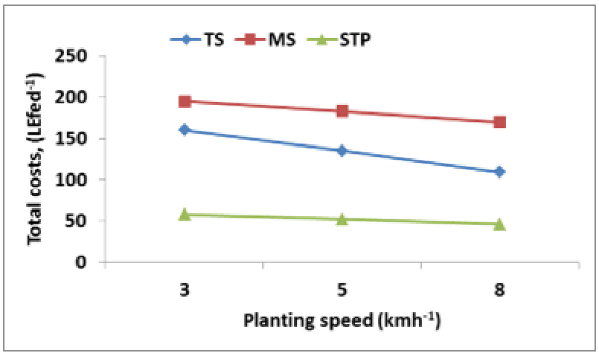

Figure 3. Effect of the planting speed on total costs for the three tillage systems at 5 cm planting depth

Statistical analysis

Analysis of variance were performed for the soil mean weight diameter, the energy requirements, the total costs, and percentage of seed germination for the three tillage systems in relation to three planting speeds, two planting depths and three replicates. Results indicated that, there were significant differences among the parameters and their interactions as shown in Table 5.

Table 5. The Probability for soil mean weight diameter, energy requirements, total costs and seed germination for the three tillage systems

Parameters		MWD	Energy	Costs	Seed germination
Source	DF	P	P	P	P
System (S)	2	0.000**	0.000**	0.000**	0.000**
Speed (V)	2	0.764	0.000**	0.000**	0.000**
Depth (D)	1	0.849	0.000**	0.000**	0.000**
Replicate (R)	2	0.203	0.009**	0.145	0.926
S*V	4	0.628	0.001**	0.000**	0.000**
S*D	2	0.476	0.375	0.000**	0.001**
S*R	4	0.285	0.639	0.794	0.604
V*D	2	0.452	0.160	0.001**	0.001**
V*R	4	0.216	0.537	0.005**	0.348
D*R	2	0.905	0.112	0.865	0.439
S*V*D	4	0.546	0.139	0.000**	0.001**
S*V*R	8	0.684	0.195	0.058	0.379
S*D*R	4	0.404	0.414	0.952	0.313
V*D*R	4	0.372	0.085	0.056	0.394
Error	8				
Total	53				

****Highly significant at 1% level of confidence**

CONCLUSION

Results of this study could be summarized as the following:

- The strip till-planting system (STP) gave the moderate values of soil mean weight diameter. However, the highest values were obtained with the traditional system (TS).
- The energy requirement increased as planting depth increased for all systems and the lowest values were obtained using strip till-planting system (STP). On the other hand, the energy requirements decreased as the planting speed increased for the three systems and the strip till-planting system (STP) resulted in the lowest values.
- The strip till planting system (STP) resulted in the lowest values of the total costs as a compared with other two systems.

- The percentage of seed germination decreased as the planting speed increased for all systems. However, it was increased as the planting depths increased.
- Under the experimental conditions of this study, it could be concluded that the strip till-planting system conserved the energy requirements for faba bean by 40% and 46% as a compared with the traditional (TS) and mechanized (MS) systems, respectively. It also reduced the total costs by 56% and 69%, respectively.

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نظام الحراثة والزراعة الشرائحي لتقليل الطاقة والتكالبف خلال زراعة الفول البلدي

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أشارات إحصائيات الجهاز المركزي للتعبئة العامة والإحصاء (2017) أن المساحة المنزعة من الفول البلدي في مصر قد قلت من عام (2005) حتى عام (2016) بمقدار 80% ونتج عن ذلك نقص الإنتاجبة بحوالي 65%. وحيث أن نظم الحراثة والزراعة التقليدية للفول تزيد من تكاليف انتاجه فإن الهدف الرئيسي من هذا البحث هو دراسة تأثير استخدام نظام الحراثة والزراعة الشرائحي كأحد نظم الحراثة القليلة لتقليل الطاقة والتكاليف اللازمة لإنتاج الفول البلدي تحت الظروف المصرية. وللوصول للهدف من هذا البحث تم إجراء تجربة حقلية في تربة طينية باستخدام تصميم القطع المنشقة Split-split plot design. وأجريت الدراسة بإستخدام ثلاثة نظم للحراثة والزراعة تحت ثلاث مستويات مختلفة من أعماق وسرعات الزراعة حيث كانت تلك النظم كما يلي: (نظام الحراثة الشرائحي (STP) - نظام الحراثة المميكن (MS) - نظام الحراثة التقليدي (TS)). وتم قياس كل من المحتوي الرطوبي للتربة - كثافة التربة - القطر المتوسط لحبيبات التربة - إستهلاك الوقود - نسبة الانبات كما تم حساب كلا من القدرة الناتجة للجرار Power requirement - الطاقة لوحدة المساحة Energy requirements وكذلك تكاليف التشغيل Cost of operations. وكانت أهم النتائج التي تم التوصل إلبها أن نظام الحراثة الشرئحي أعطى القيمة المتوسطة للقطر المتوسط لحبيبات التربة بينما أعطى نظام الحراثة التقليدي القيمة القصوى - نظام الحراثة الشرائحي أعطى القيم الدنيا لكلا من متطلبات الطاقة لوحدة المساحة والتكاليف مقارنة بالنظامين الأخرين تحت الدراسة كما زادت متطلبات الطاقة مع زيادة عمق الزراعة للأنظمة الثلاثة وأعطى النظام المميكن القيم القصوى ونظام الحراثة الشرئحي القيم الدنيا وكانت القيم المتوسطة للنظام التقليدي - انخفضت متطلبات الطاقة مع زيادة سرعة الزراعة للأنظمة الثلاثة عند المستويات المختلفة لأعماق الزراعة بينما انخفضت نسبة إنبات البذور للأنظمة المختلفة مع زيادة سرعة الزراعة لكنها زادت بزيادة أعماق الزراعة - أظهرت نتائج التحليل الإحصائي معنوية النتائج لكل القياسات تحت الدراسة. لذلك وبناءا على النتائج المتحصل عليها من هذه الدراسة وتحت ظروف التجربة، يمكن التوصية بأن نظام الحراثة الشرائحي يمكن إستخدامه لزيادة انتاجية الفول البلدي تحت الظروف المصرية حيث حقق انخفاضا في متطلبات الطاقة بنسبة تراوحت بين40٪ و 46٪ مقارنة بالنظام التقليدي والنظام المميكن على الترتيب كما أحدث إنخفاضا في التكاليف الكلية بنسبة تراوحت بين 56٪ و 69٪ مقارنة بالنظامين الاخرين تحت الدراسة.