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THE ROLE OF SOME AROMATIC PLANTS INTERCROPPING ON *TUTA ABSOLUTA* INFESTATION AND THE ASSOCIATED PREDATORS ON TOMATO

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ABSTRACT

This study was conducted at El-Riad region, at Kafr El-Sheikh Governorate during two successive growing seasons, 2013 and 2014 to investigate the role of intercropping on the infestation with *Tuta absoluta*. and the associated predators. Four aromatic plants were; geranium, spearmint, rosemary and sweet basil plants. Results showed that intercropping aromatic plants with tomato plantations reducing the infestation percentage with *Tuta absoluta* especially on geranium + tomato and increase the associated numbers of predators especially on sweet basil + tomato.

Key words: *Tuta absoluta*, intercropping, tomato, aromatic plants, predators

INTRODUCTION

The vegetable crop tomato (*Lycopersico esculentum* Mill) Family Solanacea is one of the most consumed vegetables in the world and global production is estimated at around 136 Billion ton per year (FAOSTAT, 2009). Tomato is the 3rd most economically important vegetable crop after potato and onion. Major production, in descending order include China, USA, India, Turkey and Egypt respectively (FAO, 2008). Tomato is a dietary source of vitamins especially A and C, minerals and fiber, which are important for human nutrition and health. Also, tomatoes are the richest source of lycopene, a phytochemical that protects cell from oxidants that have been linked to human cancer (Giovannuci, 1999 and Mutanen *et al.*, 2011). Other antioxidant compounds in tomato fruit include flavonoids and phenolic acid .Flavonoids and phenols are regarded as potentially health benefitting compounds since they are implicated in the prevention of human inflammatory and cardiovascular diseases as well as cancer (Martin *et al.*, 2004; Tan *et al.*, 2010 and Mutanen *et al.*, 2011). Tomato (crop), suffers damage from a large numbers of insect pests.

The tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is one of the most important lepidopterous pests associated with tomato crops in South America (Abro *et al.*, 1988 and Torres *et al.* 2010). It is considered as a limiting factor for tomato production all over the world , accounting for about 70% of the losses (Benaventa *et al.*, 1978; Silva *et al.*, 1998 and Derbalah *et al.*, 2012). This pest entered Europe through the Mediterranean cost, being first sighted late 2006 in the Liberian Peninsula (Urbaneja, *et al.*, 2007). In August 2007, the first affected tomato plantation was detected in the South of Catalonia (NE Spain) (Ssv, 2008). Recently the pest has been detected in France, Italy, United Kingdom and the Netherlands (Benaventa *et al.*, 1978 and Debnath *et al.*, 2010) and it has become significant problem in green houses or in open field in other Mediterranean countries. The newly introduced pest from South America to the shores of the Mediterranean found a prefect new environment where it can breed between 10-12 generations a year (Eppo, 2009).

Owing to the increasing environmental hazards and enhanced resistance to words insecticides, prompted active research in biological control (plant extracts) and in highly efficacious insecticides with novel modes of action.

Studies concerned with the enhanced of integrated biological control have so for mainly focused on tritrophic interaction and requirements of the pests, natural enemies (Gurr and written, 1999). A companion plant is an intercrop that influences the 1st trophic level by enhancing nutrition and/or chemical defense of the crop plants. In addition, it might have a matter of repellency and/or the intercropping effects on pests and pathogens and also, attract natural enemies or provide a food source for natural enemies (Parolin, *et al.* 2012). A companion plant is a crop plant which is grown closer to the another crop plant species in horticulture and agriculture. The species may benefit from each other in terms of increased yield (Finch *et al.* 2003). Some plants produce chemical that suppress or repel pests and protect neighboring plants (Ode 2006). A repellent plant is generally used to keep pest organisms away from the main crop (Hjalten *et al.* 1993). A banker plant is specifically associated with classical biological control, the aim of which is to increase the establishment of natural enemies (Murphy 2004; Osbrne *et al.* 2005 and Frank 2010). A ban her plant may feed and attract natural enemies (Parolin *et al.* 2012). In Egypt the intercropping of basil with cotton was significantly reduced to all pest infestation and led to a 50% reduction in abundance of the pink bollworm, *Pectinophora gossypiella* Saunders (Lepidoptera: Gelechiidae) (Schader *et al.* 2005).

