Allelopathic Influence of Sunflower
III- Response of Wheat and Wheat Weeds to Allelopathic Effects of Sunflower Residues under Different Nitrogen Rates

By

S.H.Abou- Khadrah; A.A.E.Mohamed; Soad A.Youssef and H.S.Gharib
Department of Agron., Fac. of Agric., Kafr El-Sheikh, Tanta Univ., Egypt

ABSTRACT

Two field experiments were conducted in a clay soil during 1998/99 and 1999/2000 seasons, at the Experimental Farm, Fac. of Agric., Tanta Univ., at Kafr El-Sheikh, Egypt, to determine the allelopathic influence of sunflower residues under different nitrogen rates on growth, grain yield and its components of wheat, as well as growth of wheat weeds. The experimental design was strip-plot with four replications. The horizontal plots were assigned to five treatments of sunflower residues (roots, stems, roots + stems, control and herbicide), while the vertical plots included three nitrogen rates (i.e., 60, 75 and 90 kg N/ fed.). The main findinges could be summarized as follows:

I- Weeds :

Ten annual weeds comprised a list of grass and broadleaf weeds in wheat experimental area at 80 days after sowing in both seasons. Herbicide treatment and soil incorporation of sunflower roots, stems and roots + stems markedly decreased number of grass, broadleaf and total weeds/m^2, as well as fresh and dry weights of different weeds/m^2 at 80 days after sowing, compared with the control treatment in the two seasons.

Increasing nitrogen rate substantially suppressed weed density, as well as fresh and dry weights of total weeds in both seasons.

II- Wheat :

Sunflower residues (roots, stems and roots + stems) and herbicide treatment significantly increased dry matter accumulation of wheat/m^2, LAI, CGR, NAR, number of spikes/m^2, spike length, (number of spikelets and grains/spike in the 2nd season, only), 1000- grain weight, as well as grain and straw yields/fed., compared to the control treatment. In general, soil incorporation of sunflower roots or herbicide, being insignificant, resulted in the highest values with respect to most growth, grain yield and its attributes.

Increasing nitrogen rate up to 90 kg N/fed. significantly increased dry matter accumulation of wheat/m^2, LAI, CGR, wheat plant height at harvest, number of spikes/m^2, (spike length and 1000- grain weight in the 1st season, only), (number of spikelets and grains/spike in the 2nd season,

only), as well as grain and straw yields/fed. Whereas, it did not significantly affect NAR. There was no significant difference between 75 and 90 kg N/fed. in most cases.

It may be concluded that sunflower is a potential allelopathic crop and its allelopathic nature has more suppressive effects on weeds than wheat. Also, data indicated that soil incorporation of sunflower roots, roots + stems or herbicide treatment, with 75 kg N/fed., produced similar grain yield/fed. It can be concluded that soil incorporation of sunflower roots with 75 kg N/fed. could be recommended for optimum wheat grain yield under the environmental condition of this study, in addition to minimizing the environmental pollution caused by chemical herbicides.

INTRODUCTION

One of the most serious problems of modern agriculture is crop losses caused by weeds. Worldwide, 10% loss of agricultural production is caused by weeds alone (Altieri and Liebman, 1988). Successful weed management in wheat may depend on herbicides. However, weed resistance to herbicides, water contamination, impact of herbicides on nontarget organisms, as well as some cases of reduced profit from high herbicide cost have prompted weed scientists to search for new strategies of weed management. Optimally, yield increases must be sought through agronomic approaches that are environmentally safe. Controlling weeds through allelopathy is one focal points for researchers working to sustain the world's food supply for future generations. Allelopathic potential can be utilized for weed control through four ways; namely, plant associated allelopathic plants to provide weed control; use of allelopathic plants in crop rotation and obtain allelopathic activity from plant residues in soil; identify and isolate potent allelochemicals and use these as herbicides and optimize the allelopathic potential in the crop by developing allelopathic cultivars (Duck, 1985). Sunflower (*Helianthus annuus* L.), among several crops, exhibit a strong allelopathic property (Park and Moody, 1991 and Mehboob *et al.*, 2000). Naseem (1997), in field experiments, reported that incorporation of whole sunflower plants or roots + leaves showed more suppressive effect on weed density and dry matter accumulation. He also stated that the density and growth of weeds were less in wheat grown with fertilizer than wheat grown without fertilizer. He also observed that the effects of sunflower residue treatments on grain yield and its components of wheat ranged from stimulatory to inhibitory and incorporation of sunflower roots with fertilizer increased the wheat grain yield and its components. Ahmed *et al.* (1994) noted similar varying effects of sorghum residues on wheat.

Nitrogen fertilization is very important for plant growth and final grain yield of wheat and it should be applied at the optimum rate to meet the crop need (Abd El-Gawad *et al.*,1993; Darwiche, 1994; Eissa, 1995; El-Shami *et al.*, 1995; Essa, 1996; Latiri *et al.*, 1998; Sorour *et al.*, 1998 and Sharshar *et al.*, 2000). Increasing wheat growth by application of higher rates of nitrogen might, also, improve the growth of wheat weeds.

The main objectives of this study were to investigate the allelopathic activity of soil amended with sunflower plant materials and their residues on wheat and wheat weeds under different nitrogen rates.

