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EFFECT OF SOWING DATE AND INTERCROPPING PATTERN OF SUNFLOWER WITH SUGAR CANE ON STALK-ROT DISEASE, PRODUCTIVITY AND QUALITY

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ABSTRACT

One of the major problems in the Egyptian agricultural system is the severe shortage of edible oil production. Spring sugar cane area could provide a chance for farmers to use it for intercropping with oil crop such as sunflower in order to obtain additional income and help overcoming oil shortage. So, two field experiments were conduct at Mallawi Agric. Res. Station, El Minia–Egypt (latitude of 27.43° N & longitude of 30.50° E) during the seasons 2011/2012 and 2012/2013. The work aimed to study the effect of two intercropping dates (after cane harvest and after one month from the first date) and three cropping patterns of sunflower on the productivity and quality of cane and sugar yields in a split plot design.

The obtained results could be summarized as follows:

Seed yield/fed, of sunflower with sowing after cane harvest and remove crop waste was increased by 146.81 and 40.74% than sowing sunflower after one month from the first date in the two seasons, respectively. Sowing two rows of sunflower at 60 cm on sugar cane recorded increases in seed yield (ton/fed) by 30.00 and 7.06% in the 1st season and by 8.51 and 6.25% in the 2nd season compared with sowing one row of sunflower at 30 cm and sowing three rows of sunflower at 90 cm. respectively. The minimum stalk–rot disease of sunflower was recorded at sowing sunflower

with sugar cane after month from the first date with one row of sunflower at 30 cm.

Intercropping date and pattern of sunflower with sugar cane showed insignificant effect on yield and its components of sugar cane, i.e. stalk height, stalk diameter, number of stalks/ m^2, cane yield in both seasons and sugar yield in the 1st season. Also quality traits of cane juice such as total soluble solids, sucrose, purity and pol percentages, reducing sugars% and sugar recovery% in the two growing seasons were improved with the exception of reducing sugars % in the 2nd season only. The minimum stalk–rot disease of sugar cane was recorded at sowing sunflower on sugar cane after month from the first date with three rows of sunflower at 90 cm.

The Land Equivalent Ratio (LER) of sugarcane and sunflower the intercropping systems ranged between 1.28 to 1.81during 2011/2012season and between1.41 to 1.72 during 2012/2013 season. The highest values (±2.06 and ±1.83) of Aggressively (Agg) were negative (dominated) for sugarcane and positive (dominant) for sunflower in both seasons. The highest net profits were 8768.65 and 8003.75 LE/fed obtained by the intercropping patterns two rows of sunflower at 60 cm. in the 1st season and one row of sunflower at 30 cm on sugar cane in the 2nd season with sowing date after cane harvest and remove crop waste , respectively. From the obtained results intercropping two rows of sunflower at 60 cm or one row of sunflower at 30 cm on sugar cane with sowing date after cane harvest and remove crop waste could be recommended to reduce exhaustive competition between plants of sunflower and sugar cane for essential growth factors.

INTRODUCTION

One of the major problems in the Egyptian agricultural system is the severe shortage of edible oil production. Local production covered about 3-5% of the total need only. The concept of using sugar cane in intercropping is world wide adapted long time ago and is still accepted as a measure to increase farmer's income. Sunflower has become the third most important of annual oil crops in the world due to large part from the efforts of plant breeders in improving seed yield, seed oil content and the adaptability of the varieties to a wide rang of climatic conditions. In Egypt, sunflower still cultivated in a small area in spite of the great shortage of edible oils. Sugarcane *(Saccharum officinarum L.)* produced approximately 51.9% of 1.9 million tons of local sugar

production in Egypt. Sugarcane plantation in Minia Governorate (nearly 38759 fed) is directed to sugar and treacle production as well as to the fresh use of cane juice (CCSC, 2012).Spring sugar cane area reach 30000 fed, this area could provide a chance for farmers to use it for intercropping with oil crop such as sunflower in order to obtain additional income and help overcoming oil shortage. Cane-sunflower intercropping system were examined by many workers, particularly in south East Asia countries where hand labor farming system are common. Most workers indicated that sunflower reduced cane yield compared to shorter crops such as legumes.

Several fungi were found to be associated with damping off and charcoal–rot of sunflower in Etay Elbaroud locality, Behera Governorate. These were *Phythium sp. Fusarium oxysporum, Rhizoctonia solani, Sclerotium rolfsii* and *Macrophomina phaseolina.* However, *Pythium sp.* was not able to incite any disease to sunflower in the pathogenicity tests while the other fungi incited pre- and post-emergence damping–off at different degrees. Meantime, charcoal-rot disease, as evident by the presence of black sclerotia in plant stem base, was only developed with *Macrophomina phaseolina.* These findings are in agreement with several reports in Egypt and other parts of the world. (El-Zarka 1976, Ibrahim 2006 and Bokor 2007). The RS+Urea compost, however, showed the lowest suppressive effect over the three intervals of asasessment but still significantly effective in checking the total developed disease on sunflower. These findings are in agreement with several reports on the disease suppressive effect of such rice based compost (Osunlaja, 1990). Gracha *et al.* (1997) reported that cane yield was reduced when intercropped with sunflower compared to short legumes. Singh and Chauhan (1998) revealed that intercropping sunflower with sugar cane decreased cane yield by 28.20 %. Muhammad *et al.* (1998) indicated that intercropping sunflower with sugar cane decreased cane yield by 7.50 %. They also reported a non-significant net income increased due to intercropping. El-Gergawi *et al.* (2000) indicated the minimum reduction in yield of sugar cane to be 7.41 tons when a single row of sunflower planted at 30 cm compared to sole cane that yielded 52.48

tons/fed. However, quality traits of sugar cane juice were not affected by intercropping. Sunflower yield was highly significantly reduced as a result of intercropping. Cane aggressiveness was higher on dense planting of two rows of sunflower. Misra (2003) found that intercropping sugar cane with other crops affected the incidence of wilt diseases (*Cephalosporium sacchari* or *Fusarium sacchria*). The role of allelochemicals released from the roots and other plants parts is noted.

Gadallah *et al.* (2006) showed that seed yield of sunflower increased by increasing number of intercropped sunflower ridges. So, intercropping system which including 100% sunflower recorded the highest value for sunflower seed yield, followed by 33% and 25% of its pure stand in a descending order. They reported that the pure stand gave higher yield than that sowing a rows soybean: 2 rows sunflower gave the highest yield compared to other intercropping patterns. Osman (2007) revealed that *Bipolaris spicifera*, *Fusarium moniliforme*, *Fusarium solani*, *Penicillium sp*, *phthium sp*, and *Rizoctonia solani* were isolated from roots and seed cuttings of sugar cane cultivars. *R. solani* and *F. moniliforme* gave thew highest frequency 28.33% frequency/stalk, root rot/wilted plants, while *F. solani* gave the lowest frequency 3.34% in this respect.