Plants with aromatic qualities contain volatile oils that may interfere with host plant location, feeding, distribution and mating in decreased pest abundance (Uvah and Coaker, 1984 and Lu *et al.*, 2007).

The present study aimed to investigate the effect of intercropping the four tested aromatic plants (geranium, spearmint, rosemary and sweet basil) between tomato and only tomato on the infestation percentage with the tomato leaf miner *Tuta absoluta* (Meyrick) and the associated predators under field conditions.

MATERIALS AND METHODS

The experiment was carried out under natural conditions during the two tomato growing successive seasons; 2013 and 2014 on *Tuta absoluta* at El-Raid region, Kafr El-Sheikh Governorate. An area of half feddan was prepared and divided into 16 plots (each about 131 m^2) in a randomized complete block design.

Seedling of geranium (*Geranium* spp.), spearmint (*Mentha viridis*), rosemary (*Rosmarinus officinalis*) and sweet basil (*Ocimum basilicum* L.) plants with tomato crop were transplanted in plots of intercropping system, on April 15th during the two tested seasons. The seedlings of tomato were transplanted on the other side of row where the previous four aromatic plants on the same time at a space of 35 cm between plants and a width of 150 cm. Weekly samples were taken randomly from May 1st to August 2nd. Each sample consisted of 60 leaflets from 20 plants randomly chosen (3 leaflets/plant) and 60 fruits from 20 plants randomly chosen (3 fruits/plant) repeated three times. Selected samples picked up, put in labeled paper bags and transferred to the laboratory, where the *T. absoluta* immature stages (eggs and larvae) were examined and counted on the two leaf surfaces with the aid of a stereo–microscope.

For studying the effect of intercropping, for the tested aromatic plant species with tomato crop on the infestation of *T. absoluta* stages and their associated predators .

Treatments were; tomato + geranium, tomato + spearmint, tomato + Rosemary, tomato + sweet basil and tomato only (control). Charmin tomato cultivar was chosen as a major common variety (main crop).

Population fluctuations of *T. absoluta* stages (eggs, larvae and larvae mines) and associated predators; *Cheysoperla carnea* Stephens. (eggs, larvae and adults), *Paederus alfieri* Koch (adults), *Scymnus* spp. (larvae and adults), spiders (spider lings and adults) and *Nesidiocoris tenuis* (adults and nymphs) were investigated at 60

(3 leaflets/plants) plants/replicate. Inspection started 15 days after transplanting for leaf infestation and 30days for with first fruit occurrence, and continued biweekly till the end of crop season.

Statistical Analysis:

The obtained data were treated statistically according Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Population fluctuations of *Tuta absoluta*:

The effect of intercropping system on tomato infestation with *Tuta absoluta* stages crop with the four aromatic plant (geranium, spearmint, rosemary and sweet basil plants) during two seasons (2013 and 2014) are presented in Tables (1 to 5).

1.1.Intercropping geranium plants with tomato crop:

During 2013 season, fluctuation of *T. absoluta* eggs and larvae infesting leaflets were classified into tow peaks. The first one was on June 6th and the second peak on July 18th. The highest mean number were 8.75 eggs and 6.50 larvae/60 leaflets in June 6th, however, the lowest mean number of *T. absoluta* eggs was 0.75 eggs and 0.25 larvae/60 leaflets in the 1st sample (Table 1).

Table (1): Effect of intercropping geranium plants with tomato on the mean number of *Tuta absoluta* stages during 2013 and 2014 seasons.

