DEVELOPMENT OF THE MECHANICAL CULTIVATION-OPERATION FOR SUGAR-BEET CROP

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ABSTRACT

The aim of this study is to develop the mechanical inter-row cultivation operation for sugar-beet crop at big-scale projects. The investigated parameters were inter-row cultivator forward speed (4, 5, 6 and 7 km/h), number of shares (1, 2, 3) and weed intensity (without, low "< 20 weed/m^2", moderate "20 - 30 weed/m^2", high "30 - 40 weed/m^2", and very high "> 40 weed/m^2"). The main results were: The maximum cultivation-efficiency of 100 % was obtained using forward speed of 4 km/h, number of shares of 3 and at low weed intensity (< 20 weed/m^2). Meanwhile, the minimum cultivation-efficiency of 58.7 % was obtained using forward speed of 7 km/h, number of shares of 1 and at very high weed intensity (> 40 weed/m^2). The maximum sugar-beet root yield of 35.5 ton/fed was obtained using forward speed of 4 km/h, number of shares of 3 and without weed. Meanwhile, the minimum sugar-beet root yield of 22.39 ton/fed was obtained using forward speed of 7 km/h, number of shares of 1 and at very high weed intensity (> 40 weed/m^2).

I-INTRODUCTION

It is evident that improving agricultural production depends mainly on using improved methods and up-to-date technology through all different agricultural operations. Selection of the appropriate qualitative and quantitative needs concerning agricultural operations of any crop is of great importance to minimize production costs. Sugar beet is considered one of the most important crops, not only for sugar production but also for fodder and organic matter for the soil. It is also considered as a double benefit crop to the farmers, where the roots are processed for sugar production and the green leaves and tops are used for animal feeding. Moreover, beet consumes less water than cane by about two-thirds and it may also grow under a wide variety of soil and climatic conditions.

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The cultivated area of sugar beet in Egypt was about 555 thousand feddens yearly producing about 11.981 million Mg (ton) with an average yield of 21.5 Mg/fed (t/fed) according to Bulletin of Estimates Agricultural Income, 2015.

Sugar beet crop is an expensive labor consuming under traditional method. The three main labor-intensive operations of sugar beet production are planting, inter-row cultivation and harvesting. Inter-row cultivation of sugar beet is one of the most critical operations.

Ever since the first cultivation systems were developed for food production farmers of all generations and areas have been faced with the problems of non-crop plants growing amongst the crops. These non-crop plants, which compete with the crops for moisture, light, nutrients and space, have long been known as weeds.

The problems which these non-crop plants have caused to farmers have led to the term weed being used as an insult to other humans, often inferring lack of courage or strength. Yet weeds which are thin, spindly and pale are often so because of their resilience and ability to compete with the crop plants.

Weed management is a strategy that make a desired plant population successful in a particular agro ecosystem using knowledge of the ecology of the undesired plants, that is the weeds (Ghersa et al., 2000). The most effective method of weed management is by making physical contact with the weeds themselves, which is weed control. Currently, there are several ways of controlling weeds, either by using manual, chemical, mechanical or biological means.

The earliest and the simplest weed control method is manual weed control. This method was and is accomplished by a person bending down and using their hands to pull weeds out of the soil. This method then advanced to hand tools, from using a stick to using a hand-hoe. The labor required for weeding is expensive, time consuming and difficult to organize (Weide et al., 2008). Gianessi and Reigner (2007) reported that manual labor costs have increased from $0.10/hour in 1940s to $1.00/hour in 1960s. As of 2005, the rate had further increased to $10/hour. Furthermore, problems such as back pain due to frequent repetitive bending caused manual weed control to be avoided. In areas such as California, hoe weeding and hand weeding was banned due to permanent back damage in workers. Before the existence of chemical weed control, mechanical weed control was the best option to solve issues related to manual weeding. In mechanized agriculture, there were times where weeding tools were pulled by draft animals such as buffaloes and horses, which now in the developed world have generally been replaced by tractors. There are various types of mechanical weeding implements in the market that use three 3 main techniques: burying weeds, cutting weeds and uprooting weeds. The burial of weeds through the action of tillage tools, and is usually done during land preparation. For cutting and uprooting weeds, there are two types of machinery available: inter-row cultivators and intra-row cultivators. Inter-row weeding is a weeding method that accomplishes between-planting row weeding, while intra-row does within-planting-row weeding.

Weerasooriya et al. (2016) tested the suitability/adaptability of this new cultivator under the field conditions. It was found that weeding efficiency varied from 69.1 to 89.3 % showing a significantly higher negative relationship with soil bulk density. Further, it gave partial weeding efficiencies for major weed categories such as; 76 % for sedges, 78 % for grasses and 76 % for broad leaves. Plant damaged percentage varied from 1.54 to 13.33 % and did not show any significant relationship with the test field conditions.

Tekade and Dhaliwal (2007) developed a four row rotary weeder to carry out studies on rotary weeding for sugarcane and maize crop. It was found that the field capacity, plant damage, weeding index and fuel consumption varied from 0.062 to 0.214 ha/h, 1.56–4.13%, 65.54–89.96%, 3.26–6.931/ha, 0.039–0.168ha/h, 1.34–3.83%, 65.91–90.76%, 2.96–6.921/ha for C & L types of blades respectively. Field capacity of rotary weeder was 0.077 ha/h in sugarcane and 0.050 ha/h in maize as compared to wheel hand hoe 0.035 ha/h in sugarcane and 0.015 ha/h in maize.

The objectives of the present investigation are:

1. Developing the inter-row cultivation operation for sugar-beet crop at big-scale projects.

2. Optimizing some operating parameters for sugar beet inter-row cultivator such as machine forward speed, number of shares and weed intensity.
3. Evaluation the sugar beet production from the economic point of view including the mechanical inter-row cultivation operation.

2- MATERIALS AND METHODS

2.1. Materials:

The main experiments were carried out through successive agricultural seasons of 2014, 2015 and 2016 at Alexandria Sugar Company farm (شركة أسكندرية للسكر), Nobaria, El Behira Governorate (النوبارية، محافظة البحيرة) to study the mechanical operation of inter-row cultivation for sugar beet crop to select the optimum forward speed and number of shares at big-scale projects.

The mechanical analysis of the experimental soil was classified as a sandy soil "table 1". The soil mechanical and chemical analyses "table 2" were conducted in the Soil Testing Laboratory, Desert Development Center, and Research Station in Sadat City.

Table 1: Mechanical analysis of the experimental soil.

Gravels, %.	Particle size distribution, %.			Soil Texture.
	Sand	Silt	Clay	
23	95.00	3.00	2.00	Sandy

Table 2: Chemical analysis of the experimental soil.

