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SUNFLOWER AND CUCUMBER AS AFFECTED BY INTERCROPPING UNDER SOME DEFOLIATION TREATMENTS OF SUNFLOWER

BY

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ABSTRACT

Two field trials were carried out at Mellawy Agricultural Research Station, during 2002 and 2003 summer seasons to study the growth, yield and yield components of sunflower with cucumber association. Four defoliation levels (75, 50, 25 % and zero %) for sunflower plants at flowering and at milk ripe stage was investigated. In addition monocultures of sunflower and cucumber were under taken. The obtained results indicated that growth, yield and yield components of intercropped sunflower (*Helianthus annuus* L.) with cucumber (*Cucumis sativus* L.) were significantly affected by defoliation. The reduction in growth and yield traits differed according to defoliation time and its level. Over two seasons the highest seed yield/fed. (1256.2 Kg/fed.) of intercropped sunflower was recorded with defoliation at milk ripe stage, while the lowest seed yield (1002.3 Kg/fed) was obtained with defoliation at flowering stage.

For cucumber, the highest yield of fruits (5046.9 Kg/ fed.) was obtained when defoliation of sunflower was done at flowering stage. However, the lowest yield (4769.3 Kg/fed) over both seasons was recorded with defoliation sunflower at milk ripe stage.

Concerning the level of defoliation effect, seed yield of sunflower were maximized (1501.8 Kg/fed.) with no defoliation followed by 25% level defoliation, while the lowest yield (675.1 Kg/fed.) was obtained at 75% defoliation, over two seasons. Without defoliation for sunflower, cucumber yield was the lowest (3228.3 Kg/fed.), while the highest value (6280.3 Kg/ fed.) was recorded at 75% defoliation over two seasons.

The maximum value of Land Equivalent Ratio (LER), 1.58 and 1.56 in the first and second seasons, respectively was recorded with defoliating 25 % of sunflower leaves at milk ripe stage. The highest value of relative crowding coefficient (K), 17.38 and 18.63 in the first and second seasons, respectively was recorded when cucumber intercropped with sunflower defoliated (25%) at milk ripe stage. Also, with defoliating 25% of sunflower leaves at milk ripe stage sunflower was the dominant component in intercropping pattern in both seasons. The highest value of total income (4277 L.E.) was recorded when 25% of sunflower leaves was defoliated at milk ripe stage over two seasons.

INTRODUCTION

In Egypt, the area devoted to sunflower in the crop structure is so limited. Therefore, increasing the cropped area of oil seed crops is an important target to reduce the gab between our production and consumption from edible oils. Intercropping can be used, as one of the most effective methods to increase the area of oil crops.

Mitchell, (1984) found that seed yield from plants with 50 and 100 % defoliation was reduced by 45 and 98 %, respectively, as compared with plants having little or no defoliation. Intercropping soybean with sunflower increased Land Equivalent Ratio (Shafshak *et al.*, 1986 b). Schneiter *et al.*, (1987) found that sunflower yield was reduced most by defoliation during flowering stage. Schneiter and Johnson (1994) reported that removing of the leaf bud or the upper third of the plant during the flowering stage reduced sunflower yield especially at flowering stage. Nagangoud *et al.*, (1996) stated that seed yield was generally decreased by defoliation, with defoliation at 50 days after sowing having the most effect.

Muro *et al.* (2001) stated that sunflower yield loss increase with increasing level of defoliation. They also found that preflowering stage was the most sensitive. At this stage a 100 % defoliation of the leaf surface resulted in 92 % yield loss. 100 % defoliation at back of head a pale yellow caused a 50 % yield loss, while at physiological maturity, defoliation had no effect on yield. Sunflower was observed to be fairly tolerant of competition with maize (Olanite *et al.*, 2002). Moriondo *et al.*, (2002) reported that the final yield results showed that defoliation during pre-anthesis caused a higher production loss.

Abbaspour *et al.*, (2003) indicated that plant height and stem diameter, head diameter, 1000-grain weight, harvest index and grain yield decreased as a result of partial or complete leaf excision when compared with the undefoliated control (no leaves removed). The interaction of different growth stage and defoliation (0, 25, 50, 75 and 100%) indicated greater reduction in yield and 1000 weight as defoliation increased at late growth stage (Johnson 2003). The seed yield of sunflower and intercrops were reduced under intercropping (Sahoo *et al.*, 2003).

Little information is available about the intercropping of sunflower and cucumber. Intercropping tomato and cucumber showed relatively great increase in yields than monocultures (Schultz *et al.*, 1987). Income and Land Equivalent ratios increased with intercropping chewing cane with cucumber (Yuan *et al.*, 1988). Data showed that the possibility to double cucumber and tomatoes yield comparable to that of cucumber staked system, a culture technique that would result in producing cucumber more economically (Hanna and Adams, 1991). Cucumber yield was significantly greater with intercropping with sweet peppers than monoculture (Kashi, 1992). Competitive relationships data of Kamel *et al.*, (1992) indicated that intercropping cucumber (Nigra Hybird) with cotton gave

best advantage in land use utilization, as well as, the relative crowding coefficient.