Sampling date	Mean No. of stages							
	2013				2014			
	Eggs	Larva on leaflets	Larva on fruits	Mines	Eggs	Larva on leaflets	Larva on fruits	Mines
1/5	0.75	0.25	-	2.25	0.50	0.25	-	2.00
8/5	1.25	1.00	-	3.75	1.0	2.25	-	3.25
15/5	3.50	2.50	-	5.50	2.75	3.25	-	5.00
22/5	5.25	3.25	-	6.75	5.00	3.00	-	6.50
29/5	7.75	5.50	0.75	7.25	7.00	5.00	0.50	6.75
6/6	8.75	6.50	1.25	9.50	8.00	6.25	1.00	9.0
13/6	7.00	4.25	1.50	6.50	6.25	4.00	1.00	5.75
20/6	3.75	2.25	2.25	4.25	3.00	2.25	1.75	4.00
27/6	3.50	1.50	3.00	3.50	2.75	1.25	2.75	3.25
4/7	4.25	2.00	5.00	2.75	3.50	1.75	4.50	2.00
11/7	5.00	2.50	2.50	4.75	4.25	2.25	2.25	3.50
18/7	6.75	3.75	1.75	3.50	6.25	3.75	1.25	3.25
25/7	5.00	1.75	0.50	2.25	4.00	1.00	0.50	1.75
2/8	2.00	0.25	0.25	2.00	1.25	0.25	0.25	1.500
Total	63.50	37.25	18.75	64.50	55.50	36.50	15.75	57.50
Over all mean	4.54	2.66	1.88	4.61	3.96	2.61	1.58	4.11

Fluctuations of *T. absoluta* larvae infesting fruits was classified into one peak on July 4th. The highest mean number of *T. absoluta larvae* infesting tomato fruits was 5.00 larvae/60 fruits in July 4th, and the lowest was 0.25 larvae/60 fruits in the last sample (Table 1).

Fluctuation of *T. absoluta* larva mines on leaflets was divided into two peaks, the 1st in June 6th, and the 2nd in July 11th. The highest mean number of *T. absoluta* larvae mines was 9.50 larvae mines in June 6th, and the lowest was 2.00 larvae mines/60 leaflets in the last sample (Table 1).

Population fluctuations of *T. absoluta* stages during 2014 season was similar to that of 2013 (Table 1).

1.2. Intercropping spearmint plants with tomato crop:

Data in Table (2) showed two peaks of *T. absoluta* eggs during 2013 season; the 1st one on June 6th and the 2nd on July 18th. The highest mean number of *T. absoluta* eggs was 13.50 eggs/60 leaflets in June 6th, however, the lowest mean number of *T. absoluta* eggs was 5.00 eggs/60 leaflets in the 1st sample. According to larvae infesting leaflets were two peaks, the 1st one on June 6th, and the 2nd in July 11th. The highest mean number of *T. absoluta* larvae was 12.50 larvae/60 leaflets on June 6th, however, the lowest mean number of *T. absoluta* was 4.00 larvae/60 leaflets in the 1st sample.

Table (2): Effect of intercropping spearmint plant with tomato on the mean number of *Tuta absoluta* stages during 2013 and 2014 seasons .

Sampling date	Mean No. of stages							
	2013				2014			
	Eggs	Larva on leaflets	Larva on fruits	Mines	Eggs	Larva on leaflets	Larva on fruits	Mines
1/5	5.00	4.00	-	5.75	4.25	3.25	-	5.25
8/5	8.75	7.00	-	8.50	8.25	6.25	-	8.00
15/5	9.75	8.25	-	9.00	9.00	7.75	-	8.75
22/5	10.75	10.00	-	11.25	10.00	9.25	-	11.00
29/5	12.50	11.00	4.75	11.75	11.75	10.50	4.25	11.50
6/6	13.50	12.50	5.50	13.25	12.75	12.25	5.00	13.00
13/6	12.75	6.25	6.25	7.25	11.75	5.75	6.00	7.00
20/6	7.50	5.50	7.25	6.25	6.75	5.00	7.00	5.75
27/6	7.25	6.75	8.25	7.50	6.25	6.25	7.50	7.25
4/7	8.50	8.75	9.00	9.25	7.50	8.00	8.25	9.00
11/7	11.00	10.00	3.75	11.25	10.25	9.75	3.25	11.00
18/7	13.25	9.25	3.25	10.50	12.50	8.75	2.75	10.25
25/7	12.00	8.75	2.75	9.50	11.25	8.00	2.25	9.25
2/8	10.00	7.00	2.50	8.25	9.25	6.25	2.00	8.00
Total	142.50	115.00	53.26	129.25	131.50	107.00	48.25	160.00
Over all mean	10.18	8.21	5.33	9.23	9.39	7.64	4.83	8.93