Available level of nutrients, ppm.				
P	K	Fe	Zn	Mn
12.15	141.20	3.88	1.12	1.82
Cu	Om,%	$CaCO_3$, %	pH	EC, dS/m
0.97	0.22	3.59	8.48	3.72
Soluble salts, milligram/L				
Ca	Mg	Na	K	CO_3
15.29	5.71	24.56	1.84	0.00
HCO_3	Cl	SO_4	SAR	N,
9.29	23.49	11.69	8.91	714.00

2.1.1. Sugar beet crop: Sugar beet crop "Jostaph" variety, mono-germ seeds were used in this investigation. Number of seeds planted by planter per feddan was 60 thousand (about 1.5 -2 kg/fed). Planted-seed spacing intra row of 14.5 cm and row spacing of 45 cm was used in this study.

3.1.2. Tractor: Tractor was used to operate and draw the tested inter-row cultivator. The specifications of this tractor are: Brand name: Fiat, 130-90DT model, rated engine power: 90 kW (120 hp), PTO speed: 1000 rpm, tire recommendation for 45 cm row spacing, 27 cm wide, 2 tires on the rear axle and 2 tires on the front axle.

2.1.3. Equipment:

(a) Land preparation steps and equipment: Irrigation + Chisel plow (9 shares) two passes + Moldboard plow 4 bottoms.

(b) Planter: French made; sugar beet planter was used in planting the experimental crop. The planter specifications, according to the manufacturer's operating manual, are as follows: brand name: Monosem, model: MECA V4 , mounted, No. of rows: 12, rows spacing: 45 cm, width: 610 cm, tested seed-spacing: 14.5 cm, seed size: coated seeds with size of 3.5 – 4.75 mm and seed depth of 1.5 - 2 cm.

(c) Inter-row cultivator: The tested precision inter-row cultivator (Super Crop Company; French made) consists of the parts shown in fig. 1: (1) Coulter spring adjustable by crank, (2) Easily adjustable units with pivoting clamps with one single nut, (3) Extra wide clamping no lateral play, (4) Ground clearance under toolbar (65 to 70 cm), (5) Stand delivered as standard equipment for easier linkage, (6) Unbeatable sturdiness with the 127 x 127 mm toolbar and the solid, heavy duty units, (7) Large parallelogram with individual looking catch for hitching up, (8) Tine brackets in high resistance steel, (9) 32 x 10 flexible tines with foot-duck shares (200 mm wide), (10) Long units help avoid packing up of earth in the tines, (11) Assembly of 1. 2 or 3 foot-duck shares according to working width with share spacing of 20 cm (maximum cultivation width of 25 cm), (12) Protection discs diameter 58 cm mounted on sealed ball bearings: No obstruction by hub on the plant side of disc, Instantly retractable into upper position with locking catch and Totally, independent so as to avoid stones or other obstacles, (13) Crank for rapid depth control adjustment, (14) Easy rolling depth control wheels (diameter 30 cm) very stable (width 10 cm): mounted on sealed ball bearing, equipped with self-cleaning tires, (15) Adjustable coulter angle by means of screw and (16) Stabilizer disc coulters (2 per machine): retractable, mounted on sealed ball bearing, in constant contact with the ground-adjustable spring.

(d) Sprayer: The trailed boom sprayer (Kuhn Blanchard Co., French made, model Atlantique) specifications: boom width: 24 m, sprayer mass: 2200 kg, tank capacity: 3200 Liter, water-cleaning tank: 300 Liter, mixer with 35 L size for powder and liquid chemicals, hydraulic agitator and pump: piston type of 15 bar with capacity 250 L.

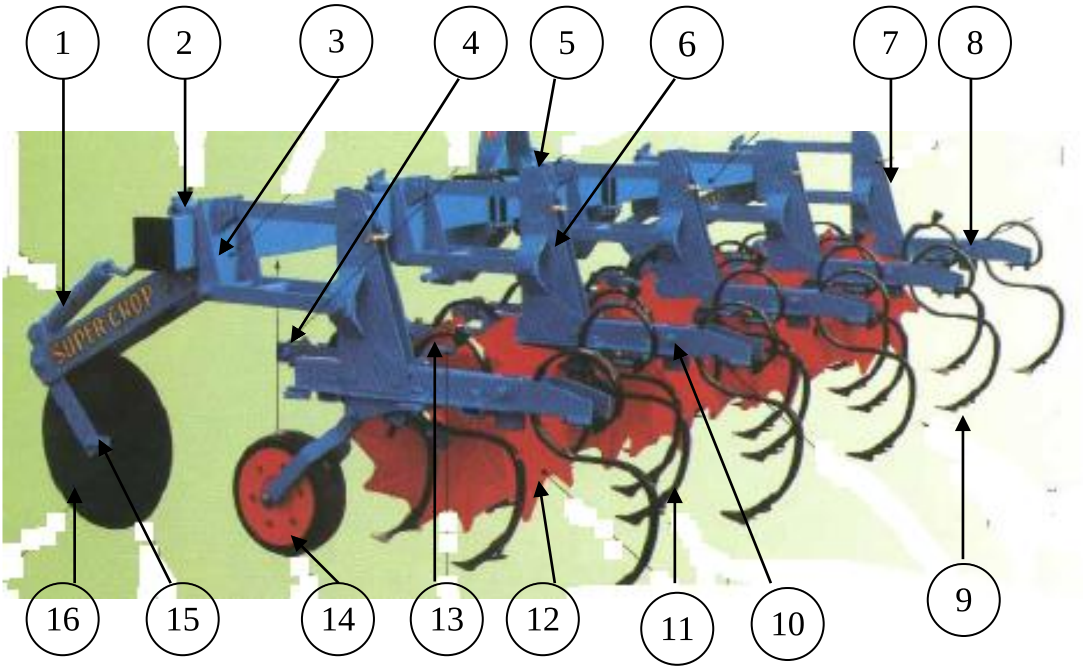


Fig. 1: The tested precision inter-row cultivator.

(1) Coulter spring adjustable by crank, (2) Easily adjustable units, (3) Extra wide clamping no lateral play, (4) Good ground clearance under toolbar, (5) Stand delivered as standard equipment for easier linkage, (6) Unbeaten sturdiness, (7) Large parallelogram with individual looking catch for hitching up, (8) Tine brackets, (9) Flexible tines with foot-duck shares, (10) Long units help avoid packing up of earth in the tines, (11) Assembly of the tine, (12) Protection discs mounted on sealed ball bearings: (13) Crank for rapid depth control adjustment, (14) Easy rolling depth control wheels: (15) Adjustable coulter angle by means of screw and (16) Stabilizer disc coulters.

(e) Center pivot irrigation specifications: Center pivot specifications were: 8" PVT point, 7 spans x 180 feet length 6 5/8" dia., over hang of 18 m length and 6 5/8” diameter, total length of 389 m and wetted area of 47 ha.

2-2 Methods:

2.2.1. Investigated parameters:

(1) Forward speeds: four forward-speeds of 4, 5, 6 and 7 km/h were tested.

(2) Number of shares: three numbers of shares of 1, 2 and 3 were tested. Fig. 2 shows the arrangement of cultivation duck-foot shares in cultivation area. Also, the same figure shows the tested row-spacing, intra-row spacing (plant spacing in the same row), and number of shares, share width and safety-band width.