The present work was carried out to define precisely the competition effect of intercropping date and its patterns of sunflower on productivity, quality and profitability of sugar cane under Middle Egypt conditions.

MATERIALS AND METHODS

Two field experiments were conducted at Mallawi Agric. Res. Station, Minia Governorate, Egypt, (latitude of 27.43° N & longitude of 30.50° E) during 2011/2012 and 2012/2013 seasons to study the effect of two intercropping dates and three intercropping patterns of sunflower on the productivity, quality and profitability of sugarcane (third ratoon). Sugarcane variety namely G.T.54.9 (The commercial variety) and sunflower variety (Sakha 53) were used. A split-plot design with three replications was used. Sowing or cutting and

harvesting dates of sugar cane and sunflower crops are presented in Tables (1 and 2) as follow:

The main plots were two intercropping dates of sunflower with sugar cane (A):

A1-After cane harvesting and remove crop waste (first sowing date of sunflower with sugar cane).

A2- After one month from the first date (month from cane harvest and remove crop waste).

The sub-plots were occupied with the intercropping patterns of sunflower (B):

B1-Sugarcane + one row of sunflower at 30 cm (40% of pure stand of sunflower).

B2- Sugarcane + two rows of sunflower at 60 cm (40%of pure stand of sunflower).

B3- Sugarcane + three rows of sunflower at 90 cm (40%of pure stand of sunflower).

Table 1. Cutting and harvesting dates of sugarcane (third ratoon) during 2011/2012 and 2012/2013 seasons.

Crop	Cutting date	Grown cultivar	Harvesting date
2011/2012 season			
Sugarcane	15/1/2011	G.T. 54-9	18/1/2012
2012/2013 season			
Sugarcane	12/1/2012	G.T. 54-9	13/1/2013

Table 2. Sowing and harvesting dates of sunflower crops during 2011 and 2012 seasons.

Crop	Sowing dates	Grown cultivar	Harvesting dates
2011 season			
Sunflower	24 /1/2011(First sowing date)	Sakha 53	٣١/٥/2011
Sunflower	24/2/2011(Second sowing date)	Sakha 53	٢٥/٦/2011
2012 season			
Sunflower	21/1/2012 (First sowing date)	Sakha 53	٢٨/٥/2012
Sunflower	21/2/2012 (Second sowing date)	Sakha 53	٢٦/٦/2012

Note: This cultivar from new sunflower cultivars which grown during the different year seasons.

Plot area was 25 m^2 it consisted of 5 ridges, 5 m length x 1 m width. Sugar cane was planted in ridges, one meter apart. Pure stand of sunflower was planted with recommended (plant density 35000/fed). Intercropped sunflower with sugar cane was planted in hills 30, 60 and 90 cm of one, two and three rows (plant density 14000/fed). Phosphorus fertilizer was added in the form of calcium super-phosphate (15.5% P_2O_5) at the rate of 100 kg/fed, which was broadcasted after ridging in furrows after sowing sunflower and before irrigation. Recommended fertilization of 45 kg N/fed, in the form of urea (46% N) was applied in two equal does before each of the second and the third irrigations. The plants were thinned to one plant/hill before the second irrigation. Potassium fertilizer was added as potassium sulphate (48% K_2O) at the rate of 48 kg/fed after full emergence for the third ratoon after harvesting sunflower. Nitrogen fertilizer was added as urea 46% nitrogen at the rate of 210 kg/fed in two equal doses as side dressing in cane rows, the first one after harvesting sunflower and one month later. All the required agricultural practices were done as followed by sugarcane growers in the region. Some chemical and physical properties of the soil of the experimental site were determined before seed bed preparation according to the procedures outlined by Jackson (1967). The physical analysis of the soil of experimental site showed that the soil was silty clay loam. Its chemical analysis cleared that the soil contained 22.2 and 20.25 ppm N, 9.50 and 8.65 ppm P, 185 and 190 ppm K with pH of 8.10 and 8.00 in the 1st and 2nd season, respectively .

The recorded data:

A. Sunflower: At harvest time, ten guarded plants were taken at random from each plot to study yield and its components: plant height (cm.), no. of leaves/plant, head diameter (cm.), stem diameter (cm.) measured at the third internode above the soil surface level. Also, weight of head (g), weight of seed/head (g) shilling%, weight of 100 seeds (g) and seed yield/fed were calculated from central ridges of each experimental unit and then transformed to ton/fed. Stalk-rot %= Infected plants number X 100/total plants number according to Osunlaja, (1990).

B. Sugar cane: At harvest time 20 guarded plants of sugarcane were harvested at age of 12 months from each plot to estimate the following traits:

The average percentages of disease incidence were calculated as the number of rotted sugar cane plant relative to the total number of examined plants.

Stalk height (cm): It was measured from soil surface to the top visible dewlap, stalk diameter (cm): It was measured at the middle part of the stalk, stalk weight (kg), number of stalks/m^2 was counted. Total soluble solids percentage (TSS%), was determined using "Brix hydrometer" standardized at 20 C0 according to A.O.A.C. (2005), sucrose % was determined using "Sacharemeter" according to A.O.A.C. (2005). Juice purity %, was estimated according to Satisha *et al.* (1996) using the following equation:

Purity %= sucrose % x 100 / TSS %. Pol % of cane stalks was calculated using the following equation, after the determination of sucrose % in the cane juice, according to Satisha *et al.* (1996):

Pol % = {Brix % – (Brix %- sucrose %) 0.4} 0.73, sugar recovery% (rendment) which was calculated using the following equation according to Satisha *et al.* (1996).

Sugar recovery % = {Pol %-0.8/Purity % juice x Purity % juice – 40/100-60}x 100. Reducing sugars of cane juice was determined according to A.O.A.C. (2005).

Millable cane yield (ton/fed): cane stalks of the guarded rows were harvested at age of 12 months, topped, cleaned, weighed and cane yield was calculated as ton/fed. Recoverable sugar yield (ton/fed), was estimated according to the following equation reported by Mathur (1981):

Recoverable sugar yield (ton/fed) = millable cane yield (ton/fed) x rendement and stalk-rot % = Infected stalks number X 100/total stalks number according to Osman (2007).

C. Competitive relationships and yield advantage: This study included the calculation of:

1- Land Equivalent Ratio (LER) according to Willey (1979).

$$LER = \frac{yab}{yaa} + \frac{yba}{ybb}$$

Where: yaa= pure stand yield of species a
ybb= pure stand yield of species b
yab= mixture yield of a (when combined with b)
yba= mixture yield of b(when combined with a)

2- Relative crowding coefficient (RCC) according to Hall (1974).

$$K = k_{ab} \times k_{ba}$$

Where: $k_{ab} = (Y_{ab} \times z_{ba}\ \%) / (Y_{aa} - Y_{ab}) \times z_{ab}\ \%$

$k_{ba} = (Y_{ba} \times z_{ab}\ \%) / (Y_{bb} - Y_{ba}) \times z_{ba}\ \%$

Z_{ba} % = Area occupied by sugar cane Z_{ab} % = Area occupied by sunflower

3- Aggressivity (Agg) according to Mc-Gilchrist (1965).

$$A_{ab} = \frac{y_{ab}}{y_{aa} \times z_{ab}\%} - \frac{y_{ba}}{y_{bb} \times z_{ba}\ \%}$$

D- Economic analysis was carried out according to Nazir *et al.* (2002).