Fluctuations of *T. absoluta* larvae infesting fruits recorded only one peak on July 4th. While the highest mean number of *T. absoluta* infesting tomato fruits was 9.00 larvae/60 fruits on July 4th, and the lowest was 2.5 larvae/60 fruits in the last sample (Table 2). Fluctuation of *T. absoluta* larvae mines infesting leaflets was classified into tow peaks, the 1st one on June 6th, and the 2nd on July 11th. The highest mean number of *T. absoluta* larvae mines was 13.60 larvae mines/60 leaflets on June 6th, however, the lowest mean number of *T. absoluta* larvae mines was 5.75 larvae mines/60 leaflets in the 1st sample. Population fluctuation of *T. absoluta* stages during 2014 season was similar to that of 2013 (Table 2).

1.3. Intercropping rosemary plants with tomato crop :

During 2013season, fluctuation of *T. absoluta* eggs was classified into two peaks, the 1st one on June 6th and the 2nd on July 25th. The highest mean number of *T. absoluta* eggs was 38.00 eggs/60 leaflets on June 6th, however, the lowest mean number of *T. absoluta* eggs was 7.75 eggs/60 leaflets in the 1st sample (Table 3).

Table (3): Effect of intercropping rosemary plants with tomato on the mean number of *Tuta absoluta* stages during 2013 and 2014 seasons.

Sampling date	Mean No. of stages							
	2013				2014			
	Eggs	Larva on leaflets	Larva on fruits	Mines	Eggs	Larva on leaflets	Larva on fruits	Mines
1/5	7.75	4.50	-	5.25	7.00	4.00	-	5.00
8/5	12.50	8.75	-	9.50	11.75	8.50	-	9.25
15/5	15.00	10.75	-	11.75	14.25	8.00	-	11.25
22/5	20.75	12.00	-	18.25	20.00	10.50	-	18.00
29/5	27.50	19.50	7.50	26.25	26.75	16.50	7.00	25.75
6/6	38.00	25.00	8.75	37.75	37.50	23.75	8.00	37.25
13/6	17.25	33.50	10.00	15.25	16.50	35.00	9.50	15.00
20/6	12.50	9.00	21.50	10.50	11.75	13.00	21.00	10.00
27/6	11.50	8.00	32.50	9.75	10.50	8.25	32.00	9.25
4/7	12.50	8.50	11.00	10.25	11.75	7.75	10.50	9.75
11/7	15.00	11.75	6.75	13.25	14.25	11.00	6.25	12.50
18/7	18.75	15.50	5.00	17.50	18.00	15.25	4.25	17.00
25/7	19.25	16.00	7.75	16.75	18.75	15.00	7.00	16.25
2/8	17.50	13.50	10.00	14.25	16.75	12.50	9.50	14.00
Total	245.75	196.25	120.75	216.25	235.50	189.00	115.00	210.25
Over all mean	17.55	14.02	12.08	15.45	16.82	13.50	11.50	15.02

Fluctuation of *T. absoluta* larvae infesting leaflets was observed into two peaks, the 1st one on June 13th, and the 2nd on July 25th. The highest mean number of *T. absoluta* larvae infesting leaves was 33.50 larvae/60 leaflets on June 13th, however, the lowest mean number of *T. absoluta* larvae was 4.50 larvae/60 leaflets in the 1st sample (Table 3).