MATERIALS AND METHODS

Two field experiments were conducted in a clay soil during 1998/99 and 1999/2000 seasons, at the Experimental Farm, Fac. of Agric., Tanta Univ., at Kafr El-Sheikh, Egypt, to determine the allelopathic influence of sunflower residues under different nitrogen rates on growth, grain yield and its components of wheat, as well as growth of wheat weeds. The soil of the experimental field was clay in texture with p^H value of 8.14 and 1.25% organic matter and contained 16.5, 9.35 and 279 ppm available N, P and K, respectively (mean of the two seasons for the upper 30 cm of soil). Seeds of the sunflower hybrid "Euroflore" were sown in the second week of June in 1998 and 1999 seasons. However, maize was sown in plots of treatments, not containing roots of sunflower. All cultural practices for both summer crops were done as recommended in the area. At maturity, sunflower plants were uprooted after harvest of heads. The uprooted plants were transported and air dried for ten days, then, they were manually separated into leaves and stems. Most leaves were lost during transportation. Stems were weighed to determine weight of dry stems per unit area and chopped into small pieces (1-5 cm long) by an electric fodder cutter. The chopped-sunflower stems were incorporated into the respective plots with the help of rotator according to the treatments. The experimental design was a strip-plot, with four replications. The horizontal plots were assigned to the five treatments of sunflower residues, as given in Table (1), whereas the vertical plots included the three nitrogen rates (i.e., 60, 75 and 90 kg N/fed.). The nitrogen fertilizer in the form of Urea (46% N) with the above mentioned rates, was splitted into three additions (1/5, 2/5 and 2/5 applied at sowing and before the first and second irrigations, respectively).

The plot size was 21 m^2 (3 × 7 m). The experimental soil was fertilized with 100 kg calcium superphosphate (15.5% P_2O_5) per feddan during seed- bed preparation. Sowing of wheat took place on November 25^{th} and 20^{th} in 1998 and 1999, respectively. Grains of wheat (Sakha cv.

69) were mechanically drilled in rows, 12.5 cm apart, at a rate of 60 kg/fed. The herbicide "Arelon" SC (Isoproturon 50% FL) was sprayed at the rate of 1.25 l/fed. at the 2-4 leaf stage of wheat plants on plots of herbicide treatment. The other cultural practices were done as recommended.

Table (1): Treatments of sunflower residues.

No.	Treatment	Sunflower residue	Preceding crop
1	Control*	No-residue	Maize
2	Herbicide	No-residue	Maize
3	Roots (R)	Roots	Sunflower
4	Stems (S)	Stems	Maize
5	Roots + stems (R+S)	Roots & stems	Sunflower

*(Without sunflower residue and unweeded).

Measurements:

A. Weeds :

At 80 days after sowing one square meter was randomly selected from each plot. Then, the number of grass and broadleaf weeds/m^2, as well as their fresh and dry weights/m^2 were determined.

B. Wheat :

Two sampling dates at 82 and 101 days after sowing were taken. Wheat plants in one meter area of two rows ($1 \times 0.25 = 0.25$ m^2) from each plot, were randomly selected and wheat plants of samples were carefully harvested at soil surface. The samples were separated into leaves (leaf blades), stems (stems + sheaths) and spikes. Dry matter accumulation per unit area was recorded. Leaf area index (LAI), crop growth rate (CGR) in g/m^2/week and net assimilation rate (NAR) in g/m^2/week were computed, according to Watson (1952), as follows:

LAI = unit of leaf area per plant of sample/ground area of sample.

$CGR = (W_2 - W_1) / (t_2 - t_1)$

$NAR = (W_2 - W_1)(\ln A_2 - \ln A_1) / (A_2 - A_1)(t_2 - t_1)$

Where : W_1, A_1 and W_2, A_2, respectively, refer to dry weight and leaf area at time t_1 and t_2 in weeks.

At harvest, plant height and number of spikes/ m^2 were measured and ten spikes were randomly selected from each plot to determine spike length, number of spikelets/spike, number and weight of grains/spike and 1000- grain weight. To determine grain and straw yields/fed., the central area of 12 m^2 (2×6 m) from each plot was harvested and sun dried for two days and weighed to record the total biomass (biological yield per unit area).

It was mechanically threshed by a wheat thresher. Grain and straw yields/plot were converted into metric tons per feddan.

The analysis of variance was carried out according to Gomez and Gomez (1984). Treatment means were compared by Duncan's multiple range test (Duncan, 1955). All statistical analysis was performed, using the analysis of variance technique by means of "IRRISTAT" computer software package.

RESULTES AND DISCUSSION

A- Weeds:

Ten annual weeds comprised a list of grass and broadleaf weeds in wheat experimental area at 80 days after sowing in both seasons. Grass weed species were *Phalaris minor* Retz., *Phalaris paradoxa* L., *Polypogon monspeliensis* L. and *Lolium temulentum* L. Broadleaf weed species were *Vicia sativa* L., *Melilotus indicus* All., *Melilotus siculus* All., *Medicago hispida* Gaerth., *Beta vulgaris* L. *subsp. Perennis* (L.) Allen and *Rumex dentatus*,L.