The proper statistical analysis of data was done according to Gomez and Gomez (1984). The differences between means of the studied treatments were compared using least significant difference (LSD) at 5% level.

RESULTS AND DISCUSSION

A. Sunflower:

Data in Tables (3 and 4) indicated that intercropping date had significant effects on stem diameter (cm.), head diameter (cm.), weight of head (g), weight of seeds/head (g), weight of 100 seeds (g) and seed yield/fed of sunflower in the two growing seasons , plant height (cm.) in the 1st season and shilling% in the 2nd season .

Table 3. Effect of sowing dates and intercropping patterns of sunflower with sugar cane on stalk- rot, sunflower yield and yield components during 2011 and 2012 seasons.

Sowing date (A)	Intercropping pattern (B)	Stalk-Rot percentage	Plant Height (cm)	No. of plant leaves	Stem meter (cm)	Head diameter (cm)	Wt. of Head (g)
2011 season							
A_1	B_1	7.24	191.00	26.33	2.17	21.20	133.70
	B_2	8.24	189.67	25.33	2.70	22.83	178.30
	B_3	9.48	187.00	26.00	2.43	22.90	175.70
Mean		**8.32**	**189.22**	**25.88**	**2.43**	**22.31**	**162.56**
A_2	B_1	5.38	158.33	24.00	1.48	13.03	72.50
	B_2	6.29	155.67	25.33	1.57	11.73	82.30
	B_3	7.38	142.33	27.00	1.29	10.20	72.10
Mean		**6.35**	**152.11**	**25.44**	**1.44**	**11.65**	**75.63**
Average of B	B_1	6.31	174.66	25.16	1.82	17.11	103.10
	B_2	7.26	172.67	25.33	2.13	17.28	130.30
	B_3	8.43	164.66	26.50	1.86	16.55	123.90
Overall mean		**7.33**	**170.66**	**25.66**	**1.93**	**16.98**	**119.09**
LSD at 0.05	A =	1.72	23.04	Ns	0.22	1.74	2.48
	B =	0.60	Ns	Ns	Ns	Ns	6.04
	AB=	0.84	Ns	Ns	Ns	Ns	Ns
Sole sunflower			193.70	26.50	2.50	21.80	268.00
2012 season							
A_1	B_1	6.71	165.00	20.87	1.53	17.00	112.67
	B_2	7.50	171.67	20.60	1.57	16.73	122.33
	B_3	8.31	164.50	20.33	1.51	17.60	119.00
Mean		**7.50**	**167.05**	**20.60**	**1.54**	**17.11**	**118.00**
A_2	B_1	4.49	169.67	20.60	1.29	14.83	78.67
	B_2	5.45	165.00	20.53	1.43	15.90	84.00
	B_3	6.61	165.00	18.87	1.51	16.13	78.33
Mean		**5.51**	**166.56**	**20.00**	**1.41**	**15.62**	**80.33**
Average of of B	B_1	5.60	167.33	20.73	1.41	15.91	95.67
	B_2	6.47	168.33	20.56	1.50	16.31	103.16
	B_3	7.46	164.75	19.60	1.51	16.86	98.66
Overall mean			**166.80**	**20.30**	**1.47**	**16.36**	**99.16**
LSD at 0.05	A=	0.29	Ns	Ns	0.17	1.00	2.48
	B =	0.20	Ns	Ns	Ns	Ns	2.72
	AB=	NS	Ns	Ns	Ns	Ns	Ns
Sole sunflower			228.00	26.10	2.71	20.30	168.30

A_1= after cane harvest directly. A_2= after one month from cane harvest.
B_1=one row of sunflower at 30 cm. B_2= Two rows of sunflower at 60 cm.
B_3= Three rows of sunflower at 90 cm.

Table 4: Effect of sowing dates and intercropping patterns of sunflower with sugar cane on sunflower yield and yield components during 2011 and 2012 seasons.

Sowing Date (A)	Intercropping pattern (B)	Wt. of seed Head (g)	Shelling%	100-seeds Wt (g)	Seed yield ton/fed
2011 season					
A_1	B_1	100.50	54.33	5.63	0.97
	B_2	95.67	54.33	6.00	1.28
	B_3	40.61	54.33	6.37	1.24
Mean		**78.92**	**54.33**	**6.00**	**1.16**
A_2	B_1	40.61	56.00	2.67	0.43
	B_2	48.51	59.33	2.67	0.54
	B_3	41.31	58.33	2.77	0.45
Mean		**43.47**	**57.88**	**2.70**	**0.47**
Average of B	B_1	70.55	55.16	4.15	0.70
	B_2	72.09	56.83	4.33	0.91
	B_3	40.96	56.33	4.57	0.84
Overall mean		**61.19**	**56.10**	**4.35**	**0.81**
LSD at 0.05	A=	20.26	Ns	0.25	0.19
	B=	4.68	1.25	0.27	0.12
	AB=	6.62	1.77	Ns	Ns
Sole sunflower		154.70	55.70	5.70	1.36
2012 season					
A_1	B_1	60.63	54.00	5.37	1.10
	B_2	65.07	53.00	5.57	1.19
	B_3	62.90	52.67	5.33	1.14
Mean		**62.87**	**53.22**	**5.42**	**1.14**
A_2	B_1	43.60	55.33	4.53	0.79
	B_2	46.83	56.00	4.63	0.85
	B_3	42.80	54.67	4.77	0.78
Mean		**44.41**	**55.33**	**4.64**	**0.81**
Average of of B	B_1	52.11	54.66	4.95	0.94
	B_2	55.95	54.50	5.10	1.02
	B_3	52.85	53.67	5.05	0.96
Overall mean		**53.64**	**54.27**	**5.03**	**0.97**
LSD at 0.05	A=	3.30	2.08	0.21	0.06
	B=	1.33	Ns	Ns	0.02
	AB=	Ns	Ns	0.20	Ns
Sole sunflower		92.00	5.80	5.80	1.37

A_1= after cane harvest directly. A_2= after one month from cane harvest.
B_1=One row of sunflower at 30 cm. B_2= Two rows of sunflower at 60 cm.
B_3= Three rows of sunflower at 90 cm.