The objective of this study was to determine sunflower yield loss to the level of defoliation at two late growth stages. And how to compensate the loss in sunflower yield by intercropping cucumber to increase the land equivalent ratio.

MATERIALS AND METHODS

Two field trials were conducted at Mellawy Agricultural Research Station, Egypt during 2002 and 2003 summer seasons. This study aimed to investigate the effect of intercropping sunflower (*Helianthus annuus* L.) with cucumber (*Cucumis sativus* L.) under eight sunflower defoliation treatments. Defoliation treatments were the combination of two defoliation times at flowering stage (45, 49 days age) and at milk ripe stage (59, 62 days age) in both season, respectively, and four levels of defoliation for sunflower plants from bottom leaves (75, 50, 25% and zero defoliation) on some growth characters, yield and yield components of sunflower and cucumber.

The soil texture of the experimental site was clay with pH 7.8 and 1.9 % organic matter. In both seasons, the preceding winter crop was Egyptian clover (*Trafolium aleeandrinun L.*). Sunflower (c.v. G.101) sowing was performed on 20th and 15th April in 2002 and 2003 seasons, respectively. Sowing was one plant in hill spaced 20 cm apart on both sides of the ridge 120 cm width. Cucumber (c.v. Prince) was sown with either in pure or intercropping at the same date of sunflower planting on one side of the top ridge in hills space 25-cm apart and leaving two plants/hill. Super phosphate (15 % P_2O_5) was added during seedbed preparation at rate of 250 kg /fed. Nitrogen fertilizer was added at the rate of 150 kg N / fed. in three doses. The first dose (20 %) in form of ammonium sulphate (20.6 % N) was added during soil preparation. Each of the second and the third dose was added at rate of 40% in form of ammonium nitrate (33.5 % N) at 30 and 45 days from sowing date. Also, potassium fertilizer was added in form of potassium sulphate (50 % K_2O) at rate of 150 kg/ fed. after 45 days from sowing date. The other cultural practices were applied for both crops, as recommended.
Bivariate analysis by Pearce and Gilliver (1978) was used with split plot in randomized complete block design with four replications as described. Time of defoliation was located in the main plots, while percentages of defoliation for sunflower levels were devoted to sub plots. Comparison among different treatments were compared by the least significantly differences (L.S.D.) at 5 % level of probability due to Roger (1985). The area of sub plot was 43.2 m^2 consisting of six ridges, each of 6.0 m long and 1.2 m in width.

The following characters were studied: -

1-Sunflower:

Plant height, leaf area, stem diameter, head diameter, number of seeds /head, weight of seeds /head, shelling percentage and seed index. These characters were recorded as the average of five guarded plants from each sub-plot. Seed yield/ fed was estimated from central four ridges, 4 m long and 1.2 m width (19.2 m^2) and converted to yield/fed. Oil percentage, in seeds was

determined according to A.O.A.C. (1990) using Soxhlet apparatus and petroleum ether as organic solvent. Oil yield/ fed. (Kg) was estimated as follows: seed yield /fed. X oil percentage in seeds.

2- Cucumber:

Stem length, number of branches/ plant, leaf area, fruit diameter, fruit length, fruit shape and fruit yield/plant were estimated as means of five random plants. Yield of cucumber/ fed. was estimated from central four ridges, 4 m long and 1.2 m width (19.2 m^2).

3-Competitive relationships:

Sown proportion of sunflower and cucumber was 0.50: 0.50.

Land equivalent ratio (LER):

The ratio of area needed under sole cropping to that of intercropping at the same management level to produce an equivalent yield according to Andrews and Kassam (1976). It was calculated as follows:

$$LER = Y_{sc} / Y_{ss} + Y_{cs} / Y_{cc}$$

Where: Y_{ss} and Y_{cc} are the sole crop yields of sunflower (s) and cucumber (c) respectively, Y_{sc} is the intercrop yield of sunflower (when combined with cucumber) and Y_{cs} is the intercrop yield of cucumber (when combined with sunflower). LER values may be less, equal or more than 1.0 which, indicate the disadvantage, no disadvantage and advantage of the intercropping, respectively.

Relative crowding coefficient (K):

It was calculated for sunflower (s) and cucumber (c) and the two crops (k) according by Hall (1974).

$$K_{sc} = Y_{sc} \times Z_{cs} / (Y_{ss} - Y_{sc}) \times Z_{sc}$$
$$K_{cs} = Y_{cs} \times Z_{sc} / (Y_{cc} - Y_{sc}) \times Z_{cs}$$
$$K = K_{sc} \times K_{cs}$$

Where: Z_{sc} = sown proportion of sunflower (s) in mixture with cucumber (c),
Z_{cs} = sown proportion of cucumber (c) in mixture with (s),
K_{sc} = relative crowding coefficient for sunflower,
K_{cs} = relative crowding coefficient for cucumber,

If (s) or (c) species has coefficient less than, equal to, or greater than 1, it means it has produced less yield, the same yield, or more yield than "expected", respectively.