The influence of sunflower residues was significant on number of weeds/m^2, as well as fresh and dry weights of grass, broadleaf and total weeds/m^2 in both seasons (Tables 2 and 3). Herbicide treatment and soil incorporation of sunflower (roots, stems and R + S) markedly decreased number, fresh and dry weights of grassy, broadleaf and total weeds/m^2, compared to control treatment in the two seasons. Herbicide and sunflower R + S treatments gave the best results in controlling weeds. Soil incorporation of sunflower residues (R, S and R+S) and herbicide treatment reduced dry weight of total weeds by 38.6, 33.6, 51.7 and 58.6% in the 1st season and by 58.9, 48.1, 71.0 and 81.0% in the 2nd season, in comparison with control treatment (Fig., 1). This is possibly due to the release of allelochemicals from sunflower residues. This was in a line with the findings of Naseem (1997), who stated that sunflower exhibited selective allelopathic effects on weed density and growth.

Increasing nitrogen rate resulted in a marked decrease in number, fresh and dry weights of grass, broadleaf and total weeds/m^2 in both seasons, but the differences in fresh weight in the 1st season and in dry weight in the two seasons of grass weeds did not reach the 5% level of significant (Tables 2 and 3). No significant differences were evidenced in these traits between 75 and 90 kg N/fed. Ahmad *et al.* (1994) and Naseem (1997) have reported similar effects for applied nitrogen fertilizer to wheat on weed population density and growth.

Table (2): Number of weeds/m^2 at 80 days after sowing as affected by sunflower residues and nitrogen rates in 1998/99 and 1999/2000 seasons.

Factor	Number of weeds/m^2					
	Grass	Broadleaf	Total	Grass	Broadleaf	Total
Residue:	1998/99 season			1999/2000 season		
	*	*	**	*	*	*
Control	104.6 a	57.4 a	162.0 a	90.7 a	94.5 a	185.2 a
Herbicide	32.7 c	22.2 d	54.9 c	28.9 d	18.0 c	46.9 c
Roots (R)	50.0 bc	37.4 bc	87.5 b	42.6 bc	28.4 bc	71.0 bc
Stems (S)	56.3 b	38.9 b	95.2 b	53.1 b	33.3 b	86.4 b
R + S	41.8 bc	29.9 cd	71.6 bc	37.9 cd	20.4 c	58.3 c
Kg N/fed. :	*	*	*	*	*	*
60	65.9 a	43.3 a	109.3 a	56.9 a	53.1 a	110.0 a
75	56.8 ab	35.7 b	92.5 ab	49.3 ab	37.0 b	86.3 b
90	48.5 b	32.4 b	81.0 b	45.7 b	26.6 b	72.3 c
Interaction:	NS	NS	NS	NS	NS	NS

*, ** and N.S. indicate $p<0.05$, $p<0.01$ and not significant, respectively. Means designated by the same letters are not significantly different at 5% level, using DMR test.

The interaction between sunflower residues and nitrogen rates had no significant effect on number of grass, broadleaf and total weeds/m^2, as well as on fresh and dry weights of different weeds in both seasons (Tables 2 and 3).

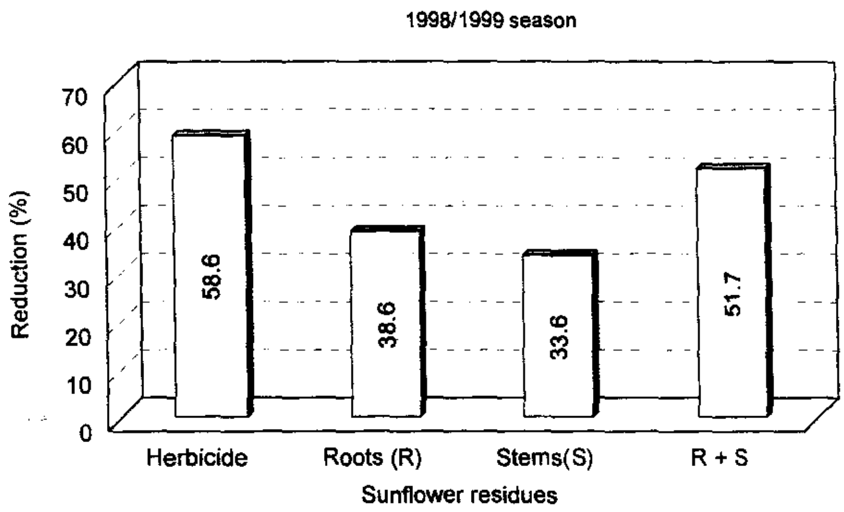
B. Wheat:

Sunflower residues [roots (R), stems (S) and R+S] and herbicide treatment substantially increased dry matter accumulation (g/m^2), leaf area index (LAI), crop growth rate (CGR) and net assimilation rate (NAR) of wheat, compared to the control at all tested growth stages in both seasons (Tables 4 and 5). Soil incorporation of sunflower roots or herbicide resulted in the largest values, with respect to these characters. This might be due to minimized weed competition and promotive effect of root allelopathic both of which were sufficient to prevent plants from becoming increasingly badly placed in the population structure so that they might grow in a better environment and would probably had a better rate of dry matter accumulation per unit of ground area (CGR). Ahmed *et al.* (1994), Narwal *et al.* (1997) and Naseem (1997) have reported allelopathic effects of crop residues on growth and LA or LAI of wheat.

Table (3): Fresh and dry weights of weeds (g/m^2) at 80 days after sowing as affected by sunflower residues and nitrogen rates in 1998/99 and 1999/2000 seasons.