On the contrary, number of leaves/plant of sunflower was not significantly affected by intercropping date in the two growing

seasons. The higher values of all previous characters were recorded with sowing sunflower after cane harvest directly in both seasons except shilling% which was higher with sowing sunflower after one month from cane harvest. Seed yield/fed with sowing sunflower after cane harvest (A1) was increased by 146.81 and 40.74 % than sowing sunflower after one month from the first date (A2) in the two seasons, respectively.

The seed yield/fed of sunflower for sowing after cane harvest (A1) was higher than sowing after one month from the first date (A2) which might be due to the increase in head diameter (cm.), weight of head (g), weight of seed/head (g) ,weight of 100 seeds (g) . Shortage occurred as a result delay cultivate sunflower on cane after one month from the first date may be due to the lack of lighting and shading resulting from the growth of cane plants . Similar results were reported by Paul and Thompson (1982) and Pena *et al.* (1989).

Results in Tables (3 and 4) indicated that intercropping patterns had significant effect on weight of head, weight of seeds/head, and seed yield/fed of sunflower in the two growing seasons, shilling% and weight of 100 seeds of sunflower in the 1st season only. Sowing two rows of sunflower at 60 cm recorded an increase in seed yield ton/fed by 30.00 and 7.06 % in the 1st season and by 8.51 and 6.25% in the 2nd season than sowing one row of sunflower at 30 cm and sowing three rows of sunflower at 90 cm on sugar cane, respectively. The increase in seed yield/fed of sunflower for sowing two rows of sunflower at 60 cm on sugar cane might be due to the increase in weight of head, weight of seed/head and weight of 100 seeds . It might be due to less competition among sunflower rows and between sunflower and sugarcane plants. The other patterns gave lower yield that might be due to closely spaced rows of sunflower which create competition among sunflower plants for nutrients and sunlight which resulting in less vigorous plants with smaller heads. Similar results were reported by Baloch (1991) and Malik *et al.* (1992.

Interaction effect between sowing dates (A) and intercropping patterns (B) of sunflower with sugar cane was not significant for all studied characters except wt. of seed/head and shelling% in the 1st

season and 100-seed weight in the 2nd season as shown in Table 1a and 1b. The minimum seed yield ton/fed was recorded at sowing sunflower on sugar cane after month from the first date with one row of sunflower at 30 cm in the 1st season and three rows at 90 cm of sunflower in the 2nd seasons. These findings revealed that the best intercropping system with respect to seed yield ton/fed appeared to be sowing sunflower on sugar cane after cane harvest and remove sugar cane waste with two rows of sunflower at 60 cm.

Concerning stalk–rot disease of sunflower, data in Tables (3) showed that intercropping date of sunflower on sugar cane had significant effects on stalk–rot disease in the two growing seasons. The higher value of sunflower stalk–rot disease was recoded for sowing sunflower after cane harvest and remove waste (A1) than sowing it after one month from the first date (A2). These findings are in agreement with several reports on the disease suppressive effect of such rice based compost (Osunlaja, 1990). Intercropping patterns of sunflower on sugar cane had significant effect on stalk–rot disease in the two growing seasons. Sowing three rows of sunflower at 90 cm on sugar cane recorded the highest value of stalk–rot disease of sunflower, followed by two rows of sunflower at 60 cm, and one row of sunflower at 30 cm. These findings are in agreement with El-Zarka, (1976); Ibrahim, (2006) and Bokor (2007). Interaction effect between sowing dates and intercropping patterns (AB) of sunflower on sugar cane was a significant for stalk–rot disease of sunflower in the 1st season only. The minimum stalk–rot disease of sunflower was recorded at sowing sunflower on sugar cane after month from the first date with one row of sunflower at 30 cm in the 1st season.

B. Sugar cane:

B.1. Yield and yield components of sugar cane.

The data in Table 5 showed that the effect of sowing date of sunflower with sugar cane was not significant on yield and its components of sugar cane , i.e. stalk height (cm), stalk diameter (cm), number of stalks/m^2 and cane yield (ton/fed) in both seasons as well as sugar yield (ton/fed) in the 2nd season .

Table 5: Effect of sowing dates and intercropping patterns of sunflower with sugar cane on stalk–rot, sugar cane yield and yield components during 2011/2012 and 2012/2013 seasons.

Sowing date (A)	Intercropping pattern (B)	Stalk-Rot%	Stalk height(cm)	Stalk diameter (cm)	Stalk weight (kg)	No .of stalks/m²	Sugar yield (ton/fed)	Cane yield (ton/fed)
2011/2012 season								
A1	B1	14.19	264.00	2.50	1.35	8.93	5.07	45.29
	B2	9.87	250.67	2.67	1.23	8.53	4.72	43.19
	B3	7.60	248.00	2.47	1.08	9.58	4.45	43.27
Mean		10.55	254.22	2.54	1.22	9.01	4.74	43.91
A2	B1	11.10	267.67	2.43	1.28	9.13	5.19	48.77
	B2	9.15	259.33	2.57	1.27	9.00	4.91	47.90
	B3	7.92	263.00	2.60	1.43	7.97	4.89	47.32
Mean		9.39	263.33	2.53	1.32	8.70	4.99	47.99
Average of B	B1	12.64	265.83	2.54	1.31	9.03	5.13	47.03
	B2	9.51	255.00	2.47	1.25	8.76	4.81	45.54
	B3	7.76	255.50	2.62	1.25	8.77	4.67	45.29
Overall mean		9.97	258.77	2.54	1.27	8.85	4.87	45.95
LSD0.05	A=	0.19	Ns	Ns	Ns	Ns	Ns	Ns
	B=	0.21	7.52	Ns	Ns	Ns	Ns	Ns
	AB=	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Sole sugar cane			266.00	2.40	1.40	10.40	5.64	49.70
2012/2013 season								
A_1	B_1	10.84	205.57	2.57	1.10	7.53	5.37	42.25
	B_2	9.35	244.47	2.60	1.30	6.87	5.57	38.20
	B_3	6.66	208.57	2.67	1.27	6.67	5.33	36.48
Mean		8.95	219.53	2.61	1.22	7.02	5.42	38.97
A_2	B_1	9.45	228.33	2.63	1.33	7.73	4.53	41.87
	B_2	7.39	222.80	2.63	1.27	7.33	4.63	41.33
	B_3	6.37	203.80	2.60	1.27	7.23	4.77	38.75
Mean		7.73	218.31	2.62	1.29	7.43	4.64	40.65
Average of B	B_1	10.14	216.95	2.60	1.21	7.63	4.95	42.06
	B_2	8.37	233.63	2.61	1.28	7.10	5.10	39.76
	B_3	6.51	206.18	2.63	1.27	6.95	5.05	37.61
Overall mean		8.34	218.92	2.61	1.25	7.22	5.03	39.81
LSD0.05	A=	Ns	Ns	Ns	Ns	Ns	0.21	Ns
	B=	0.38	Ns	Ns	Ns	Ns	Ns	2.83
	AB=	0.54	Ns	0.17	0.16	0.75	0.20	Ns
Sole sugar cane			242.00	2.60	1.30	8.40	5.70	46.20

A_1= after cane harvest directly. A_2= after one month from cane harvest.
B_1=One row of sunflower at 30 cm. B_2= Two rows of sunflower at 60 cm.
B_3= Three rows of sunflower at 90 cm.