The component crop with the higher coefficient is the dominant one. To determine if there is (s) or (c) yield advantage, of mixing, the product of the coefficient is formed by multiplying

$K = K_{sc} \times K_{cs}$ (K= relative crowding coefficient for both crops).

Aggressivity (A):

Is a simple measure of how much the relative yield increase in species sunflower (s) is greater than that of species cucumber (c). Aggressivity "A" is determined according to Mc Gilchrist (1974) using the following formula:

A_{sc} = Intercropped yield of sunflower (s)/ Expected yield of (s) X proportion of (s) intercropping – Intercropping yield of cucumber (c)/ Expected yield of (c) X proportion of (c) intercropping

$$A_{sc} = Y_{sc} / Y_{ss} X Z_{sc} - Y_{cs} / Y_{cc} X Z_{cs}$$

Where A_{sc} is the aggressivity value of species (s) in combination with (c).

A_{cs} = intercropped yield of cucumber (c)/ Expected yield of (c) X proportion of (c) intercropping - Intercropping yield of sunflower (s)/ Expected yield of (s) X proportion of (s) intercropping

$$A_{sc} = Y_{cs} / Y_{cc} X Z_{cs} - Y_{sc} / Y_{ss} X Z_{sc}$$

Where A_{cs} is the aggressivity value of species (c) in combination with(s).

An aggressivity value of zero indicates that the component species are equally competitive. For any other situation, both species will have the same numerical value but the sign of the dominant species will be positive and that dominated negative. The greater numerical value the bigger difference in competitive abilities and the bigger difference between " actual" and "expected" yield.

4- Economic evaluation:

The total income from each treatment was calculated by Egyptian pound for sunflower at market price of L.E. 3000 per ton seed sunflower and L.E. 500 per ton of fruits cucumber.

RESULTS AND DISCUSSION

A- Effect of sunflower defoliation time:

1- Sunflower:

Data presented in Table (1) showed that solid sunflower plants recorded the high values of all studied traits compared to intercropping treatments in both seasons. The results indicated that plant height, leaf area, stem diameter, head diameter, shelling percentage, and oil percentage of intercropped sunflower with cucumber were not significantly affected by time of defoliation.

Defoliation at milk ripe stage had significantly less harmful effect on number of seeds/ head, weight of seeds/ head and seed index in comparison with defoliation at flowering stage in both seasons. This mean that delaying defoliation sunflower to milk ripe stage is most active in the conversion of solar energy to chemical energy and finally in production.

Seed and oil yields of sunflower behaved the same trend of yield components. The reduction in seed yield of intercropped sunflower defoliation at flowering stage reached 39 and 24 % and 38 and 23 % in first and second seasons, respectively compared with solid sunflower. For oil yield, this reduction reached 36 and 19 % compared with solid sunflower in the first season and 36 and 21% in the second season, respectively. Similar results were obtained by Schneiter *et al.*, (1987), Nagangoud *et al.*, (1996), Olanite *et al.*, (2002). Moriondo *et al.*, (2002), Abbaspour *et al.*, (2003) and Sahoo *et al.*, (2003).

Table (1): Effect of sunflower defoliation time on growth, yield and yield components of intercropping sunflower with cucumber in 2002 and 2003 seasons.

Character / Treatment	Plant height (cm)	Leaf area (cm^2)	Stem diameter (cm)	Head diameter (cm)	Seeds/ head (No)	Seeds /head (g)	Shelling %	Seed index (g)	Seed yield/ fed (kg)	Oil %	Oil yield/ fed (kg)
2002 season											
Flowering stage	162.8	326.5	2.67	17.24	753.1	34.35	52.27	4.51	1019.8	44.67	455.56
Milk ripe stage	166.6	337.7	2.74	18.10	842.0	43.59	55.23	5.20	1284.2	44.72	574.29
Significance	NS	NS	NS	NS	**	*	NS	*	**	NS	**
Solid	176.7	358.3	2.91	20.45	961.2	54.06	55.48	5.63	1679.6	42.35	711.30
2003 season											
Flowering stage	164.3	326.1	2.56	17.43	681.6	32.66	52.16	4.72	984.7	42.93	422.73
Milk ripe stage	167.1	328.7	2.71	18.69	730.6	41.14	54.50	5.60	1228.1	42.84	526.12
Significance	NS	NS	NS	NS	*	*	NS	**	*	NS	*
Solid	169.5	370.5	2.90	20.93	817.3	50.51	53.97	6.18	1596.2	41.63	664.51

*, ** and NS: Significant, highly and non-significant, respectively.

2-Cucumber:

Solid Cucumber recorded the highest values for all characters under study as compared with both of intercropping treatments in both seasons. Reduction in cucumber fruits yield/ fed. under intercropping condition may be due to the competition between cucumber and sunflower plants on nutrients, water and shading effects of sunflower (Table, 2). Also, the results showed that stem length, number of branches/plant, leaf area/plant, diameter and length of fruit possessed higher values when defoliation of sunflower levels was performed at flowering stage compared to defoliation at milk ripe stage in both seasons. The redaction in cucumber yield reached 6.7 and 4.3 as a result of delaying defoliation from flowering to milk ripe stage in 2002 and 2003 seasons, respectively.