Fluctuations of *T. absoluta* larvae infesting fruits was classified into tow peaks, the 1st one peak on June 27th and the 2nd on August 2nd. The highest mean number of *T. absoluta* larvae infesting tomato fruits was 32.50 larvae/60 fruits in June 27th, and the lowest was 5.00 larvae/60 fruits on July 18th (Table 3).

Fluctuation of *T. absoluta* larvae mines infesting leaflets was divided into two peaks, the 1st one on June 6th, and the 2nd on July 18th. The highest mean number of *T. absoluta* larvae mines infesting leaves was 37.75 larvae mines/60 leaflets on June 6th, however, the lowest mean number of *T. absoluta* larvae mines was 5.25 larvae mines/60 leaflets in the 1st sample (Table 3).

Population fluctuation of *T. absoluta* stages during 2014 season was similar to that of 2013 (Table 3).

1.4. Intercropping sweet basil plants with tomato crop:

During 2013 season, fluctuation of *T. absoluta* eggs was divided into two peaks, the 1st one on May 29th and the 2nd on July 25th. The highest mean number of *T. absoluta* eggs was 51.25 eggs/60 leaflets on May 29th, however, the lowest mean number of *T. absoluta* eggs was 12.75 eggs/60 leaflets in the 1st sample (Table 4).

Fluctuations of *T. absoluta* larvae and larvae mines infesting leaflets were classified into two peaks the one on June 6th and the 2nd on July 25th. The highest mean number of *T. absoluta* larvae and larvae mines infesting leaves were 49.25 larvae and 55.00 larvae mines/60 leaflets on June 6th, however, the lowest mean number of *T. absoluta* larvae and larvae mines were 10.75 larvae and 13.00 larvae mines/60 leaflets in the last sample and on June 27th, respectively (Table 4).

Fluctuations of *T. absoluta* larvae infesting fruits was divided into two peaks the 1st one on June 20th and the 2nd on July 11th. The highest mean number of *T. absoluta* larvae infesting tomato fruits was 44.25 larvae/60 fruits on June 20th, and the lowest was 7.50 larvae/60 fruits in the last sample (Table 4).

Population fluctuation of *T. absoluta* stages during 2014 season was similar to that of 2013 (Table 4) .

Table (4): Effect of intercropping sweet basil plants with tomato on the mean number of *Tuta absoluta* stages during 2013 and 2014 seasons.

Sampling date	Mean No. of stages							
	2013				2014			
	Eggs	Larva on leaflets	Larva on fruits	Mines	Eggs	Larva on leaflets	Larva on fruits	Mines
1/5	12.75	10.75	-	15.25	12.25	10.25	-	15.00
8/5	22.50	18.75	-	20.75	22.00	18.00	-	20.25
15/5	29.75	27.50	-	30.50	29.25	27.00	-	29.25
22/5	40.00	37.25	-	40.75	39.25	36.75	-	40.25
29/5	51.25	40.75	19.25	49.75	51.75	40.25	19.00	49.00
6/6	43.00	49.25	25.75	55.00	42.25	49.00	25.25	54.75
13/6	39.25	35.75	30.75	41.50	39.00	35.50	30.00	41.00
20/6	25.00	22.50	44.25	25.25	24.50	22.25	44.00	25.00
27/6	13.75	11.0	28.75	13.00	13.25	10.50	28.25	12.50
4/7	21.25	17.00	18.25	20.25	21.00	16.75	17.75	19.75
11/7	28.75	25.75	27.00	31.75	28.25	25.25	26.25	31.25
18/7	32.25	30.50	16.50	35.25	32.00	30.00	16.00	34.75
25/7	40.50	35.25	10.50	40.75	40.25	34.75	10.00	40.25
2/8	21.25	17.25	7.50	21.50	21.50	17.00	7.25	21.00
Total	421.25	379.25	228.50	441.25	416.50	373.25	223.75	434.00
Over all mean	30.09	27.09	22.85	31.52	29.75	26.66	22.38	31.00