(3) Weed intensity: without weed, low (< 20 weed/m^2), moderate (20 - 30 weed/m^2), high (30 - 40 weed/m^2) and very high (> 40 weed/m^2) weed intensities were tested.

2.2.2. Measurements:

(a) Soil mechanical and chemical-analysis: Seven random samples were taken to determine soil mechanical and chemical analysis using the hydrometer method.

(b) Cultivation efficiency: Cultivation efficiency using inter-row cultivator was calculated according to the following equation:

$$\eta c = \frac{Wa}{Wb} \times 100 \qquad \text{----------------------------} \quad (1)$$

Where: ηc: Cultivation efficiency by inter-row cultivator, %, Wb = Number of weeds in the cultivation area before cultivation and Wa = Number of weeds in the cultivation area after cultivation.

(c) Sugar-beet plant damage percent: Mechanical damage of sugar-beet plants using inter-row cultivator was calculated according to the following equation:

$$MD = \frac{Nd}{Nt} \times 100 \qquad \text{----------------------------} \quad (2)$$

Where: MD: mechanical damage of sugar-beet plants using inter-row cultivator “%”, Nt = total number of sugar-beet plants and Nd = Number of damaged sugar-beet plants caused by inter-row cultivator.

(d) Effective field capacity: Four speeds were used during the field experiments. Times were recorded for the following operations: cultivation; turning; and adjusting to calculate field capacity by using the equation.

$$F.C_{ef} = \frac{60}{\text{Total time}} \quad \text{fed./h} \qquad (3)$$

Where: $F.C_{ef}$ = Effective field-capacity, “fed/h” and

Total time, “min/fed” = cultivation time + turning time + adjusting time

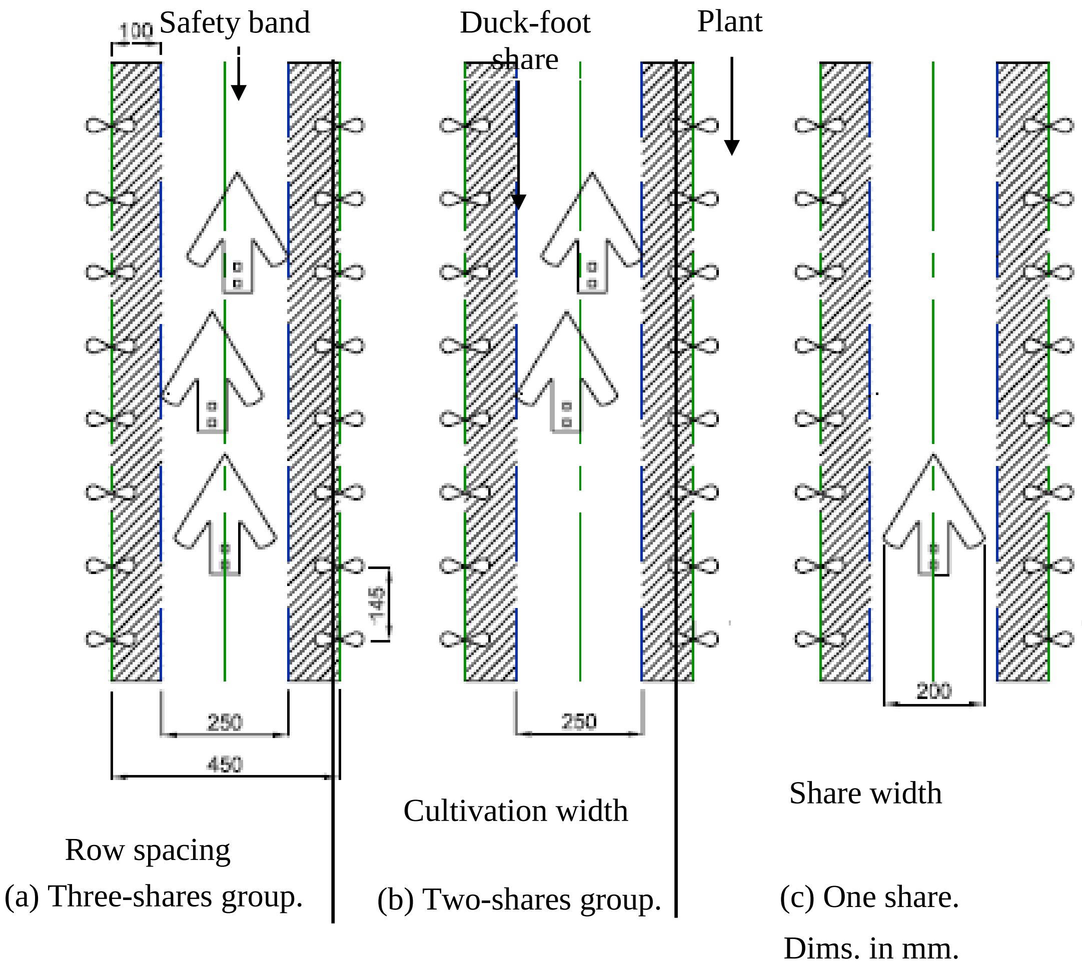


Fig. 2: Tested row spacing, intra-row spacing (plant spacing in the same row), number of shares, share width and safety-band width.

(e) Field efficiency: Field efficiency was calculated using the following equation:

$$\eta_f = \frac{F.C._{act.}}{F.C._{th.}} \times 100 \ \ \% \qquad (4)$$

Where: η_f = Filed efficiency, %, $F.C._{act.}$ = Effective field-capacity, fed./h and $F.C._{th.}$ = Theoretical field-capacity, fed./h.

(f) Root yield: The yield (R_Y) of the roots was determined using the following equation (Taieb, 1997) was used:

$$R_Y\,(ton\,/\,fed) = \frac{M \times 4200}{A \times 1000} \quad \text{---------------------------} \ (5)$$

Where: M = mass of lifted root "kg" and A = harvested area "m²".

(g) Fuel consumption: Fuel consumption was recorded by accurately measuring the decrease in fuel level in the fuel tank immediately after executing each operation of 15 minutes.

(h) Required power: Required fuel-power was estimated by using the following formula (Hunt, 1983):

$$P = F_c \times F_d \times \left(\frac{1}{3600}\right) \times C.V. \times 4270 \times \eta_{th} \times \eta_m \quad \text{-------------} \ (6)$$

$$P = 3.23\ F_c \quad \text{---------------------------} \ (7)$$

Where: P = required power "kW", F_c = fuel consumption 'L/h",
F_d = density of fuel "kg/L" (= 0.85 for diesel fuel),
C.V. = calorific value of fuel "kcal/kg" = 10^4 for diesel fuel, η_{th} = Thermal efficiency of fuel, it is assumed about 35 % for diesel engine and η_m = Mechanical efficiency of fuel, it is assumed about 80 % for diesel engine.

(i) Specific energy: Specific energy can be calculated by using the following equation:

$$Specific\ \ energy\,(kW.h\,/\,fed.) = \frac{Required\ \ power\ \ (kW)}{Actual\ \ field\ capacity\ (fed./h)} \quad \text{------} \ (8)$$

(i) Cost analysis: The operational cost by Egyptian pound per feddan was calculated according to leasing of field, equipment, irrigation, seeds, chemicals, fertilizers and labors salary.