This could be attributed to delaying striping leaves of sunflower plants to milk ripe stage depressed the characters of cucumber because of their requirements to light. Cucumber fruits yield/ fed when sunflower was defoliated at flowering stage, and at milk ripe stage amounted 75.21 and 70.19 % in first season, and 71.23 and 68.17 % in the second season of its pure stand, respectively. These results are in harmony with those obtained by Kashi (1992) and Kamel *et al.* (1992).

3-Competitive relationships: -

Table (3) showed effect of defoliation time of sunflower plants on competitive relationships. Land equivalent ratio (L.E.R.) exceeded one when sunflower was defoliated either at flowering or at milk ripe stage. Concerning relative crowding coefficient (k), the present results clarified that defoliation of sunflower at milk ripe stage gave more advantageous than at flowering stage in both seasons as shown in Table (3). With respect to aggressivety (A), cucumber was a dominant while sunflower was dominated crop when sunflower defoliated at flowering stage, whereas sunflower

was a dominant crop with defoliation at milk ripe stage sunflower in the first and second season. The presented results were at similar trend of those obtained by Yuan, *et al.* (1988), Kashi (1992) and Kamel, *et al.* (1992).

Table (2): Effect of sunflower defoliation time on growth, yield and yield components of cucumber intercropped with sunflower in 2002 and 2003 seasons.

Character / Treatment	Stem length (cm)	Branches / plant (no)	Leaf area (cm^2)	Fruit diameter (cm)	Fruit length (cm)	Fruit shape	Fruit yield / plant (g)	Fruits yield / fed (kg)
2002 season								
Flowering stage	172.1	3.61	63.12	2.97	13.39	4.51	175.20	5095.31
Milk ripe stage	167.8	3.20	56.14	2.76	10.90	3.96	162.43	4755.09
Significance	*	* *	*	*	*	NS	*	*
Solid	187.9	4.67	76.47	3.30	14.37	4.35	214.99	6774.32
2003 season								
Flowering stage	174.0	3.65	62.18	2.89	13.16	4.56	175.30	4998.51
Milk ripe stage	168.9	3.16	58.03	2.68	11.68	4.36	169.20	4783.47
Significance	*	* *	*	*	*	NS	*	*
Solid	190.4	4.87	74.27	3.53	14.18	4.02	235.78	7017.32

*, ** and Ns: significant, highly and non-significant, respectively.

Table (3): Competitive relationship values of intercropping sunflower and cucumber in 2002 and 2003 seasons.

Character / Treatment	Land equivalent ratio (LER)			Relative crowding coefficient (K)			Aggressivety (A)	
	L_s	L_c	LER	K_s	K_c	K	A_s	A_c
2002 season								
Flowering stage	0.61	0.75	1.36	1.55	3.03	4.70	-0.29	+0.29
Milky ripe stage	0.76	0.70	1.46	3.24	2.35	7.61	+0.13	-0.13
2003 season								
Flowering stage	0.62	0.71	1.33	1.61	2.48	3.99	-0.24	+0.24
Milky ripe stage	0.77	0.68	1.45	3.34	2.14	7.15	+0.18	-0.18

L_s, K_s and A_s = values of sunflower., L_c, K_c and A_c = values of cucumber., LER, K = values of both crops.

B - Effect of defoliation percentages of sunflower plants: -

1- Sunflower: -

Data in Table (4) indicated that same characters of sunflower i.e. plant height, leaf area and stem diameter were not significantly affected by defoliation percentages on intercropped sunflower plants with cucumber in both seasons of study. However, there was a slight decrease in these traits associated with increasing percentages of defoliation of sunflower from zero to 25, 50, or to 75 % in both seasons. This effect may be due to that vegetative growth was achieved before occurring defoliation treatments.

Shelling percentage was not significantly affected by defoliation percentage of intercropped sunflower in the first and second seasons (Table 4). Shelling percentage significantly increase with decreasing percentage defoliation up to 25 %. The defoliation in shelling percentage between 25 % defoliation and no defoliation did not reach the level of significant in both seasons.

Yield attributes of sunflower associated with cucumber i.e. head diameter, number of seeds /head, weight of seeds /head, seed index, seed yield and oil yield per feddan (4200m2) were significantly decreased with increasing percentages of sunflower defoliation up to 75 % of leaves. The shady effect of defoliation may be due to that leaf is the main organ in the conversion of solar energy to chemical and finally affect in the production of the seeds.

Seed yield of sunflower/fed. significantly declined by increasing defoliation percentages compared with solid sunflower in both seasons (Table 4). These results may be due to inter- specific competition between sunflower and cucumber plants for light, water and nutrients.

Concerning oil percentage, the results indicated that intercropped sunflower treatments did not show any change in oil percentage traits in both seasons. Such results may be due to this trail is a character rarely affected by cultural practices and environmental conditions. These results are in the same line of those reported by Shafshak, *et al.* (1986a), Schneiter and Johnson (1994), Nagangoud *et al.*, (1996),Muro *et al.*, (2001), Olanite *et al.*, (2002). Moriondo *et al.*, (2002), Abbaspour *et al.*, (2003) and Sahoo *et al.*, (2003).