1. 5. Population fluctuations of *T. absoluta* stages on tomato plants:

The fluctuations of *T. absoluta* eggs were divided into two peaks, the 1st one on May 29th and the 2nd on August 2nd. The highest mean number of *T. absoluta* eggs was 60.75 eggs/60 leaflets on August 2nd, however, the lowest mean number of *T. absoluta* eggs was 16.50 eggs/60 leaflets in the 1st sample (Table 5). The *T. absoluta* larvae infesting leaflets was classified into tow peaks, the first one on June 6th and 2nd in the last sample. The highest mean number of *T. absoluta* larvae infesting leaves was 60.00 larvae/60 leaflets in last sample, however, the lowest mean number of *T. absoluta* larvae was 14.75 larvae/60 leaflets in the 1st sample (Table 5).

Fluctuations of *T. absoluta* larvae infesting fruits was one peak the on July 25th. The highest mean number of *T. absoluta* larvae infesting tomato fruits was 60.75 larvae/60 fruits on July 25th, and the lowest was 29.75 larvae/60 fruits on the May 29th (Table 5). Fluctuation of *T. absoluta* larvae mines infesting leaflets was divided into two peaks, the 1st one on June 13th, and the 2nd on July 25th. The highest mean number of *T. absoluta* larvae mines infesting leaves was 86.00 larvae mines/60 leaflets on July 25th, however, the lowest mean number of *T. absoluta* larvae mines was 21.75 larvae mines/60 leaflets in the 1st sample (Table 5).

Population fluctuation of *T. absoluta* stages during 2014 season was similar to that of 2013 (Table 5).

Table (5): Mean number of *Tuta absoluta* stages infesting tomato plants during 2013 and 2014 seasons.

Sampling date	Mean No. of stages							
	2013				2014			
	Eggs	Larva on leaflets	Larva on fruits	Mines	Eggs	Larva on leaflets	Larva on fruits	Mines
1/5	16.50	14.75	-	21.75	16.00	14.00	-	21.00
8/5	35.75	30.00	-	40.75	35.25	19.75	-	40.50
15/5	42.75	41.25	-	42.50	42.00	41.00	-	42.25
22/5	54.50	52.75	-	52.25	53.50	52.50	-	51.00
29/5	60.00	53.75	29.75	54.25	60.00	53.25	29.25	54.75
6/6	55.75	58.50	31.00	60.50	55.00	57.50	30.50	60.00
13/6	42.75	41.25	36.50	76.75	42.50	40.75	35.75	76.25
20/6	35.00	30.00	43.75	48.50	34.75	29.50	43.25	48.25
27/6	32.50	28.75	45.00	50.75	31..75	28.25	44.50	50.25
4/7	41.00	39.50	47.75	61.75	40.25	39.00	47.00	61.00
11/7	48.50	42.50	54.75	66.50	48.25	41.75	54.25	66.25
18/7	54.75	50.75	60.00	74..75	52.50	50.50	59.50	74.50
25/7	60.00	55.25	60.75	86.00	58.50	54.75	60.25	85.50
2/8	60.75	60.00	54.50	77.75	60.00	60.00	54.25	77.25
Total	640.50	599.00	463.75	815.02	630.25	582.50	458.50	808.75
Over all mean	45.75	42.79	46.375	58.22	45.02	41.61	45.85	57.77

2. Effect intercropping aromatic plants with tomato plants on *Tuta absoluta* infestation :

The effect of intercropping system of tomato plants as the major crop with geranium, spearmint, rosemary and sweet basil on the density of infestation of *T. absoluta* stages during 2013 and 2014 seasons are presented in Table (6) with their statistical analysis.

Intercropping, significantly reduced *T. absoluta* population in the two seasons with these population being consistently lower in geranium + tomato, spearmint + tomato, rosemary + tomato and sweet basil + tomato intercropping than in sole tomato crop.

Table (6): Effect of four aromatic plant with tomato on mean number of *Tuta absoluta* stages during 2013 and 2014 seasons.