Cost per unit of production can be determined using the following equation:

$$\text{Cost per unit of production}\left(L.E./Mg\right)=\frac{Operational\cos t\left(L.E./\ fed.\right)}{Root\ yield\left(Mg/\ fed\right)} \quad \text{-- (9)}$$

3- RESULTS AND DISCUSSION

3-1 Effect of forward speed, number of shares and weed intensity on cultivation efficiency.

Figs. 3 and 4 show the effect of forward speed, number shares and weed intensity on cultivation efficiency.

The maximum cultivation-efficiency of 100 % was obtained at forward speed of 4 km/h, number of shares of 3 and at low weed intensity (< 20 weed/m^2). Meanwhile, the minimum cultivation-efficiency of 58.7 % was obtained at forward speed of 7 km/h, number of shares of 1 and at very high weed intensity (> 40 weed/m^2).

(a) Effect of forward speed.

By increasing forward speed from 4 to 7 km/h the cultivation efficiency decreased by 25.13 % at all tested number of shares and weed intensities.

The decreasing of cultivation efficiency by increasing forward speed is due to decrease in the cultivation depth. The decreasing of cultivation depth does not uproot the weeds by duck-foot shares.

(b) Effect of number of shares.

By increasing number of shares from 1 to 2 the cultivation efficiency increased by 10.18 % at all tested forward-speeds and weed intensities.

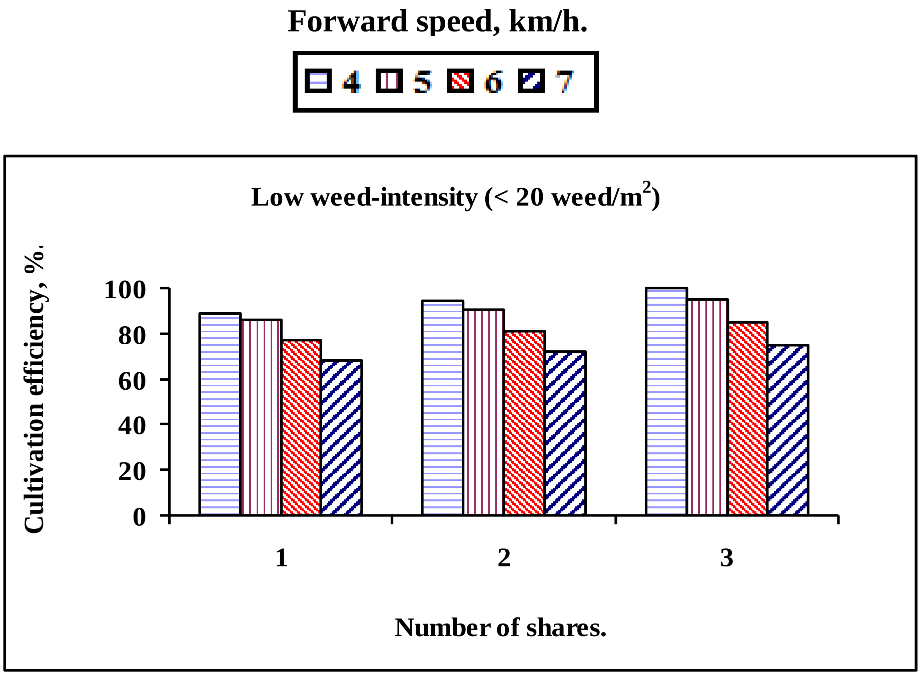
By increasing number of shares from 1 to 3 the cultivation efficiency increased by 15.93 % at all tested forward-speeds and weed intensities.

The increasing of cultivation efficiency by increasing number of shares is due to increasing the cultivation width.

(c) Effect of weed intensity.

Cultivation-efficiency ranges 68.2 – 100, 62.8 – 99.2, 61.5 98.1, 58.7 – 95.3 % were at low (< 20 weed/m^2), moderate (20 - 30 weed/m^2), high (30 - 40 weed/m^2) and very high (> 40 weed/m^2) respectively and all tested forward-speeds and number of shares.

The increasing of cultivation efficiency by decreasing weed intensity is due to increasing sugar-beet plants growing.



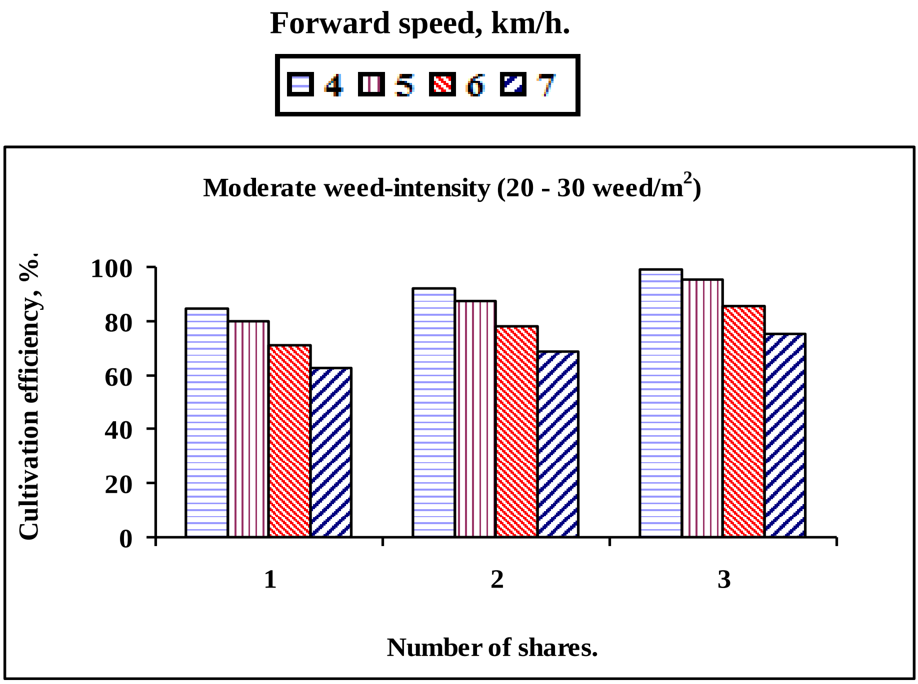


Fig. 3: Effect of forward speed, number shares on cultivation efficiency at low and moderate weed intensities.