Oil yield/ fed. significantly decreased by increasing percentages of defoliation of intercropped sunflower with cucumber. Oil yield of intercropped sunflower ranged from 45 to 94 % of its solid sunflower in the first season and from 43 to 92 % in the second season.

2-Cucumber:

Results in Table (5) indicated that all studied characters of cucumber under study were significantly affected by defoliation percentage for sunflower except fruit shape in both seasons. Defoliation 75% followed by 50% and 25% of sunflower leaves gave the highest values of stem length, number of trails/ plant, leaves area/ plant, fruit diameter and fruit length of cucumber compared to zero defoliation treatment which scored the lowest values of these traits in both seasons. These results are expected because of increasing light intensity plays main role in the conversion of solar energy to chemical energy and dry matter accumulation in cucumber fruits.

The results in Table (5) showed that defoliation percentages of sunflower treatments did not significant affected on fruit shape in both seasons. Data presented in Table (5) showed that all defoliation treatments showed reduction in the yield of intercropped cucumber comparing to no defoliation treatment. This reduction decreased by increasing defoliation percentage of sunflower leaves from 25 to 50 or 75%. This reduction in yield of cucumber fruits reached 52, 26, 23 and 9 % in the first season, and 54, 32, 26 and 9 % in the second one of solid cucumbe. These results are reflecting of cucumber growth and yield attributes such as stem

length, number of branches/ plant, leaf area, fruit diameter and fruit length. Similar results were obtained by Schultz *et al.* (1978), Yuan *et al.* (1988), Hanna and Adams (1991), Kashi (1992) and Kamel *et al.* (1992).

Table (4): Effect of defoliation percentage of sunflower plants on yield and yield components of intercropped sunflower with cucumber in 2002 and 2003seasons.

Character / Defoliation%	Plant height (cm)	Leaf area (cm^2)	Stem diameter (cm)	Head diameter (cm)	Seeds / head (No)	Seeds /head (g)	Shelling %	Seed index (g)	Seed yield /fed(kg)	Oil %	Oil yield/ fed(kg)
2002 season											
75	160.2	323.12	2.62	16.13	669.9	28.06	48.51	4.21	696.6	45.533	317.16
50	163.5	347.86	2.68	17.04	744.4	36.38	51.06	4.87	1082.9	44.733	484.38
25	165.6	326.40	2.72	17.90	840.7	42.17	56.53	5.00	1300.6	44.58	579.80
Zero	169.6	331.1	2.80	19.63	935.3	49.27	58.91	5.33	1523.0	43.92	671.10
$LSD_{0.05}$	NS	NS	NS	0.73	145.7	7.68	2.74	0.64	165.0	NS	71.08
Solid	176.7	358.27	2.91	20.45	961.2	54.06	55.48	5.63	1679.6	42.35	711.31
2003 season											
75	162.5	333.31	2.53	16.4	499.2	24.29	44.29	4.81	653.5	43.55	284.60
50	165.2	323.68	2.62	17.4	701.3	34.60	51.21	4.91	1028.6	43.83	450.84
25	164.2	315.03	2.77	18.3	766.9	41.11	58.41	5.34	1268.0	42.57	539.79
Zero	170.3	337.70	2.78	20.1	857.0	47.59	59.41	5.59	1475.5	41.60	613.81
$LSD_{0.05}$	NS	NS	NS	0.73	89.54	8.01	3.09	0.61	170.9	NS	61.95
Solid	169.7	370.50	2.90	20.93	817.3	50.51	53.97	6.18	1596.2	41.63	664.50

3- Competitive relationships: -

Land equivalent ratio (L.E.R.) exceeded one in all intercropping treatments. Defoliation at 25% of sunflower achieved the best values for L.E.R., which reached 151% and 147% in the first and second seasons, respectively (Table 6).

Also, relative crowding coefficient (K) achieved advantageous in all intercropping treatments under sunflower defoliation in both seasons as shown in Table (6). K values increased by decreasing sunflower defoliation level. Intercropping cucumber with sunflower without defoliation of sunflower plants gave the highest K value, whereas with defoliation at 50 % recorded the lowest coefficient.

For aggressivity (A), cucumber was a dominant crop whereas sunflower was a dominated under sunflower defoliation 75% and 50% treatment. Under 25% and without defoliation of sunflower plants treatment, sunflower was a dominant crop. These results are confirmed with those of Shafshak, *et al.* (1986b), Yuan, *et al.* (1988), Hanna and Adams (1991), Kamel, *et al.* (1992) and Kashi, (1992).

C- Effects of the interaction between time of defoliation and defoliation percentages of sunflower plants on intercropped crops:

1-Sunflower:

In both season, the interaction effects of defoliation time X defoliation percentage of sunflower plants on head diameter, number of seeds/ head, weight of seeds/ head, weight of 100 seeds and seed yield/ fed. as well as oil yield were significant (Table, 7).These traits were not significantly affected by this interaction.