The higher values of all the studied characters were scored from sowing sunflower after one month from the first date (A2) than sowing sunflower after cane harvesting and remove crop waste (A1). This result might be due to the delay in sowing date of sunflower permit the full emergence of sugar cane and higher level of competition with sunflower plants on space, light and nutrients.

The results in Table 5 revealed that intercropping patterns had no significant effect on yield and its components of sugar cane, i.e. stalk height (cm), stalk diameter (cm), stalk weight (kg), number of stalks/m^2, cane yield (ton/fed) and sugar yield (ton/fed) in both seasons, except stalk height in the 1st season and cane yield (ton/fed) in the 2nd season. Sowing row of sunflower at 30 cm on sugar cane recorded the highest value of cane yield (ton/fed) in both seasons .This finding might be due to sowing one row of sunflower at 30 cm on sugar cane contained the lowest competition of light and nutrients between cane plants and sunflower plants which achieved the best intercropping geometries. Similar findings were reported by El.Gergawi *et al.*(2000) .

Significant interaction effects between sowing dates (A) and intercropping patterns (B) of sunflower with sugar cane with regard to stalk diameter, stalk weight, number of stalks/m^2 and sugar yield were recorded in the 2nd season only as shown in Table 5. The highest values of sugar yield were 5.19 and 5.57 (ton/fed) were obtained by intercropping one row of sunflower at 30cm with planting sunflower after one month from cane harvest in the 1st season and two rows of sunflower at 60 cm with planting sunflower after cane harvest in the 2nd season. The difference in yield may attributed to the side effect on cane yield by intercropping. These results are in harmony with these of Garcha *et al.*(1997) and Singh and Chauhan (1998) who reported reduction on cane yield due to intercropping with sunflower. This finding indicate that under the high canopy conditions (intercropping) sugarcane plants failed to attain the highest profit from the available ecosystem such as light, nutrient and water compared with plants grown in pure stand which partially profited from environments.

Effect of sowing date and intercropping pattern of sunflower

Concerning stalk–rot disease of sugar cane, data in Tables 5 showed that intercropping date of sunflower on sugar cane had significant effect on stalk–rot disease in the 1st season. The higher value of sugar cane stalk–rot disease was recorded for sowing sunflower after cane harvesting than sowing it after one month from the first date. These results are in harmony with these of Osman (2007). Intercropping patterns of sunflower on sugar cane had significant effect on stalk–rot disease in the two growing seasons. Sowing three rows of sunflower at 90 cm on sugar cane recorded the lowest value of stalk–rot disease of sugar cane, followed by two rows of sunflower at 60 cm, while, intercropping one row of sunflower at 30 cm contained the highest value of stalk–rot disease of sugar cane. These findings are in agreement with Osman (2007). Interaction effect between sowing dates and intercropping patterns (AB) of sunflower on sugar cane was a significant for stalk–rot disease of sunflower in the 2nd season only. The minimum stalk–rot disease of sugar cane was recorded at sowing sunflower on sugar cane after month from the first date with three rows of sunflower at 90 cm in the 2nd season.

B.2. Juice quality of sugar cane.

Results in Table 6 demonstrated that sowing date of sunflower on sugarcane had insignificant effect on quality characters of cane juice such as total soluble solids (TSS%), sucrose%, purity%, pol%, reducing sugars % and sugar recovery% in the two growing seasons, except reducing sugars % in the 2nd season . This result might be due to that juice quality traits are the output of the late period of the growing season which constitute after the harvest of sunflower. Similar findings were obtained by Sarjit *et al.*(1999) and El-Gergawi *et al.*(2000).

With regard to intercropping patterns of sunflower with sugar cane , results in Table 6 pointed out that intercropping patterns of sunflower on sugarcane had insignificant effect on quality characters of cane juice such as total soluble solids %, sucrose%, purity%, pol%, reducing sugars % and sugar recovery% in the two growing seasons . Quality traits of sugar cane were not affected by intercropping patterns of sunflower because these traits are the output of the late part of

growing season after harvesting sunflower. These findings were in the same line with those reported by El-Grgawi *et al.*(2000).

Table 6: Effect of sowing dates and intercropping patterns of sunflower with sugar cane on quality sugar cane during 2011/2012 and 2012/2013 seasons.

Sowing date (A)	Intercropping pattern (B)	TSS%	Sucrose%	Purity %	Pol %	Reducing Sugar %	Sugar recovery%
2011/2012 season							
A1	B1	21.17	17.73	83.77	14.43	0.40	11.83
	B2	20.50	16.90	82.31	13.90	0.40	11.24
	B3	19.67	16.53	84.07	13.43	0.42	11.04
Mean		**20.44**	**17.06**	**83.38**	**13.92**	**0.41**	**11.37**
A2	B1	21.33	18.17	84.97	14.65	0.37	12.89
	B2	22.67	18.80	84.17	15.28	0.40	12.66
	B3	21.00	17.67	84.67	14.37	0.40	11.83
Mean		**21.66**	**18.21**	**84.60**	**14.77**	**0.39**	**12.46**
Average of B	B1	21.25	17.95	84.37	14.54	0.38	12.36
	B2	21.58	17.85	83.24	14.59	0.40	11.95
	B3	20.33	17.10	84.37	13.90	0.41	11.43
Overall mean		**21.05**	**17.63**	**83.99**	**14.34**	**0.40**	**11.91**
LSD at 0.05	A=	Ns	Ns	Ns	Ns	Ns	Ns
	B=	Ns	Ns	Ns	Ns	Ns	Ns
	AB=	Ns	Ns	Ns	Ns	Ns	Ns
Sole sugar cane		20.50	17.00	82.90	13.90	0.42	11.34
2012/2013 season							
A1	B1	21.17	17.87	84.41	14.49	0.37	12.00
	B2	21.67	18.33	84.61	14.84	0.30	12.34
	B3	21.50	18.27	84.95	14.75	0.30	12.30
Mean		**21.44**	**18.15**	**84.65**	**14.69**	**0.32**	**12.21**
A2	B1	21.67	18.47	85.22	14.88	0.20	12.45
	B2	21.00	17.70	84.29	14.37	0.30	11.88
	B3	22.00	18.70	84.86	15.09	0.23	12.61
Mean		**21.55**	**18.29**	**84.79**	**14.78**	**0.24**	**12.31**
Average of B	B1	21.42	18.17	84.81	14.68	0.28	12.22
	B2	21.33	18.01	84.45	14.60	0.30	12.11
	B3	21.75	18.48	84.90	14.92	0.26	12.45
Overall mean		**21.50**	**18.22**	**84.72**	**14.73**	**0.28**	**12.26**
LSD at 0.05	A=	Ns	Ns	Ns	Ns	0.05	Ns
	B=	Ns	Ns	Ns	Ns	Ns	Ns
	AB=	0.68	Ns	Ns	0.50	Ns	Ns
Sole sugar cane		21.67	18.40	84.80	14.85	0.27	5.71

A_1= after cane harvest directly. A_2= after one month from cane harvest.
B_1=One row of sunflower at 30 cm. B_2= Two rows of sunflower at 60 cm.
B_3= Three rows of sunflower at 90 cm.