Treatment	Mean No. of stages							
	2013				2014			
	Eggs	Larva on leaflets	Larva on fruits	Mines	Eggs	Larva on leaflets	Larva on fruits	Mines
Geranium + tomato	4.54a	2.66a	1.88a	4.61a	3.96a	2.61a	1.58a	4.11a
Spearmint+ tomato	10.18b	8.21b	5.33b	9.23b	9.39b	7.64b	4.83b	8.93b
Rosemary +tomato	17.55c	14.02c	12.08c	15.45c	16.82c	13.50c	11.50c	15.02c
Sweet basil + tomato	30.09d	27.09d	22.85d	30.09d	29.75d	26.66d	22.38d	31.00d
Tomato (only)	45.75e	42.79e	46.38e	58.22e	45.02e	41.61e	45.84e	57.77e

Means followed by a common letter are not significantly different at the 5% level by DMRT

The results of the present study agree with those obtained by other authors that intercropping has the ability to reduce the injurious on harmful insects. Sinthananthem *et al.* (1990) and Ogenga-Latigo *et al.* (1992) reported that intercropping cowpea with maize reduced the incidence of *Aphis fabae* Scop. on cowpea than sole cropped cowpea. Nampala *et al.* (2002) reported that mixed cropping of cowpea with sorghum reduced infestation by aphids. Hassan (2009) found that cowpea + sorghum intercrop reduced aphid *(Aphis craccivora* Koch.) population significantly compared to sole cowpea crop. Khafagy (2011) reported that, intercropping system of kidney bean with sweet basil, geranium, peppermint, spearmint and hot pepper showed highly reduction of *Bemisia tabaci* (Gennadius) (eggs, nymphs and adults) compared to kidney bean sole. El-Fakharany *et al.* (2012) found that, the intercropping of faba bean plants led to higher infestation rate of *Pegomia. mixeta* (Vill.) larvae in two season and *Casida vittata* (Vill.) in the first season. Nan-host volatiles have been found to be repellent and/ or deterrent for a number of insect species in various insect orders: *e. g.* Coleoptera (Schroeder, 1992; Mauchline *et al.*, 2005), aphids (Homoptera: Aphididae) (Nottingham *et al.*, 1991 ; Hardie *et al.*, 1994; Pettersson *et al.*, 1994 and Agelopoulos *et al.*, 1999), Lepidoptera (Khan *et al.*, 2000; McNair *et al.*, 2000 and Liu *et al.*, 2005), Diptera (Linn *et al.*, 2005) and Hymenoptera (Gohole *et al.*, 2003). The odors given off a non-host plant repel the searching insects. Aromatic plants have been suggested to be particularly repellent for host seeking insects (Uvah and Coaker, 1984).

The results obtained agreed with those obtained by other authors that intercropping has the ability to reduce *T. absoluta* and other insects.

El-Gobary, *et al.* (2014) found that, okra plants intercropped with aromatic plants reducing the infestation percentages of *T. absoluta* stages the associated numbers of predators compared to control (tomato solely) .

3. Associated predators:

Data recorded in Table (7) indicated that tomato plants intercropping with spearmint plants were appeared to be the highest population density of *Chrysoperla carnea* in the two seasons, compared with either control (tomato only) or the other three intercropping tested. The highest mean number of *Paederus alfierii* was on tomato plants intercropping with rosemary plants during two seasons compared with either control and intercropping tested. The highest mean number of *Coccinela* spp. was on tomato intercropping with sweet basil during two seasons, compared with either control (tomato sole) or any intercropping system tested. The same pattern was also obtained for the population density of *Scymnus* spp. and of the *Nesidioris tenuis* pages during the two seasons, compared with control (tomato only) and either intercropping system used.

The highest population density of the true spiders was observed with tomato intercropping with geranium in the two tested seasons, compared with control (tomato only) and either intercropping system used (Table 7).