Factor	1998/99 season			1999/2000 season		
	Grass	Broadleaf	Total	Grass	Broadleaf	Total
	Fresh weight (g/m^2)					
Residue:	*	*	**	*	*	*
Control	246.4 a	236.2 a	482.6 a	367.6 a	365.5 a	733.1 a
Herbicide	72.8 d	120.3 c	193.1 c	98.4 d	31.2 d	129.6 d
Roots (R)	138.2 b	171.6 b	309.8 b	166.3 bc	95.1 c	261.4 b
Stems (S)	147.6 b	175.2 b	322.8 b	224.9 b	157.1 b	382.0 b
R + S	104.8 c	135.2 bc	240.0 c	145.5 c	59.5 cd	205.0 cd
Kg N/fed. :	NS	*	*	*	*	*
60	151.4	208.5 a	360.0 a	239.9 a	197.4 a	437.3 a
75	147.6	154.9 b	302.5 b	181.5 b	134.9 b	316.4 b
90	126.8	139.7 b	266.5 b	180.2 b	92.7 b	272.9 b
Interaction:	NS	NS	NS	NS	NS	NS
	Dry weight (g/m^2)					
Residue:	**	*	*	*	*	*
Control	23.6 a	28.9 a	52.5 a	33.1 a	34.1 a	67.2 a
Herbicide	7.3 d	14.5 b	21.8 d	9.9 d	2.9 d	12.8 c
Roots (R)	14.6 bc	17.6 b	32.3 bc	17.9 bc	9.7 bc	27.6 bc
Stems (S)	17.0 b	17.9 b	34.9 b	22.3 b	12.6 b	34.9 b
R + S	10.9 cd	14.5 b	25.4 cd	14.3 cd	5.2 cd	19.5 bc
Kg N/fed. :	NS	*	*	NS	*	*
60	15.3	29.0 a	44.3 a	21.8	18.8 a	40.6 a
75	14.4	13.8 b	28.2 b	20.4	12.2 b	32.6 b
90	14.3	13.2 b	27.5 b	16.3	7.7 b	24.0 b
Interaction:	NS	NS	NS	NS	NS	NS

*, ** and N.S. indicate $p<0.05$, $p<0.01$ and not significant, respectively. Means designated by the same letters are not significantly different at 5% level, using DMR test.



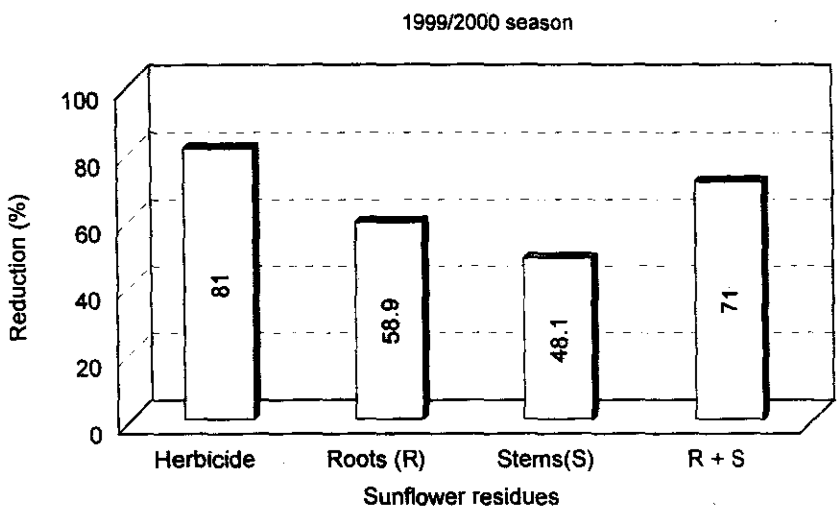


Fig.(1):Percentage of reduction in dry weight of total weeds as affected by sunflower residues in both seasons.

Table (4): Dry matter accumulation of wheat plants (g/m^2) as affected by sunflower residues and nitrogen rates in 1998/99 and 1999/2000.

Factor	Days from sowing 82	101	82	101
	1998/99		1999/2000	
Residues :	*	**	**	**
Control	266.8 b	443.2 b	299.3 c	454.0 d
Herbicide	349.0 a	692.6 a	375.0 ab	749.1 a
Roots (R)	338.0 a	689.8 a	403.8 a	748.4 a
Stems (S)	310.7 a	613.1 a	362.2 b	618.7 c
R + S	358.4 a	674.1 a	372.9 b	684.8 b
Kg N/fed. :	*	*	**	**
60	271.1 b	552.5 b	305.9 b	562.6 c
75	342.6 a	640.4 a	376.0 a	671.9 b
90	359.9 a	674.9 a	406.1 a	718.5 a
Interaction	N.S	N.S	N.S	**

*, ** and N.S. indicate p<0.05, p<0.01 and not significant, respectively. Means designated by the same letters are not significantly different at 5% level, using DMR test.

Table (5): Leaf area index (LAI), crop growth rate (CGR) and net assimilation rate (NAR) as affected by sunflower residues and nitrogen rates in 1998/99 and 1999/2000.