Table (5): Effect of defoliation percentages of sunflower leaves on growth, yield and yield components of intercropped cucumber with sunflower in 2002 and 2003 seasons.

Character / Defoliation%	Stem length (cm)	Branches /plant (No)	Leaf area (cm)	Fruit diameter (cm)	Fruit length (cm)	Fruit shape	Fruit yield /plant (g)	Fruits yield/ Fed.(kg)
2002 season								
75	181.1	3.90	66.90	3.20	13.43	4.21	203.42	6195.1
50	173.3	3.65	63.43	3.02	12.72	4.21	177.97	5247.7
25	166.9	3.20	57.37	2.70	12.05	4.46	172.27	5009.1
Zero	158.6	2.87	50.85	2.55	10.38	4.07	121.79	3248.8
$LSD_{0.05}$	7.1	0.25	6.93	0.36	1.34	NS	41.90	351.20
Solid	187.9	4.67	76.47	3.30	14.37	4.35	214.99	6774.3
2003 season								
75	183.4	3.95	63.88	3.13	14.05	4.49	219.25	6365.5
50	175.6	3.53	61.73	2.85	13.20	4.64	181.18	5225.3
25	167.7	3.23	59.90	2.65	12.65	4.77	168.02	4765.2
Zero	158.9	2.90	54.90	2.52	9.77	3.88	120.20	3207.9
$LSD_{0.05}$	7.85	0.53	5.62	0.40	0.67	NS	28.74	376.3
Solid	190.4	4.87	74.27	3.53	14.18	4.02	235.78	7017.3

Table (6): Effect of defoliation percentages of sunflower leaves on competitive relationships values of intercropped sunflower with cucumber in 2002 and 2003 seasons.

Character / Defoliation%	Land equivalent ratio (LER)			Relative crowding coefficient (K)			Agressivity (A)	
	L_s	L_c	LER	K_s	K_c	K	A_s	A_c
2002 season								
75	0.41	0.91	1.32	0.71	10.70	7.60	- 1.00	+ 1.00
50	0.64	0.77	1.41	1.81	3.44	6.23	- 0.26	+ 0.26
25	0.77	0.74	1.51	3.43	2.84	9.74	+ 0.07	- 0.07
Zero	0.94	0.48	1.42	10.08	2.36	23.79	+ 0.86	- 0.86
2003 season								
75	0.43	0.90	1.34	0.69	9.77	6.74	- 0.99	+ 0.99
50	0.64	0.74	1.38	1.81	2.92	4.73	- 0.20	+ 0.20
25	0.79	0.67	1.47	3.86	2.12	8.18	+ 0.23	- 0.23
Zero	0.97	0.46	1.43	12.22	0.84	10.76	+ 0.94	- 0.94

L_s, $K_s$and A_s= Values of sunflower. L_c, K_c and A_c =Values of cucumber. LER, K=Values of both crops

Data presented in Table (7) showed that without defoliation treatment gave the highest values of seed and oil yields as well as its, yield components (head diameter and number of seeds/ head, weight of seeds/ head and seed index) in both seasons. On the other hand the lowest values of these characters were recorded when sunflower plants were 75% defoliated at flowering stage in both seasons. These results are confirmed with those of Abbaspour *et al.*, (2003) and Johnson (2003).

2-Cucumber:

Number of branches/plant, fruit length and cucumber fruit yield/fed were significantly affected by the interaction between sunflower defoliation stages X

defoliation percentage in both seasons (Table, 8). The results indicated that when 75% or 50% of sunflower leaves were defoliation at flowering stage, cucumber recorded the highest values for these traits. With defoliation of sunflower at milk ripe stage or without defoliation the lowest values of cucumber traits were recorded in both seasons.

Table (7): Effect of defoliation treatments of intercropped sunflower plants with cucumber on growth, yield and yield components of sunflower in 2002 and 2003 seasons.

Character / Defoliation		Head diameter (cm)	Seeds/ head (No)	seeds/head (g)	Seed index (g)	Seed yield/ fed. (kg)	Oil yield/ Fed.(kg)
Time	%	2002 season					
At flowering stage	75	15.23	643.67	21.68	3.47	528.67	241.08
	50	16.27	668.33	30.63	4.59	914.97	409.27
	25	17.77	790.00	36.67	4.64	1132.84	505.59
	Zero	19.70	910.34	48.43	5.32	1502.82	656.73
At milky ripe stage	75	17.03	696.12	34.44	4.95	864.58	393.12
	50	17.80	820.36	42.13	4.14	1250.83	559.50
	25	18.03	891.45	47.67	5.34	1468.26	653.82
	Zero	19.57	960.20	50.10	5.35	1553.20	685.43
LSD 0.05		1.04	96.21	6.67	0.63	233.30	100.50
Solid sunflower		20.45	961.20	54.60	5.63	1679.59	711.31
2003 season							
At flowering stage	75	14.90	424.77	18.69	4.40	517.80	226.80
	50	16.43	649.89	29.31	4.51	868.97	380.87
	25	17.67	736.65	35.58	4.83	1092.44	465.05
	Zero	19.97	915.18	47.04	5.14	1459.58	606.16
At milky ripe stage	75	17.80	573.70	29.89	5.21	789.16	341.71
	50	18.20	752.64	39.89	5.30	1188.22	520.80
	25	18.70	797.05	46.63	5.85	1443.62	614.55
	Zero	20.07	798.80	48.13	6.04	1491.50	591.51
LSD 0.05		1.41	126.60	7.20	0.59	241.71	87.61
Solid sunflower		20.93	817.30	50.51	6.18	1596.24	664.51