Al-Fakharany *et al.* (2012) reported that, sugar beet plants intercropped with maize, faba bean and cabbage plants were the highest density of *C. carnea, P. alfierii, Scymnus* spp. and true spider during the two seasons, compared with either control (sugar beet plants).

El-Gobary, *et al.* (2014) found that, okra plants intercropped with aromatic plants increase the associated numbers of predators compared to control (tomato solely). Natural enemies (*i. e.* predators and parasitoids) of pest insects are thought to be more efficient in diverse environment because of greater diversity of pray/hosts and microhabitats. Because of the wide variety of herbivores that become available at different times or in different microhabitats, natural enemies can reach larger population sizes (Root, 1973). The availability of alternative prey and hosts is likely to mostly benefit generalist enemies. But, it has been shown that a better supply of pollen, nectar and honeydew might increase the effectiveness also of specialized predators and parasitoids. In addition, diversified communities provide better habitats for natural enemies because they have a larger variation in microclimates and microhabitats and thus provide better shelter to escape adverse condition (Jactel *et al.*, 2005). Indeed, a literature survey have shown that 68 (53%) of total of 130 natural enemy species had higher population densities in polyculturs compared to monocultures, whereas in only 9% of the cases, lower population densities were observed (Andow, 1991).

Table (7): Efficiency of intercropping of four tested aromatic plant species with tomato plants on the population density of some predators compared with on sol tomato at El- Riad City, Kafr El-Sheikh Governorate during 2013 and 2014 seasons.

Treatment	Season	Mean No./20 plants					
		Chrysoperla carnea	*Coccinela* spp.	*Paederus alfierii*	*Scymnus* spp.	True spiders	*Nesidioris tenuis*
Sweet basil + tomato	2013	18.25	24.75	16.25	34.75	30.50	31.25
Rosemary + tomato		11.75	15.25	28.50	17.50	28.00	22.25
Spearmint +tomato		27.25	14.50	20.25	21.75	19.75	21.25
Geranium + tomato		10.75	12.00	15.75	16.50	39.50	18.25
Tomato (only)		7.25	8.75	12.00	14.75	17.25	16.50
Sweet basil + tomato	2014	19.75	23.75	16.00	34.25	30.00	32.00
Rosemary+ tomato		10.25	14.50	28.50	17.25	27.50	22.00
Spearmint +tomato		17.00	13.75	19.50	21.25	19.00	21.00
Geranium + tomato		10.25	11.50	14.75	16.00	38.00	17.50
Tomato (only)		7.00	8.25	11.75	14.25	17.00	16.25

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الملخــص

دور بعض النباتات الطبية والعطرية المحملة مع نباتات الطماطم فى خفض الإصابة بحافرة أوراق الطماطم (توتا أبسليوتا) والمفترسات المصاحبة لها

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أجريت هذه التجربة فى منطقة الرياض بمحافظة كفر الشيخ خلال موسمى ٢٠١٣ و٢٠١٤م وذلك لدراسة أثر تحميل بعض النباتات العطرية على الإصابة بحشرة حافرة أوراق الطماطم على محصول الطماطم والمفترسات المصاحبة لها. ولقد كانت النباتات العطرية محل الدراسة هى: العتر' النعناع البلدي 'حصا البان والريحان مع محصول الطماطم مقارنة بالطماطم منفردة على الكثافة العددية لحشرة حافرة أوراق الطماطم وأعدائها الحيوية.

أوضحت النتائج انخفاض الإصابة بحشرة حافرة اوراق الطماطم عند تحميل النباتات محل الاختبار على الطماطم وبخاصة تحميل العتر على الطماطم تلاه تحميل النعناع البلدى ثم حصا البان' ثم تحميل الريحان مقارنة بزراعة الطماطم منفردة.

كما أظهرت هذه الدراسة أن تحميل الريحان مع الطماطم كان الأكثر جذباً لمفترس أبو العيد، بينما تحميل النعناع البلدى كان أكثر جذباً لأسد المن وذلك مقارنة بالمعاملات الأخرى.