Factor	Days from sowing 82	101	82	101	82-101		82-101	
	LAI				CGR (g/m^2/week)		NAR (g/m^2/week)	
	1998/99		1999/2000		1998/99	1999/2000	1998/99	1999/2000
Residues :	*	**	**	**	*	**	*	**
Control	2.60 c	3.37 b	2.15 c	3.08 c	65.0 b	57.0 d	22.5 b	21.9 c
Herbicide	3.88 ab	5.53 a	3.18 ab	5.62 a	126.6 a	137.8 a	28.4 a	33.6 a
Roots (R)	3.77 ab	5.24 a	3.52 a	5.97 a	129.6 a	126.9 ab	30.8 a	27.4 b
Stems (S)	3.08 bc	4.75 a	2.98 b	4.81 b	111.4 a	94.5 c	28.9 a	24.6 bc
R + S	4.07 a	5.02 a	3.09 ab	5.79 a	116.3 a	114.9 b	29.8 a	27.3 b
Kg N/fed. :	*	**	*	*	N.S	*	N.S	N.S
60	2.84 b	3.98 b	2.65 b	4.38 b	103.6	94.6 b	31.7	26.1
75	3.55 ab	4.94 a	3.16 a	5.22 a	109.7	109.0 ab	27.8	27.1
90	4.05 a	5.43 a	3.13 a	5.56 a	116.0	115.1 a	27.0	27.7
Interaction	N.S	N.S	*	N.S	N.S	N.S	N.S	N.S

*, ** and N.S. indicate p<0.05, p<0.01 and not significant, respectively. Means designated by the same letters are not significantly different at 5% level, using DMR test.

Increasing nitrogen rate from 60 to 90 kg/fed. caused a significant increase in dry matter accumulation (g/m^2) of wheat and LAI, in both seasons, and in CGR only in the second season, but it had no significant difference on NAR in the two seasons (Tables 4 and 5). The differences between 75 and 90 kg N/fed. did not reach the level of significance in all cases. Such favorable effect of nitrogen on dry matter accumulation might have been resulted from increased photosynthetic area which resulted in more photosynthates production. These results are in harmony with those of Abou-Ahmed (1991), Latiri *et al.* (1998) and Sorour *et al.* (1998).

The interaction between sunflower residues and nitrogen rates had a highly significant effect on dry matter accumulation (g/m^2) of wheat, at 101 days from sowing (DAS) and on leaf area index at 82 DAS in the second season, only (Tables 4 and 5). Wheat grown with sunflower roots and 90 kg N/fed. accumulated more dry matter per unit area (867.3 g/m^2) than all other combination treatments. The highest leaf area index (3.91) was obtained from wheat received 75 kg N/fed. plus sunflower roots or herbicide. Wheat plants grown with sunflower roots and 75 or 90 kg N/fed. did not significantly differ in LAI (Table 6).

Table (6): Dry matter accumulation (g/m^2) and leaf area index of wheat as affected by the interaction between sunflower residues and nitrogen rates in 1999/2000 season.

Kg N/fed.	Residue				
	Control	**Herbicide**	**Roots (R)**	**Stems (S)**	**R+S**
	Dry matter accumulation (g/m^2) at 101 DAS				
60	334.5 i	726.3 bcd	606.1 g	520.8 h	625.3 fg
75	497.5 h	741.9 bc	771.8 b	660.7 efg	687.7 cde
90	529.9 h	778.9 b	867.3 a	634.7 def	741.5 bc
	Leaf area index at 82 DAS				
60	1.87 g	2.76 de	3.06 b-e	2.78 de	2.78 de
75	2.04 fg	3.85 a	3.91 a	2.99 b-e	3.01 b-e
90	2.53 ef	2.92 cde	3.58 ab	2.17 bcd	3.47 abc

Means designated by the same letters are not significantly different at 5% level, using DMR test.

Sunflower residue treatments significantly influenced wheat plant height at harvest, number of spikes/m^2, spike length, 1000- grain weight and straw and grain yields/fed. in both seasons, as well as the number of spikelets and grains/spike in the second season, only (Tables 7 and 8). Plant height, grain yield and its attributes and straw yield of wheat were

Table (7): Plant height, straw yield, grain yield and its attributes of wheat as affected by sunflower residue and nitrogen rate in 1998/99 season.

Factor	Plant height (cm)	Nº of spikes/m^2	Spike length (cm)	Nº of spikelets/ spike	Nº of grains /spike	1000-grain weight (g)	Straw yield (t/fed.)	Grain yield (t/fed.)
Residue :	**	**	*	**NS**	**NS**	**	**	**
Control	102.9 b	164.2 c	10.3 b	23.0	47.9	50.94 b	3.180 c	1.354 c
Herbicide	110.6 a	334.4 ab	11.7 a	23.5	51.5	52.73 a	3.398 c	2.582 a
Roots (R)	112.8 a	371.6 a	11.7 a	23.5	52.9	53.89 a	4.317 a	2.544 a
Stems (S)	111.1 a	278.0 b	11.4 a	23.1	52.3	53.59 a	3.475 c	2.311 b
R + S	111.2 a	334.2 ab	11.8 a	23.7	52.8	52.99 a	3.914 b	2.412 a
Kg N/fed. :	**	*	*	**NS**	*	**	*	**
60	107.6 b	260.4 b	10.9 b	23.1	48.0 b	50.58 c	3.190 b	2.032 b
75	109.0 ab	311.9 a	11.4 ab	23.4	51.4 ab	53.47 b	3.782 a	2.274 a
90	112.6 a	317.2 a	11.8 a	23.6	55.0 a	54.44 a	3.998 a	2.415 a
Interaction:	**NS**	*	**NS**	**NS**	**NS**	**	**NS**	**

*, ** and NS indicate $p < 0.05$, $p < 0.01$ and not significant, respectively. Means of each factor designated by the same letters are not significantly different at 5% level, using Duncan's multiple range test.