3- Competitive relationships: -

Land equivalent ratio (LER): - Results in Table (9) showed that defoliation treatments for sunflower plants increased land usage in intercropping pattern in both season. Intercropping sunflower with cucumber and defoliation 25 % of sunflower at milk ripe stage recorded the highest values of L.E.R. followed by 50 % defoliation at the same stage, which were 1.58 or 1.50 and 1.56 or 1.47 in the first and seasons, respectively. Whereas, intercropping sunflower with cucumber recorded the lowest values of cucumber traits, with defoliation 75% of sunflower leaves at flowering stage being 1.24 and 1.26 in the two successive seasons, respectively.

Relative crowding coefficient (K): Results in Table (9) indicated that intercropping sunflower with cucumber under all combinations of times and percentages defoliation of sunflower leaves were advantageous. The best result was achieved with intercropping pattern and defoliation 25 % sunflower leaves at milk ripe stage in both seasons.

Table (8): Effect of some defoliation treatments of sunflower plants on growth, yield and yield components of cucumber intercropped with sunflower in 2002 and 2003 seasons.

Character / Defoliation		Branches /plant (No)	Fruit length (cm)	Fruit yield /fed (kg)	Fruits /plant (No)	Fruit length (cm)	Fruits yield /fed (kg)
Time	%	2002 season			2003 season		
At flowering stage	75	4.27	14.87	6331.1	4.37	15.07	6596.28
	50	4.00	14.50	5317.0	3.73	14.00	5297.98
	25	3.27	13.73	5178.5	3.4	13.70	4871.95
	Zero	2.90	10.47	3554.7	3.05	9.87	3227.97
At milk ripe stage	75	3.53	12.00	6059.1	3.53	13.03	6135.16
	50	3.30	10.93	5178.5	3.33	12.40	5152.64
	25	3.13	10.36	4839.8	3.07	11.60	4658.43
	Zero	2.83	10.30	2943.0	2.70	9.67	3187.79
$LSD_{0.05}$		0.35	1.89	496.6	0.27	0.958	652.30
Solid		4.67	14.37	6774.3	4.87	14.18	7017.32

Table (9): Effect of some defoliation treatments of sunflower plants on competitive relation ships values of intercropped cucumber with sunflower in 2002 and 2003 seasons.

Character / Defoliation		Land equivalent ratio (LER)			Relative crowding coefficient (K)			Agressivity (A)	
		L_s	L_c	LER	K_s	K_c	K	A_s	A_c
Time	%	2002 season							
At flowering stage	75	0.31	0.93	1.24	0.46	14.29	6.57	- 1.24	+ 1.24
	50	0.54	0.78	1.32	1.20	3.65	4.38	- 0.48	+ 0.48
	25	0.67	0.76	1.43	2.07	3.24	6.71	- 0.18	+ 0.18
	Zero	0.89	0.52	1.41	8.50	1.10	9.35	+ 0.74	- 0.74
At milk ripe stage	75	0.51	0.89	1.40	1.06	8.47	8.98	- 0.76	+ 0.76
	50	0.74	0.76	1.50	2.92	3.24	9.46	+ 0.04	- 0.04
	25	0.87	0.71	1.58	6.95	2.50	17.38	+ 0.32	- 0.32
	Zero	0.92	0.43	1.35	12.29	0.77	9.46	+ 0.98	- 0.98
		2003 season							
At flowering stage	75	0.32	0.94	1.26	0.48	15.67	7.52	- 1.23	+ 1.23
	50	0.54	0.75	1.29	1.19	3.08	3.67	- 0.42	+ 0.42
	25	0.68	0.69	1.37	2.17	2.27	4.93	- 0.02	+ 0.02
	Zero	0.91	0.46	1.37	10.68	0.85	9.08	+ 0.91	- 0.91
At milk ripe stage	75	0.49	0.87	1.36	0.98	6.95	6.81	- 0.76	+ 0.76
	50	0.74	0.73	1.47	2.91	2.76	8.03	+ 0.02	- 0.02
	25	0.90	0.66	1.56	9.46	1.97	18.63	+ 0.48	- 0.48
	Zero	0.93	0.45	1.38	14.24	0.83	11.82	+ 0.96	- 0.96

L_s, K_s and A_s = Values of sunflower. L_c, K_c and A_c = Values of cucumber. LER, K = Values of both crops.

Agressivity (A): Results in Table (9) showed that sunflower was the dominated component with defoliation sunflower treatments at flowering stage. But with zero defoliation for sunflower, the sunflower crop was the dominant components

in both seasons. These results are in harmony with those of Shafshak, *et al.* (1986 b), Yuan *et al.* (1988), Hanna and Adams (1991) and Kamel *et al.* (1992).