Effect of sowing date and intercropping pattern of sunflower

Significant interaction was found between sowing dates (A) and intercropping patterns (B) of sunflower on sugar cane with regard to TSS% and pol% of sugar cane in the 2nd season only as shown in Table 6. The highest values of TSS% were 22.67 and 22.00 % and pol% were 15.28 and 15.09% obtained by intercropping two rows of sunflower at 60 cm with sugar cane after one month from the first date in the 1st season and three rows of sunflower at 90 cm with planting sunflower after one month from the first date in the 2nd season respectively.

C. Competitive relationships.

Data in Table 7 revealed the values of competitive relationships and yield advantages for different sowing date of intercropping sunflower with sugar cane under three different patterns. The total LER of sugarcane and sunflower in intercropping system ranged between 1.28 to 1.81 during 2011/2012 and between 1.41 to 1.72 during 2012/2013. Relative crowding coefficient plays remarkable role in determining the competitive effects and intercropping advantages. It gives a measure of whether a species has produced more or less yield than the expected one. The results indicated that the RCC of all the sugarcane-sunflower intercropping patterns tested in the intercropping system produced yield advantages. The highest K value of 106.15 and 43.58 was obtained with intercropping two rows of sunflower at 60 cm. in the 1st season and one row of sunflower at 30 cm. in the 2nd season with sowing date after direct cane harvest, respectively.

The data in the previous Table showed that the highest values (±2.06 and ±1.83) of Aggressivity (Agg) were negative (dominated) for sugarcane and positive (dominant) for sunflower in an intercropping two rows of sunflower at 60 cm. in the 1st season and one row of sunflower at 30 cm in the 2nd season with sowing sunflower after cane harvesting and remove crop waste, respectively. This result might be due to the growth rate of sunflower was higher than sugar cane before harvest of sunflower. These results of competition relationship and yield advantage are in agreement with

those obtained by El-Gergawi *et al.* (1995), Zohry (2003) and Khakwani (2003).

Table 7: Competitive relationships and yield advantage for sowing dates and intercropping patterns of sunflower with sugar cane during 2011/2012 and 2012/2013seasons.

Sowing date (A)	Intercropping patterns(B)	Land equivalent ratio (LER) $L_C + L_S = ER$	Relative crowding coefficient (RCC) $K_C * K_S = K$	Aggressivity (Agg) A_C	A_S
2011/2012 season					
A1	B1	0.91 + 0.71 = 1.62	4.19 * 6.09 = 25.54	-1.20	+ 1.20
	B2	0.87 + 0.94 = 1.81	2.71 * 39.17 = 106.15	-2.06	+2.06
	B3	0.87 + 0.91 = 1.78	2.75 * 25.30 = 69.54	-1.95	+1.95
Mean		0.88 + 0.86 = 1.74	3.10 * 14.20= 44.07	-1.73	+1.73
A2	B1	0.98 + 0.31 = 1.29	21.42 * 1.13 = 24.25	+0.28	-0.28
	B2	0.96 + 0.40 =1.36	10.87 * 1.61 = 17.52	-0.03	+0.03
	B3	0.95 + 0.33 = 1.28	8.12 * 1.21 = 9.83	+0.19	-0.19
Mean		0.97 + 0.83= 1.80	11.53 * 1.29 = 14.91	+0.16	-0.16
Averages of B	B1	0.85 + 0.51 = 1.36	7.19 * 2.60 = 18.68	-0.46	+0.46
	B2	0.92 + 0.67 = 1.59	4.48 * 4.95 = 22.20	-1.04	+1.04
	B3	0.91 + 0.62 = 1.53	4.19 * 4.08 = 17.12	-0.90	+0.90
2012/2013 season					
A1	B1	0.92 + 0.80 = 1.72	4.37 * 9.97 = 43.58	-1.48	+1.48
	B2	0.83 + 0.86 = 1.69	1.95 * 16.19 = 31.57	-1.83	+ 1.83
	B3	0.79 + 0.83 = 1.62	1.53 * 12.13 = 18.60	- 1.76	+ 1.76
Mean		0.84 + 0.83 = 1.67	2.21 * 12.13 = 18.60	-1.68	+ 1.68
A2	B1	0.91 + 0.58 = 1.49	3.55 * 3.33 = 13.17	-0.71	+ 0.71
	B2	0.90 + 0.62 = 1.52	3.47 * 4.00 = 13.87	-0.88	+0.88
	B3	0.84 + 0.57 = 1.41	2.12 * 3.24 = 6.87	-0.78	+ 0.78
Mean		0.88 + 0.59 = 1.47	2.99 * 3.54 = 10.59	- 0.80	+ 0.80
Averages of B	B1	0.91 + 0.69 = 1.60	4.15 * 5.35 = 22.21	-1.09	+ 1.09
	B2	0.86 + 0.74 = 1.60	2.53 * 7.13= 18.03	- 1.36	+ 1.36
	B3	0.81+ 0.70 = 1.51	1.79 * 5.73 = 10.27	- 1.27	+1.27
LC:LER sugar cane e LS: LER Sunflower			KC :RCC Sugar cane K KS : RCC Sunflower	AC:AggSugarcane AS :Agg Sunflower	

A_1= after cane harvest directly. A_2= after one month from cane harvest.
B_1=One row of sunflower at 30 cm. B_2= Two rows of sunflower at 60 cm.
B_3= Three rows of sunflower at 90 cm.

D. Economical evaluation and net profit.

The economic benefits obtained from different intercropping planting patterns of sugarcane and sunflower was compared with the sole crop of sugarcane. The net profit from different treatments was worked out by subtracting the cost of production for each treatment from its gross profit. The data presented in Table 8 scored that the highest net profit were 8768.65 and 8003.75 LE/fed obtained by the intercropping patterns two rows of sunflower at 60 cm with sowing sunflower after cane harvest and remove crop waste in the 1st season and one row of sunflower at 30 cm with sowing sunflower after cane harvest and remove crop waste in the 2nd season, respectively .This is slightly higher than the net profit recorded from sole sugarcane crop. The lowest net profit was produced by the intercropping pattern, three rows of sunflower at 90cm with sowing sunflower after month from cane harvest in both seasons. These results confirm the findings of Kannappan *et al.* (1990) and Ahmad *et al.* (1993) reported that all the intercropping systems tested in these experiments failed to increase the net return over sole crop of sugarcane. The decrease in net return as a result of sunflower intercropping might be attributed to exhaustive competition between the component crops for essential growth factors.