Table (8): Plant height, straw yield, grain yield and its attributes of wheat as affected by sunflower residue and nitrogen rate in 1999/2000 season.

Factor	Plant height (cm)	Nº of spikes/m^2	Spike length (cm)	Nº of spikelets/ spike	Nº of grains /spike	1000-grain weight (g)	Straw yield (t/fed.)	Grain yield (t/fed.)
Residue :	*	*	**	*	**	**	**	**
Control	101.0 b	248.8 b	10.7 b	22.4 b	54.6 b	48.60 c	3.305 c	1.607 c
Herbicide	107.8 a	359.2 a	11.7 a	22.7 ab	59.2 ab	50.65 b	4.313 ab	2.733 a
Roots (R)	112.9 a	345.9 a	11.6 a	23.2 a	61.4 a	53.86 a	4.231 ab	2.774 a
Stems (S)	108.4 a	332.3 a	11.7 a	22.9 ab	59.5 ab	53.62 a	3.788 bc	2.422 b
R + S	109.9 a	356.3 a	11.6 a	23.0 a	62.4 a	54.38 a	4.507 a	2.683 a
Kg N/fed. :	*	*	**NS**	*	**NS**	**NS**	*	**
60	104.7 b	307.4 b	11.3	22.3 b	58.3	51.20	3.543 b	2.325 c
75	108.3 ab	338.6 a	11.5	23.1 a	59.2	52.66	4.108 a	2.463 b
90	111.0 a	339.6 a	11.7	23.1 a	60.8	52.80	4.436 a	2.543 a
Interaction:	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

*, ** and NS indicate $p< 0.05$, $p<0.01$ and not significant, respectively. Means of each factor designated by the same letters are not significantly different at 5% level, using Duncan's multiple range test.

significantly higher in plots where R or R + S of sunflower were added than those of the control. No significant differences in most of these characteristics were observed in plots that contained sunflower roots, compared to the herbicide plots. However, all sunflower residue and herbicide treatments produced significantly higher plant height, number of spikes/m^2, spike length, 1000- grain weight and grain yield/fed. (in the two seasons), as well as the number of spikelets and grains/spike and straw yield in the second season, only than the control treatment. More grain yield in case of sunflower roots might be attributed to more fertile tillers (spikes/m^2), spikelets and grains/spike and 1000-grain weight. These results are confirmed with the findings of Naseem (1997), who reported that soil incorporation with roots of fertilized sunflower significantly recorded maximum plant height, maximum straw yield and higher grain yield and its attributes of wheat, compared to the control.

Increasing nitrogen rates from 60 to 90 kg/fed. substantially increased plant height, number of spikes/m^2, straw and grain yields/fed. (in both seasons), spike length, number of grains/spike and 1000- grain weight (in the first season, only), as well as the number of spikelets/spike (in the second season, only) (Tables 7 and 8). With respect to plant height, spike length and number of grains/spike, wheat plants received 75 kg N/fed. did not practically differ from those received 60 or 90 kg N/fed. Wheat plants received 75 or 90 kg N/fed. produced significantly higher number of spikes/m^2, number of spikelets/spike as well as straw and grain yields/fed. than those received 60 kg N/fed. in the two seasons With respect to 1000-grain weight (in the first season) and grain yield/fed. in the second season, a significant increase accompanied each increament of applied nitrogen. Grain yield is a final indicator of crop behavior under different crop management practices. The increase in plant height, grain yield and its attributes, with increasing nitrogen rate, was possibly due to the absorption of more nutrients from the soil, which promoted the growth of wheat. Nitrogen rate increased grain yield through increasing number of spikes/m^2, number of spikelets and grains/spike and 1000-grain weight. Moreover, growth in terms of LAI, DM and CGR were in favor of nitrogen additions and this was reflected on increasing different yield attributes. A positive association between nitrogen fertilization and grain yield and its attributes has been reported by Darwiche (1994), El-Shami *et al.* (1995), Essa (1995), Said (1998) and Sharshar (2000).

The interaction between sunflower residues and nitrogen rates had a significant effect on number of spikes/m^2, 1000-grain weight and grain yield of wheat/fed. in the first season, only (Tables 7 and 8). Data in (Table 9) indicated that soil incorporation of sunflower residues and herbicide treatment significantly increased number of spikes/m^2, compared to the control at the same nitrogen rate. The highest number of spikes/m^2 resulted from herbicide, sunflower R and R + S at the rates of 75 or 90 kg N/fed. Data also, shwed that soil incorporation of sunflower R + S at 90 kg N/ fed. produced the highest 1000-grain weight (55.35g) . Herbicide and sunflower R and S treatments at 75 or 90 kg N/fed., did not significantly differ from the mentioned treatment in this respect (Table 9). At the same nitrogen rate, sunflower residues and herbicide treatment significantly increased grain yield, compared to the control treatment. Soil incorporation of sunflower R at 90 kg N/fed. produced the highest grain yield/fed. without significant difference with herbicide treatment or R at 75 kg N/fed., as well as with herbicide treatment or R + S at 90 kg N/fed.