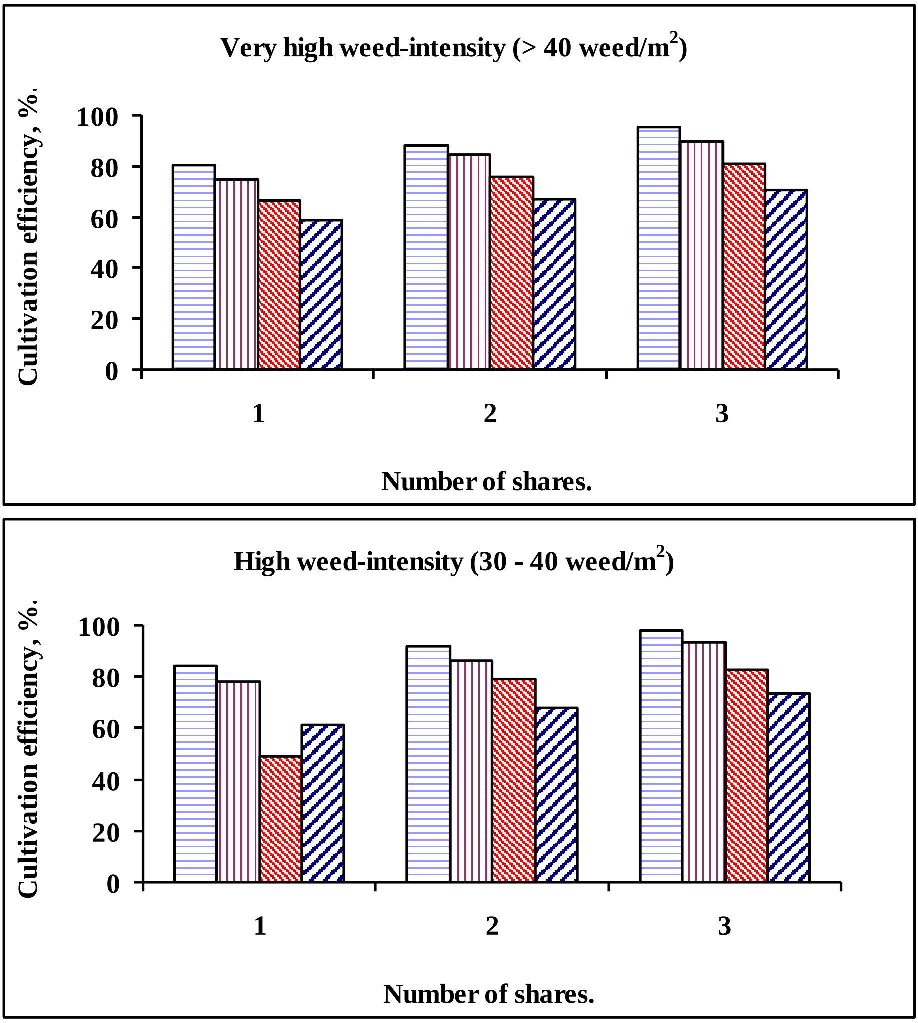


Fig. 4: Effect of forward speed, number shares on cultivation efficiency at high and very high weed intensities.

4-2 Effect of forward speed and number of shares on sugar-beet plant damage percent.

Fig. 5 shows the effect of forward speed and number shares on sugar-beet plant damage percent.

The maximum sugar-beet plant damage percent of 5.6 % was obtained at forward speed of 7 km/h and number of shares of 3. Meanwhile, the minimum sugar-beet plant damage percent of 0.69 % was obtained at forward speed of 4 km/h and number of shares of 1.

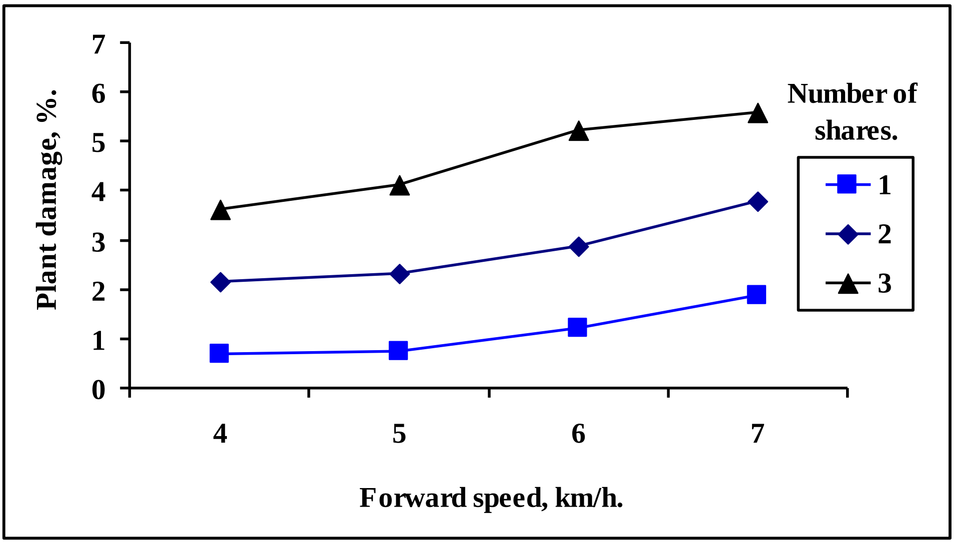


Fig. 5: Effect of forward speed, number shares on sugar-beet plant damage.

The increasing of sugar-beet plant damage by increasing forward speed is due to increasing the vibration of inter-row cultivator in the direction perpendicular to direction of motion. Meanwhile, the increasing of sugar-beet plant damage by increasing number of shares is due to increasing the cultivation width which increases the chance of contact of the shares with the sugar-beet plants.

3-1 Effect of forward speed, number of shares and weed intensity on sugar-beet root yield.

Figs. 6 and 7 show the effect of forward speed, number shares and weed intensity on sugar-beet root yield.

The maximum sugar-beet root yield of 35.5 ton/fed was obtained at forward speed of 4 km/h, number of shares of 3 and without weed. Meanwhile, the minimum sugar-beet root yield of 22.39 ton/fed was obtained at forward speed of 7 km/h, number of shares of 1 and at very high weed intensity (> 40 weed/m^2).

(a) Effect of forward speed.

By increasing forward speed from 4 to 7 km/h the sugar-beet root yield decreased by 15.31 % at all tested number of shares and weed intensities.

The decreasing of sugar-beet root yield by increasing forward speed is due to decreasing the cultivation efficiency and increasing of plant damage.