According to the obtained results, it could be recommended to intercropping two rows of sunflower at 60 cm. or one row of sunflower at 30 cm on sugar cane with sowing date after direct cane harvest to reduce exhaustive competition between plants of sunflower and sugar cane for essential growth factors.

Table 8: Economic analysis of sowing date and intercropping patterns of sunflower with sugar cane during 2011/2012 and 2012/2013 seasons.

Sowing date (A)	Intercropping patterns (B)	Crop yield (ton/fed)		Income (LE/fed)		Total income (LE/fed)	Total expenditure (LE/fed)	Net profit (LE/fed)
		Sugarcane	Sunflower	Sugarcane	Sunflower			
2011/2012 season								
A1	B1	45.29	0.97	15172.15	2425	17597.15	8900	8697.15
	B2	43.19	1.28	14468.65	3200	17668.65	8900	8768.65
	B3	43.27	1.24	14495.45	3100	17595.45	8900	8695.45
Mean		43.91	1.16	14712.08	2908	17620.41	8900	8720.41
A2	B1	48.77	0.43	16337.95	1075	17412.95	8900	8542.95
	B2	47.90	0.54	16046.50	1350	17396.50	8900	8496.50
	B3	47.32	0.45	15852.20	1125	16977.20	8900	8077.20
Mean		47.99	0.47	16078.88	1183	17262.21	8900	8372.21
Overall mean		45.95	0.81	15395.48	2045	17441.31	8900	8546.31
Averages of B	B1	47.03	0.70	15755.05	1750	17505.05	8900	8605.05
	B2	45.55	0.91	15259.25	2275	177534.2	8900	8634.25
	B3	45.29	0.85	15172.15	2125	17297.15	8900	8397.15
Sole sunflower		-	1.36	--	3400	3400	2000	1400.00
Sole sugar cane		49.70	--	16649.50	--	--	8900	7749.50
2012/2013 season								
A1	B1	42.25	1.10	14153.75	2750	16903.75	8900	8003.75
	B2	38.20	1.19	12797.00	2975	15772.00	8900	6872.00
	B3	36.48	1.14	12220.80	2850	15070.80	8900	6170.80
Mean		38.97	1.14	13057.18	2858	15915.50	8900	7015.50
A2	B1	41.87	0.79	14026.45	1975	16001.45	8900	7101.45
	B2	41.33	0.85	13845.55	2125	15970.55	8900	7070.55
	B3	38.75	0.78	12981.25	1950	14931.25	8900	6031.25
Mean		40.65	0.80	13617.75	2016	15774.90	8900	6734.44
Overall mean		39.81	0.97	13337.46	2437	15845.20	8900	6874.90
Averages of B	B1	42.06	0.94	14090.10	2350	16440.10	8900	7540.10
	B2	39.77	1.02	13322.95	2550	15872.95	8900	6972.95
	B3	37.62	0.96	12602.70	2400	15002.7	8900	6102.70
Sole sunflower		--	1.37	--	3425	3425	2000	1425.00
Sole sugar cane		46.20	--	15477.00	--	15477	8900	6577.00

A_1= after cane harvest directly. A_2= after one month from cane harvest.
B_1= one row of sunflower at 30 cm. B_2= two rows of sunflower at 60cm.
B_3= three rows of sunflower at 90 cm.

REFERENCES

A. O.A.C. (2005). Association of Official Analytical Chemists. Official methods of analysis, 16th Ed. AOAC I International, Washington, D.C., USA.

Baloch,M.K.(1991). Sowing method cum fertilizer effect on the Performance of two sunflower (Helianthus annuus L.) cultivars. M. Sc. Thesis, SAU. Tandojam.

Bokor, P. (2007). Macrophomina phaseolina causing a charcoal-rot of sunflower through Slovakia. Biologia, 62: 136-138.

CCSC (2012). Central Council for Sugar Crops. Annual Report, Ministry of Agriculture, Egypt.

El-Gergawi, A.S.; Saif, Lila M; Nour El.Hoda, M.Taha and E.H.El-Geddawy (1995). The relative benefit of intercropping maize with spring cane in middle Egypt. J. Appl. Sci. **10** (2):525-632.

El-Gergawi, A.S; Saif, Lila M and Abou-Salma, A.M.(2000). Evaluation of sunflower intercropping 0n spring sugarcane fields in Egypt. Assiut J. Agric.Sci. **31**(2): 164-174.

El-Zarka, A.M. (1976). Diseases of sunflower in Egypt, their occurrence and incidence. Proc. 2nd Phytopathol. Conf., Cairo. 317-323.

Gadallah R.E ; M.M.A. Badr and Abdel –Galil A.M. (2006). Effect of intercropping patterns and plant distribution of soybean and sunflower with sugar cane . Minufiya J. Agric. Res. **31**(4): 915-938.

Gomez, K.A. and Gomez, A.A (1984). Statistical procedures for Agriculture research. A Wiley-Inter Science Publication, John Wiley and sons, Inc. New York, USA

Gracha,A.I.S.,S.S.Toor, S.Sarjit.and L.K.Saini.(1997). Sugarcane base Intercropping system for enhanced productivity a case study of Pulses and oilseeds Crop research (Hisar) 13: 277-284.

Hall, R.L. (1974). Analysis of Nature of interference between plants of different species , Aust, J. Res. 35: 749-756.

Ibrahim, M.M. (2006). Studies on charcoal-rot disease caused by Macrphomina phaseolina on sunflower and its control. Ph.D. Thesis, Fac. Agric. Ain Shams, Univ., Egypt.

Jackson, M.L. (1967). Soil chemical analysis. Prentice-Hall, Inc Englewood Cliffs, NJ, USA.

Khakwani, A.A. (2003): Studies on sugarcane – sunflower intercropping system at different planting rations, geometrical patterns and NPK levels, M.Sc. (Hons) Agronomy.Gomal University .

Malik, M.A., M.Akram and A.Tanvir.(1992). Effect of planting geometry and fertilizer on growth, yield and quality of a new sunflower cultivar SF-100. J. Agric. Res. **30** (1): 59-64.

Mathur, R. B. (1981). Handbook of cane sugar technology. Oxford & IBH Publishing Co.

Mc-Gilchrist, C.A.(1965). Analysis of competition on experiments biometrics. 21975-985.

Misra, S.R. (2003). Effect of intercrops on disease and pests of sugar cane. Cooperative Sugar, **34** (8): 657-658.