Table (9): Number of spikes/ m^2, 1000-grain weight and grain yield of wheat/ fed. as affected by the interaction between sunflower residues and nitrogen rates in 1998/99 season.

Kg N/fed.	Residue				
	Control	**Herbicide**	**Roots (R)**	**Stems (S)**	**R+S**
	Number of spikes/ m^2				
60	155.0 d	271.0 c	377.4 a	245.0 c	253.5 c
75	169.7 d	352.8 ab	361.0 a	288.4 c	387.6 a
90	168.0 d	379.5 a	376.3 a	300.5 bc	361.6 a
	1000-grain weight				
60	48.11 e	50.68 d	51.99 cd	50.86 d	51.27 cd
75	52.28 bcd	53.23 abc	54.35 ab	55.12 a	52.35 bcd
90	52.43 bcd	54.29 ab	55.32 a	54.81 a	55.35 a
	Grain yield of wheat (t/fed.)				
60	1.255 g	2.345 c-f	2.216 def	2.209 ef	2.138 f
75	1.408 g	2.694 ab	2.605 abc	2.231 def	2.434 b-e
90	1.398 g	2.709 ab	2.811 a	2.492 bcd	2.665 ab

Means designated by the same letters are not significantly different at 5% level, using DMR test.

REFERENCES

Abd El-Gawad, A.A.; N.A. Noureldin; M.A. Ashoub and M.A. Kashabah (1993). Studies on consumptive use and irrigation scheduling in relation to nitrogen fertilization on wheat. II-Response of wheat yield and its attributes. Annals of Agric. Sci., Fac. of Agric., Ain Shams Univ. Cairo, Egypt, 38(1): 173-181.

Abou-Ahmed, E. I. (1991). Some agronomic and physiological studies on wheat. Ph. D. Thesis, Fac. of Agric., Kafr El-Sheikh, Tanta Univ., Egypt.

Ahmed,S.; Z.A. Cheema; M. Yaseen; M. Saeed and A. Tanveer (1994). Responses of wheat and wheat-weeds to allelopathic effects of sorghum residues under varying levels of fertility. Pak. J. Weed Sci. Res.,7(1-2):58-66.

Altieri, A.M. and M. Liebman (1998). Weed Management in Agroecosystems Ecological Approaches .Florida: CRC Press.

Darwiche, A.A. (1994). Agricultural studies on wheat Ph. D. Thesis, Fac. of Agric., Zagazig Univ., Egypt.

Duck, S.O. (1985). Biosynthesis of phenolic compounds-chemical manipulation in higher plants. The chemistry of allelopathy: Biochemical interactions among plants (Ed.A.C.Thampson)., 113-131.

Duncan, D.B. (1955). Multiple range and multiple F-tests. Biometrics 11: 1-42.

Eissa, Y.G.A. (1995). Response of some Egyptian varieties to phosphorus and nitrogen fertilization levels under New Valley Governorate conditions. Ph.D. Thesis, Fac. of Agric. Minia Univ., Egypt.

El-Shami, M.M.; M.S. Sharshar and A.H. Abdel Latif (1995). Effect of late planting date and nitrogen fertilization on wheat. Egypt. J. Appl. Sci., 10 (9): 177-188.

Essa, F.A. (1996). Agronomic studies on wheat Ph. D. Thesis, Fac. of Agric., El-Mansoura Univ., Egypt.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. An International Rice Research Institute Book John Willey and Sons Inc., New York., USA.

Latiri, S. K; S. Nortcliff and D.W. Lawlor (1998). Nitrogen fertilizer can increase dry matter, grain production and radiation and water use efficiencies for durum wheat under semi-arid conditions. European J. of Agronomy, 9(1): 21-34.

Mehboob, N.; B. Saleem and M.J. Qureshi (2000). Allelopathic influence of sunflower (*Helianthus annuus*) on germination and seedling growth of linseed (*Linum usitatissimum*). Pakistan J. of Biological Sci., 3 (8): 1305-1307.

Narwal, S.S.; M.K. Sarmah and D.P.S. Nandal (1997). Allelopathic effects of wheat residues on growth and yield of fodder crops. Allelopathy. J., 4 (1): 111-120.

Naseem, M.(1997). Allelopathic effects of autumn sunflower residues on wheat productivity and wheat weeds . Ph. D. Thesis, Dept. of Agron., Univ. of Agric. ,Faisalabad , Pakistan.

Park, K.H. and K. Moody (1991). Allelopathic activity and identification of allelochemicals of sunflower (*Helianthus annuus* L.). Philipp. J. Weed Sci., 18: 25-40.

Said, S.M.H. (1998). Effect of some cultural practices on wheat production. M.Sc. Thesis, Fac. of Agric., Al-Azhar Univ., Egypt.

Sharshar, M.S.; M.M. Sobh and Fatma A. Sherif (2000). Effect of some N-biofertilizer sources as supplementary fertilization on wheat yield, yield components and quality under graded levels of N-chemical fertilizer. J. Product. & Dev., 5 (1): 1-11

Sorour , F. A.; M.E. Mosalem and Azza.E. Khaffagy (1998). Effect of preceding crop , seeding rates and nitrogen levels on wheat growth and yield and its components. J. Agric. Res., Tanta Univ., Egypt, 24(3):263-281.