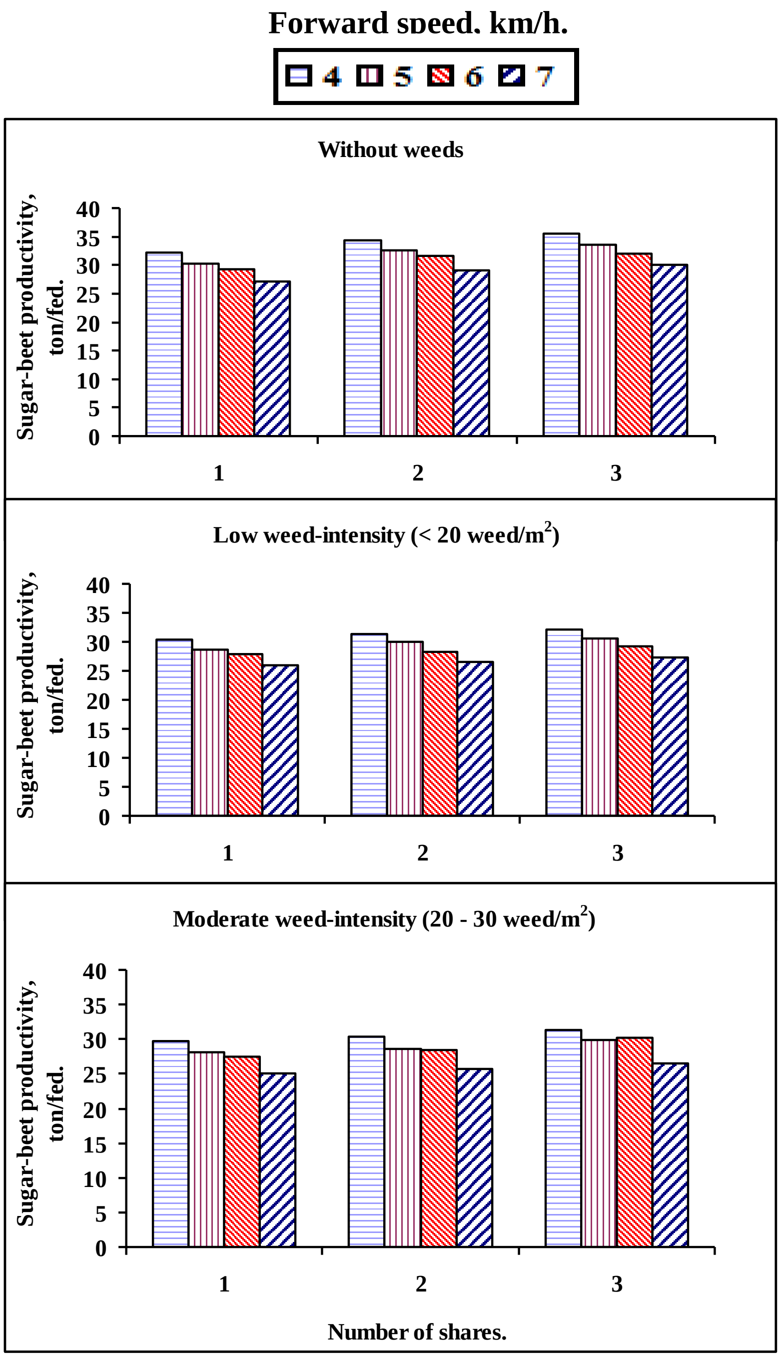


Fig. 6: Effect of forward speed, number shares on sugar-beet productivity without weed, at low and moderate weed intensity.

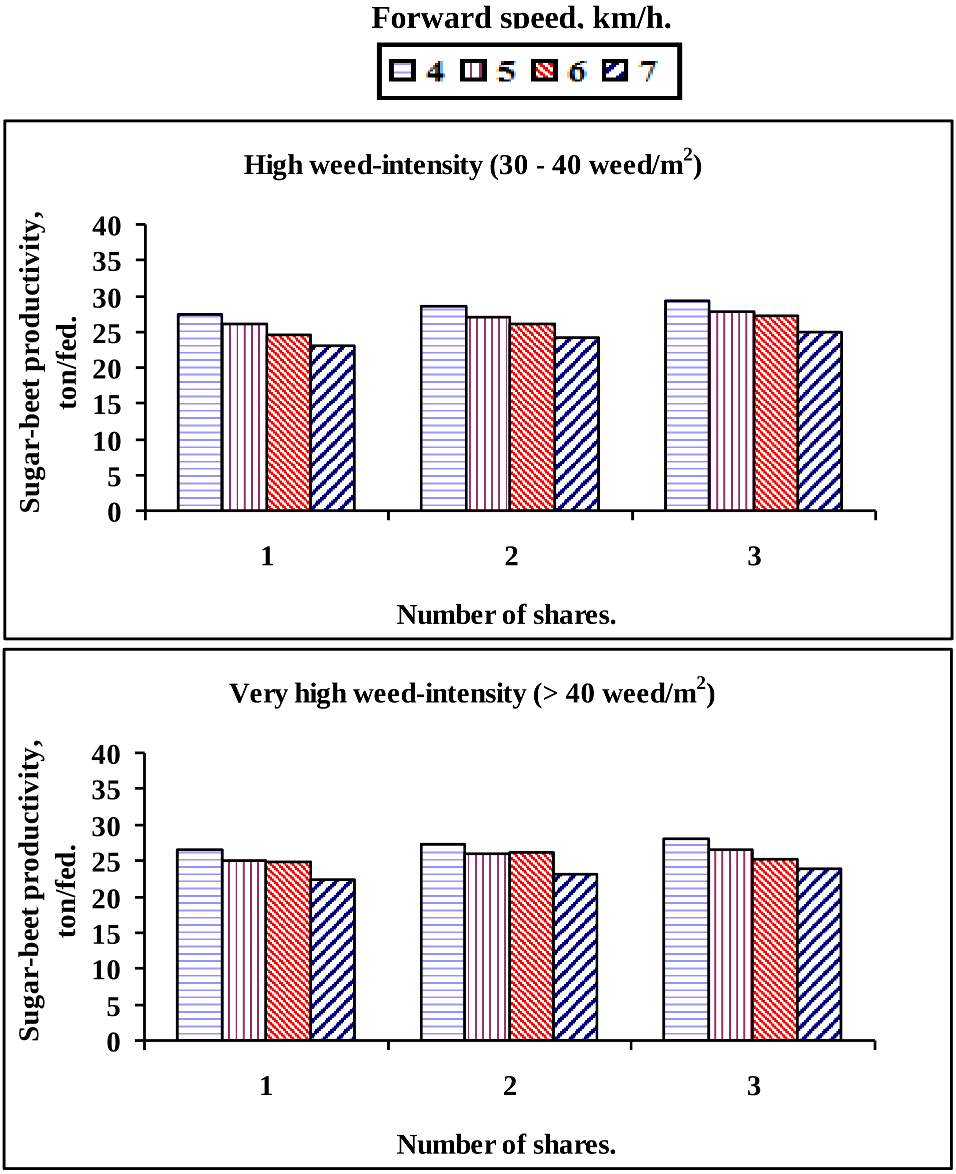


Fig. 7: Effect of forward speed, number shares on sugar-beet yield at high and very high weed intensity.

(b) Effect of number of shares.

By increasing number of shares from 1 to 2 the sugar-beet root yield increased by 4.15 % at all tested forward-speeds and weed intensities.

By increasing number of shares from 1 to 3 the sugar-beet root yield increased by 6.78 % at all tested forward-speeds and weed intensities.

The increasing of sugar-beet root yield by increasing number of shares is due to increasing the cultivation efficiency and decreasing plant damage.

(c) Effect of weed intensity.

Sugar-beet root yield ranges 27.21 – 35.5, 25.91 – 32.2, 25.1 – 31.4, 23.13 – 29.4 and 22.39 – 28.1 ton/fed were for without weed, low (< 20 weed/m^2), moderate (20 - 30 weed/m^2), high (30 - 40 weed/m^2) and very high (> 40 weed/m^2) respectively and all tested forward-speeds and number of shares.