Muhammad , A.;M.A. Javed and K.B.Malik (1998). Economic feasibility of intercropping raya and sunflower at different plant densities in autumn planted sugar cane . Pakitan Sugar J. 13:15-17.

Nazir, M.S; M.Bukhsh; R.H.Sahi and R.Ahmad I.H.Bhatti (2002). Effect of plant density & geometry on yield and quality of first and second autumn ratoon sugar cane. Pak. J. Agric. Sci. **22** (4): 234-238.

Osman, M.A.G.M. (2007). Studies on some sugarcane diseases in Egypt. M.Sc. Thesis, Fac. Agric. Minia Univ. Egypt.

Osunlaja, S.O. (1990). Effect of organic soil amendments on the incidence of stalk rot of maize caused by *Macrophomina phaseolina* and *Fusarium moniliforme*. Plant and Soil, 127: 237-241.

Paul, W.U. and Thompson,T.E.(1982). Planting date effects on Sunflower head and seed development. Agron. J. 74,389-395.

Pena, J.A., P.Dominguez and O. Agudelo.(1989). Sowing dates for Sunflowers intercropping with sugarcane Acta-Agronomica. 39 (3-4):150-158.

Sarjit, S., S. Makhan, M.L.Kapoor, S.I.S. Garcha, and L.K. aini.(1999). Productivity and economics of autumn sugarcane- Based intercropping systems Indian Sugar 48:977-981.

Satisha, G.C.; M. Krishnappa and K. Srikanth (1996). Input of sulphur on yield and quality of sugarcane. Indian Sugar 45(9): 397-401.

Singh, R.K. and R.K. Chauhan. (1998). Effect of intercropping on yield and quality of sugarcane. Agricultural Sic. Digest (Karnal) 18:255-257.

Willey, R.W.(1979). Intercropping, its importance and research needs. advantages. Field Abst. 32:1-10.

Zohry, A.H.A. and A.I.N., Abd El-Aal (2003). Soil morphological features and competition of intercropping mung bean with sugar cane in Upper Egypt. Egypt J. Agric. Res. **81**(1): 1

تأثير ميعاد زراعة ونظام تحميل دوار الشمس مع قصب السكر على مرض عفن الساق وإنتاجية وجودة المحصول

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يشكل النقص الحاد في إنتاج الزيوت الصالحة للاستهلاك احد المشاكل الرئيسية في الزراعة المصرية ، من ناحية أخرى تمثل مساحة القصب الربيعي الفرصة للمزارعين لإمكانية استخدامها في التحميل مع محصول زيتي مثل دوار الشمس ، لذا أقيمت تجربتين حقليتين بمحطة البحوث الزراعية بملوى – محافظة المنيا – مصر خلال موسمي ٢٠١١/٢٠١٢ م ، ٢٠١٢/٢٠١٣ م لدراسة انسب ميعاد لتحميل دوار الشمس على قصب السكرخلفة ثالثة (مواعيد زراعة دوار الشمس هى بعد كسر القصب وأزاله مخلفات المحصول و بعد شهر من الميعاد الاول) وتاثير نظام تحميل دوار الشمس (تحميل خط واحد على مسافة ٣٠ سم بين الجور ،خطين على مسافة ٦٠ سم بين الجور وثلاثة خطوط على مسافة ٩٠ سم بين الجور) على إنتاجية ،جودة وربحية قصب السكر في تصميم قطع منشقة مرة واحدة .

ويمكن تلخيص النتائج المتحصل عليها كالاتى :

١- حدث زيادة في ناتج محصول دوار الشمس المحمل المنزرع بعد الكسر (١٤٦,٨١ و ٤٠,٧٤ %) عن ناتج محصول دوار الشمس المحمل المنزرع بعد شهرمن الميعاد الاول في الموسمين الزراعيين ، وقد وجد إن نظام زراعة خطين من دوار الشمس على القصب على مسافة ٦٠ سم بين الجور زيادة في ناتج محصول دوار الشمس (٨,٥١ ، ٦,٢٥ %) عن زراعة خط واحد من دوار الشمس على مسافة ٣٠ سم بين الجور او زراعة ثلاثة خطوط من العباد على مسافة ٩٠ سم بين الجور على

التوالي. وسجل اقل إصابة بمرض عفن الساق فى دوار الشمس عند تحميل دوار الشمس بصف واحد على مسافات ٩٠ سم على القصب بعد شهر من الميعاد الأول.

٢- ليس لميعاد الزراعة ونظام تحميل دوار الشمس على القصب تأثير معنوي على ناتج ومكونات محصول القصب مثل ارتفاع وقطر العود ، عدد العيدان/م^{2} ، نواتج العيدان النظيفة والسكر طن / فدان وكذلك صفات جودة العصير مثل نسبة المواد الصلبة الذائبة الكلية ، نسبة السكروز ، نسبة النقاوة ، نسبة الحلاوة ونسبة السكريات المختزلة فى موسمى الزراعة عدا ناتج السكر طن/ فدان و نسبة السكريات المختزلة فى الموسم الثاني فقط كان معنوي . وسجل اقل إصابة بمرض عفن الساق فى قصب السكر عند تحميل دوار الشمس بثلاث صفوف على مسافات ٩٠ سم على القصب بعد شهر من الميعاد الأول

٣- حدث زيادة فى كفاءة استغلال الأرض (LER)عند تحميل دوار الشمس على قصب السكر وسجلت القيم الأعلى لهذه الصفة (١,٨١ ، ١,٧٢) عندما حمل خطين من دوار الشمس على مسافة ٦٠ سم بين الجور و خط واحد على مسافة ٣٠ سم بين الجور بعد الكسر في الموسمين على التوالي .

٤- سجلت القيم الأعلى فى العدوانية (Agg) (± ٢,٠٦ ، ±١,٨٣) بين القصب المحمل و دوار الشمس وكانت سالبة للقصب وموجبة لدوار الشمس مما يشير الى سيادة دوار الشمس على محصول القصب.

٥- كان صافى العائد الاقتصادي الناتج من تحميل دوار الشمس على قصب السكر مربح للمزارع وسجل القيم الاعلى ٨٧٦٨,٦٥ ، ٨٠٠٣,٧٥ جنية عند زراعة دوار الشمس بعد كسر القصب وتحميل خطين من دوار الشمس على مسافة ٦٠ سم بين الجور و خط واحد على مسافة ٣٠ سم بين الجور في الموسمين على التوالي ، علاوة على زيادة المساحة المنزرعة و الإنتاجية من عباد الشمس الذي يمثل احد المحاصيل الزيتية الهامة

٦- من النتائج المتحصل عليها يوصى بزراعه دوار الشمس بعد كسر القصب مباشرة وتحميل خطين من دوار الشمس على مسافة ٦٠ سم بين الجور او خط واحد على مسافة ٣٠ سم بين الجور تحت ظروف مصر الوسطى لخفض المنافسة الحادة بين نباتات دوار الشمس