Watson,D.I. (1952). The physiological basis of variation in yield .Adv.in Agron., 4:101-144.

الملخص العربى

التأثير الأليلوباثى لعباد الشمس

ثالثا: استجابة كل من القمح والحشائش النامية معه للتأثير الأليلوباثى لبقايا عباد الشمس تحت مستويات مختلفة من الأزوت

سعد حسن أبوخضره، عبدالواحد عبدالحميد السيد محمد، سعاد أحمد يوسف، هانى صبحى غريب

قسم المحاصيل– كلية الزراعة بكفرالشيخ– جامعة طنطا

أجريت تجربتان حقليتان فى أرض طينية بالمزرعة البحثية لكلية الزراعة بكفرالشيخ– جامعة طنطا خلال موسمى ١٩٩٩/٩٨ ، ٢٠٠٠/١٩٩٩ لدراسة التأثير الأليلوباثى لبقايا عباد الشمس (الجذور، السيقان، الجذور+السيقان ، بالإضافه إلى معامله بمبيد الحشائش الأليرون ومعاملة المقارنه) تحت ثلاثة معدلات من السماد الأزوتى (٦٠، ٧٥، ٩٠ كجم ن/فدان) على نمو ومحصول الحبوب ومكوناته للقمح و كذلك نمو الحشائش المصاحبة له. استخدم فى هذه التجربة تصميم القطاعات المتعامدة فى أربع مكررات حيث وزعت معاملات بقايا عباد الشمس الخمسة فى القطع الأفقية، بينما تم توزيع مستويات التسميد الأزوتى الثلاثة فى القطع المتعامدة عليها. **وتتلخص أهم النتائج المتحصل عليها فيما يلى :**

<u>١- الحشائش :</u>

* تم حصر عشرة أنواع من الحشائش النجيليه وعريضة الأوراق فى أرض تجربتى القمح خلال موسمى الزراعه.

* أدى استخدام بقايا عباد الشمس (الجذور و السيقان والجذور + السيقان) أو استخدام مبيد الحشائش الى إنخفاض واضح فى عدد الحشائش النجيلية أو عريضه الأوراق أو عدد الحشائش الكلية بالمتر المربع وكذلك الوزن الطازج والجاف لها بعد ٨٠ يوم من الزراعة بالمقارنة بمعاملة المقارنة فى كلا الموسمين.

* أدت زيادة معدل السماد الأزوتي من ٦٠ الى ٩٠كجم أزوت/ فدان الى نقص واضح في عدد الحشائش بالمتر المربع وكذلك الوزن الغض والجاف لها بدون فروق معنوية في الغالب بين معدلي ٧٥، ٩٥ كجم أزوت/ فدان.

٢- القمح :

* أدت إضافة بقايا عباد الشمس (الجذور و السيقان و الجذور + السيقان) أو استخدام مبيد الحشائش الى زيادة معنوية في الوزن الجاف لنباتات القمح بالمتر المربع، دليل مساحة الأوراق، معدل نمو المحصول، معدل التمثيل الصافي، عدد السنابل بالمتر المربع، طول السنبلة، (عدد السنيبلات والحبوب بالسنبلة في الموسم الثاني فقط)، وزن الـ ١٠٠٠ حبة وكذلك محصول الحبوب و القش للفدان بالمقارنة بمعاملة المقارنة في كلا الموسمين. و بصفة عامة فان استخدام جذور عباد الشمس أو مبيد الحشائش (بدون فروق معنوية بينهما) أعطيا أعلى القيم في معظم صفات النمو ومحصول الحبوب ومكوناته لنبات القمح.

* أدت زيادة معدل السماد الأزوتي حتى ٩٠كجم أزوت/فدان الى زيادة معنوية في الوزن الجاف لنباتات القمح بالمتر المربع، دليل مساحة الأوراق، معدل نمو المحصول، ارتفاع نبات القمح عند الحصاد، عدد السنابل بالمتر المربع و (طول السنبلة ووزن الـ ١٠٠٠ حبة بالموسم الأول فقط) ، (عدد السنيبلات والحبوب بالسنبلة بالموسم الثاني فقط)، وكذلك محصول الحبوب و القش للفدان، بينما لم يكن لها تأثير معنوي على معدل التمثيل الصافي. ولم تظهر فروق معنوية بين معدلي التسميد الأزوتي من ٧٥ ، ٩٠كجم أزوت/ فدان في أغلب الصفات المدروسة.

* ويتضح من النتائج المتحصل عليها أن لنباتات عباد الشمس تأثير أليلوباثي مثبط لنمو الحشائش أكثر من القمح. كما يتضح أن اضافة جذور عباد الشمس الى التربة مع معدل التسميد الأزوتي ٧٥ كجم أزوت/ فدان أدت الى الحصول على أعلى محصول حبوب قمح ويماثل المحصول الناتج من المعاملة الموصى بها (التسميد بالمعدل السابق مع استخدام مبيد الحشائش "أريلون"). لذا يمكن أن يوصى بها للحصول على أعلى محصول من حبوب القمح تحت ظروف هذه الدراسة وللحد من تلوث البيئة من جراء استخدام مبيدات الحشائش.