The increasing of sugar-beet root yield by decreasing weed intensity is due to increasing the sugar-beet plants growing because of decreasing the competition between weeds and sugar-beet plants.

3-4 Effect of forward speed and number of shares on specific energy.

Fig. 8 shows the effect of forward speed and number shares on specific energy.

The maximum specific energy of 12.5 kW.h/fed was obtained at forward speed of 4 km/h and number of shares of 3. Meanwhile, the minimum specific energy of 7.7 kW.h/fed was obtained at forward speed of 7 km/h and number of shares of 1.

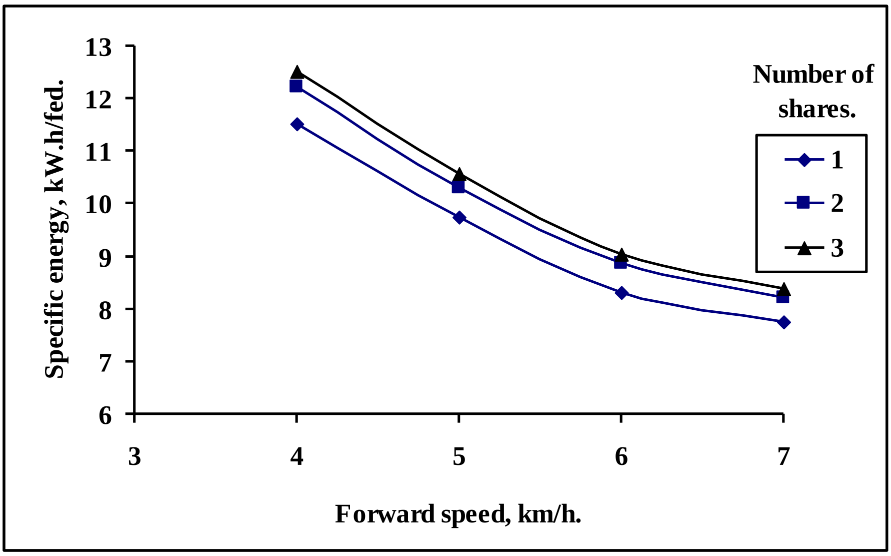


Fig. 8: Effect of forward speed and number of shares on specific energy.

3-5 Effect of forward speed on effective field-capacity and field efficiency.

Fig. 9 shows the effect of forward speed and number shares on effective field-capacity and field efficiency of inter-row cultivator.

The maximum effective field-capacity of 8.71 fed/h was obtained at forward speed of 7 km/h. Meanwhile, the minimum effective field-capacity of 5.04 fed/h was obtained at forward speed of 4 km/h.

The maximum field efficiency of 90.5 % was obtained at forward speed of 4 km/h. Meanwhile, the minimum field efficiency of 84.3 % was obtained at forward speed of 7 km/h.

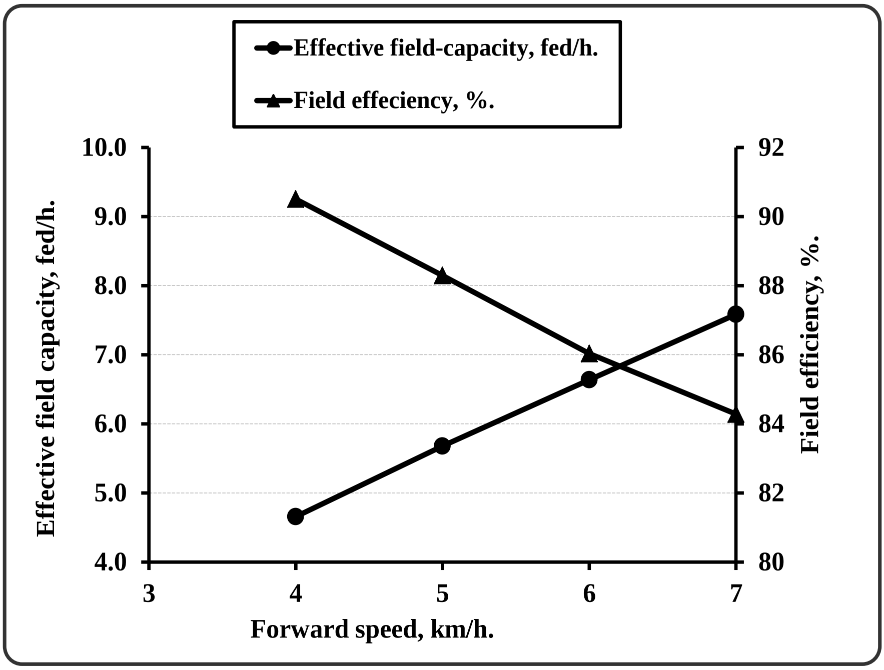


Fig. 9: Effect of forward speed on effective field-capacity and field efficiency of inter-row cultivator.

3-6 Effect of number of shares and weed intensity on operation and production costs.

Table 3 shows that the real costs for sugar beet production was 11589 L.E./fed. Meanwhile, the sugar beet production cost with company subsidize was 10201 L.E./fed.

Table 3: Production costs "L.E./fed" for sugar beet.

Items	Production costs, L.E./fed.	
	Real	With company subsidize
Lease	5000	5000
Seeds	1728	720
Labor	300	300
Fertilizers	2326	2326
Chemicals	610	610
Land preparation	80	80
Spreader	75	75
Sprayer	90	90
Leveling machine	60	1000
Planter	100	
Inter row cultivator	60	
Harvesting	1100	
Loading	60	
Total cost	11589	10201

Table 4 shows the effect of forward speed and number of shares on production costs and net profit at optimum inter-row cultivator forward speed of 4 km/h.

The maximum production costs of 317, 337, 343, 372 and 385 L.E./ton were obtained without weed, low, moderate, high and very high weed-intensity respectively and using forward speed of 4 km/h and number of shares of 1. Meanwhile, the minimum production-costs of 287, 317, 325, 347 and 363 L.E./ton were obtained without weed, low, moderate, high and very high weed-intensity respectively and using forward speed of 4 km/h and number of shares of 3.

The maximum profits of 5774, 4289, 3929, 3029 and 2444 L.E./fed were obtained without weed, low, moderate, high and very high weed-intensity respectively and using forward speed of4 km/h and number of shares of 3. Meanwhile, the minimum profits of 4289, 3434, 3164, 2129 and 1724L.E./fed were obtained without weed, low, moderate, high and very high weed-intensity respectively and using forward speed of 4 km/h and number of shares of 1.

Table 4: Production costs and net profits using optimum inter-row cultivator speed of 4 km/h at different numbers of shares.