4 - Total income of different treatments: -

The highest value of total income recorded 4277.11 L.E. with defoliating sunflower at 25% intensity at milk ripe stage over two seasons (Table 10).

It is become clear that to obtain highest total income from intercropping sunflower and cucumber must defoliate sunflower with 25 % at milky ripe stage.

Table (10): Total income of intercropped sunflower with cucumber under defoliation sunflower leaves treatments in 2002 and 2003 seasons.

Defoliation Time	%	Sunflower	Cucumber	Total income	Sunflower	Cucumber	Total Income
		2002season			2003 season		
At flowering stage	75	723.24	3165.56	3888.80	680.40	3298.14	3978.54
	50	1227.81	2658.49	1886.30	1142.61	2648.99	3791.60
	25	1516.77	2589.24	4106.01	1393.15	2435.98	3831.13
	Zero	1970.219	1777.33	3747.52	1818.48	1613.99	3432.13
At milky ripe stage	75	1179.36	3029.57	1208.93	1025.13	3067.58	4092.71
	50	16718.50	2589.24	4267.74	1562.40	2576.32	4138.77
	25	1961.46	2419.89	4381.35	1843.65	2329.22	4172.87
	Zero	2056.29	1471.48	3527.77	1774.53	2393.90	3368.42
Solid		2133.93	3387.16	—	1993.35	3508.66	—

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تحميـل عباد الشمس والخيار تحت معاملات مختلفة من التوريق لعباد الشمس

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أقيمت تجربتان حقليتان في محطة البحوث والتجارب الزراعية بملوي خلال الموسمين الصيفيين ٢٠٠٢-٢٠٠٣. بهدف لدراسة النموومكونات المحصـول لعبـاد الشمس المحمل والخيار مع التوريق لعباد الشمس عند مرحلة التزهير ومرحلة الطـور اللبني بأربعة مستويات من التوريق لنبا ت عباد الشـمس (٧٥، ٥٠، ٢٥ % وبـدون توريق) بالإضافة للمحصول المنفرد لكلا المحصولين. الصنف المسـتخدم مـن عبـاد الشمس صنف هوجيزة ١٠١ ومن الخيار صنف برنس.

التصميم المستخدم كان القطع المنشقة مرة واحدة فى أربع مكررات حيـث وضعت مراحل التوريق فى القطع الرئيسية أما النسبة المئوية للتوريق فقد وضعت فى القطع الشقية.

أظهرت النتائج المتحصل عليها أن النموومكونات المحصول والإنتاجية لعباد الشمس قد تأثرت معنويا عند مرحلتى التزهير والطور اللبني للبـذور، وكـان تـأثير التوريق على عباد الشمس أكثر وضوحا عند التوريق فى مرحلة التزهير.

حيث كان محصول البذور للفدان من عباد الشمس عند أجراء التوريـق فـي مرحلـة الطور اللبني (١٢٥٦,٢كجم/فدان) كمتوسط للموسمين، بينما كان ١٠٠٢,٣ كجم/فـدان عند التوريق فى مرحلة التزهير.

بالنسبة لمحصول الخيار سجل أعلى ناتج من الثمار عندما تم التوريق لعباد الشمس فى مرحلة التزهير (٥٠٤٦,٩ كجم/فدان) مقارنة بالتوريق لعباد الشمس فى مرحلة الطور اللبنى (٤٧٦٩,٣كجم/فدان) كمتوسط للموسمين.

أما بخصوص النسبة المئوية للتوريق فان محصول البذور للفدان العباد الشمس بلغ أقصاه فى معاملة بدون توريق (١٥٠١,٨كجم/ف) بينما سجل اقل محصول عند توريق ٧٥ % (٦٧٥,١ كجم/ف كمتوسط للموسمين). وبلغت إنتاجية ثمار الخيار للفدان أقل ما يمكن عند توريق عباد الشمس بنسبة ٢٥ % (٣٢٢٨,٤كجم/ف) بينما بلغت أعلا قيمة عند توريق العباد الشمس بنسبة ٧٥ % (٦٢٨٠,٤كجم/ف كمتوسط للموسمين) .

أعطى التوريق بنسبة ٢٥ % عند الطور اللبني لعباد الشمس مع الخيار أعلا قيم لمعامل كفاءة استغلال الأرض حيث كان ١,٥٨ ، ١,٥٦ في الموسم الأول والثانى على الترتيب. والتحميل لعباد الشمس مع الخيار سجل أعلا قيم لمعامل الحشد النسـبي حيث كان ١٧,٣٨، ١٨,٦٣ في الموسم الأول والثاني على الترتيب عندما كان معـدل التوريق لعباد الشمس ٢٥ % عند الطور اللبني.

وتوصي هذه الدراسة بتحميل عباد الشمس مع الخيار بإجراء التوريق لعبـاد الشمس بنسبة ٢٥ % في مرحلة الطور اللبني لتعظيم إنتاجية الفـدان مـن محصـول الخيار ومحصول البذور من عباد الشمس.