Weed density	Number of share	Yield, Ton/fed.	Production cost, L.E./fed.	Production cost, L.E./ton.	Total income, L.E./fed.	Net profit, L.E./fed
Without weed	1	32.2	10201 (with company subsidize)	317	14490	4289
	2	34.4		297	15480	5279
	3	35.5		287	15975	5774
Low < 20 weed/m^2	1	30.3		337	13635	3434
	2	31.4		325	14130	3929
	3	32.2		317	14490	4289
Moderate 20 - 30 weed/m^2	1	29.7		343	13365	3164
	2	30.3		337	13635	3434
	3	31.4		325	14130	3929
High 30 - 40 weed/m^2	1	27.4		372	12330	2129
	2	28.6		357	12870	2669
	3	29.4		347	13230	3029
Very high > 40 weed/m^2	1	26.5		385	11925	1724
	2	27.3		374	12285	2084
	3	28.1		363	12645	2444

Sugar-beet roots price = 450 L.E./ton.

4- CONCLUSION

It is concluded that using the tested inter-row cultivator with forward speed of 4 km/h and number of shares of three which gave the cultivation efficiencies of 100, 100, 99.2, 98.1 and 95.3 %, plant damage of 0.69 %, sugar-beet yields of 35.5, 32.2, 31.4, 29.4 and 28.1 ton/fed, specific energy of 12.5 kW.h/ton, production costs of 317, 325, 347 363 L.E./ton, and net profits of 4289, 3929, 3029 and 2444 L.E./fed at weed intensities of low (< 20 weed/m^2), moderate (20 - 30 weed/m^2), high (30 - 40 weed/m^2), and very high (> 40 weed/m^2),

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الملخص العربي

تطوير عملية العزيق الآلى لمحصول بنجر السكر

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تهدف الدراسة إلى تطوير عملية العزيق الآلى بين خطوط بنجر السكر في المشاريع العملاقة. وتم دراسة العوامل الآتية: السرعة الأمامية لآلة العزيق بين الخطوط وهى ٤، ٥، ٦، ٧ كم/ساعة، عدد أسلحة وحدة العزيق وهى: ١، ٢، ٣ أسلحة، كثافة الحشائش وهى: بدون، منخفضة "< ٢٠"، متوسطة "٢٠ – ٣٠"، مرتفعة "٣٠ – ٤٠"، مرتفعة جداً " > ٤٠" حشيشة/م^{٢}.

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وكانت أهم النتائج المتحصل عليها هى كالتالى:

(١) **كفاءة العزيق:** تم الحصول على أعلى كفاءة عزيق ١٠٠ % عند سرعة أمامية لآلة العزيق ٤ كم/ساعة، وعدد ٣ أسلحة لوحدة العزيق، كثافة حشائش منخفضة "< ٢٠ حشيشة/م^{2}". بينما تم الحصول على أقل كفاءة عزيق ٥٨.٧ % عند سرعة أمامية لآلة العزيق ٧ كم/ساعة، وسلاح واحد لوحدة العزيق ، كثافة عزيق مرتفعة جداً "> ٤٠ حشيشة/م^{2}".

(٢) **تلف النباتات:** تم الحصول على أعلى تلف نباتات بنجر السكر ٥.٦ % عند سرعة أمامية لآلة العزيق ٧ كم/ساعة، وعدد ٣ أسلحة لوحدة العزيق، بينما تم الحصول على أقل تلف نباتات بنجر السكر ٠.٦٩ % عند سرعة أمامية لآلة العزيق ٤ كم/ساعة، وبإستخدام سلاح واحد لوحدة العزيق.

(٣) **إنتاجية درنات بنجر السكر:** تم الحصول على أعلى إنتاجية درنات بنجر السكر ٣٥.٥ طن/فدان عند سرعة أمامية لآلة العزيق ٤ كم/ساعة، وعدد ٣ أسلحة لوحدة العزيق، وبدون حشائش. بينما تم الحصول على أقل إنتاجية درنات بنجر السكر ٢٢.٣٩ طن/فدان عند سرعة أمامية لآلة العزيق ٧ كم/ساعة، وبإستخدام سلاح واحد لوحدة العزيق، كثافة عزيق مرتفعة جداً "> ٤٠ حشيشة/م^{2}".

(٤) **الطاقة النوعية:** تم الحصول على أعلى طاقة نوعية ١٢.٥ كيلووات.ساعة/فدان عند سرعة أمامية لآلة العزيق ٤ كم/ساعة، وعدد أسلحة لوحدة العزيق ٣، كثافة عزيق منخفضة "< ٢٠ حشيشة/م^{2}". بينما تم الحصول على أقل طاقة نوعية ١٢.٥ كيلووات.ساعة/فدان، ٧.٧ كيلووات عند سرعة أمامية لآلة العزيق ٧ كم/ساعة، وعدد أسلحة لوحدة العزيق سلاح واحد، كثافة عزيق مرتفعة جداً "> ٤٠ حشيشة/م^{2}".

(٥) **السعة الحقلية الفعلية والكفاءة الحقلية:** تم الحصول على أعلى سعة حقلية فعلية ٧.٦ فدان/ساعة عند سرعة أمامية لآلة العزيق ٧ كم/ساعة. بينما تم الحصول على أقل سعة حقلية فعلية ٤.٧ فدان/ساعة عند سرعة أمامية لآلة العزيق ٤ كم/ساعة. وتم الحصول على أعلى كفاءة حقلية ٩٠.٥ % عند سرعة أمامية لآلة العزيق ٤ كم/ساعة. بينما تم الحصول على أقل سعة حقلية فعلية ٨٤.٣ % عند سرعة أمامية لآلة العزيق ٧ كم/ساعة.

(٦) **تكاليف الإنتاج وصافى الربح:** تكاليف الإنتاج الفعلية لمحصول بنجر السكر المنزرع آلياً تحت الرى المحورى هى ١١٥٨٩ جنيه/فدان. بينما التكاليف بعد دعم شركة السكر هى ١٠٢٠١ جنيه/فدان.

تم الحصول على أعلى صافى ربح من إنتاج لمحصول بنجر السكر ٥٧٧٤، ٤٢٨٩، ٣٩٢٩، ٣٠٢٩، ٢٤٤٤ جنيه/فدان مع المساحات عديمة الحشائش، ذات كثافة الحشائش المنخفضة "< ٢٠ حشيشة/م^{٢}"، المتوسطة "٢٠ – ٣٠ حشيشة/م^{٢}"، المرتفعة "٣٠ – ٤٠ حشيشة/م^{٢}"، المرتفعة جداً "> ٤٠ حشيشة/م^{٢}" على الترتيب وباستخدام سرعة أمامية ٤ كم/ساعة وعدد أسلحة ٣. بينما تم الحصول على أقل صافى ربح من إنتاج لمحصول بنجر السكر ٤٢٨٩، ٣٤٣٤، ٣١٦٤، ٢١٢٩، ١٧٢٤ جنيه/فدان مع المساحات عديمة الحشائش، ذات كثافة الحشائش المنخفضة "< ٢٠ حشيشة/م^{٢}"، المتوسطة "٢٠ – ٣٠ حشيشة/م^{٢}"، المرتفعة "٣٠ – ٤٠ حشيشة/م^{٢}"، المرتفعة جداً "> ٤٠ حشيشة/م^{٢}" على الترتيب وباستخدام سرعة أمامية ٤ كم/ساعة وعدد أسلحة ١.