INFLUENCE OF INTERCROPPING ON THE POPULATION DYNAMICS OF SOME INSECT PESTS INFESTING POTATO, *SOLANUM TUBEROSUM* L. IN NORTH SINAI , EGYPT

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INTRODUCTION

The present and future role of the potato, *Solanum tuberosum* L. crop as staple food in developing countries has been discussed (El-Marzoki, 1975; Woodford, 1983; El-Sayed, 1985 and Pavek, 1987). Potato as an economic vegetable crop in Egypt is attacked in the field and store by various insect pests which cause considerable losses. The most serious insect pests of potato plants are whitefly (*Bemisia tabaci* (Gennandius)), aphids (*Myzus persicae*), thrips (*Thrips tabaci* Lind.) and the leaf hopper (*Empoasca discipiens* Paoli.).

Intercropping produces more vigorous and less damaged crops by insect pests and viral diseases (Potts and Gunadi 1991; Ali *et al.*, 1994 and 1995, Davis and Fick 1995; Theunissen 1997; Alghali *et al.* 1999; Razvi *et al.* 1999; Finch and Collier 2000 and Mogahed, 2005).

To avoid the high cost of pesticides and their adverse effects on the environment, intercropping of potato with perennial crops, and multiple cropping, such as potatoes grown alone and with onion (*Allium cepa* L.) or garlic (*Allium sativum* L.) plants, was carried out associated with the yellow sticky traps to study the efficacy in controlling major pests *i.e. B. tabaci, T. tabaci, M. persicae* and *E. discipiens* attacking potato crop under field conditions.

MATERIAL AND METHODS

Field experiment was conducted during the winter season (from December to April) of 2003-2004 and 2004-2005 in the potato field of Oam Shyhan area, and a field in Al-Arish district, North Sinai Governorate.

Tubers of Nicola or Spunta potato cultivars were planted in rows alternate with each associated crops, viz onion or garlic. The crops were selected according to their suitability in the agroclimatic conditions of the planting season. A check plot, planted with potato alone (monocropping) was used for comparison. The experimental design was a complete randomized blocks with 3 replicates.

Yellow sticky paper traps :

The sticky paper traps were used in the field of experiment mainly to catch the cotton whitefly, cotton or onion thrips, the winged insect of potato aphids and potato leaf hopper.

Each yellow paper strip (12 cm x 25 cm) was fixed to a wooden plate (20 cm x 25 cm), this plate was fixed to a wooden stand and can be adjusted according to the hights of potato plants (30 cm above the foliage of the plants). The sticky traps were placed in the field of experiment in the first week of potato seedlings appearance above the soil.

The traps were distributed both in the intercropped and mon-cultured potato plant fields. The traps were located in the middle of each plot (Plot = 4 m X 5 m). The yellow paper strips were renewed weekly. The number of insects caught by the sticky traps were counted and the monthly averages of insect population were recorded till harvest of the crop.

RESULTS AND DISCUSSION

A) Al-Arish area :

Cotton whitefly *Bemisia tabaci* (Gen.) recorded one peak in December (season 2003-2004) on Spunta potato, followed by "Nicola" potato (Table 1). However, the lowest number of whitefly was recorded in Nicola potato + garlic, recording 10.6 insect/month. Nicola potato showed the least infestation of whitefly compared with Nicola intercropped with onion plants (11 insect/month) and Nicola alone which was most infested one with whitefly (21.4 insect/month). The same trend of insect activity of whitefly was recorded on Spunta potato. However, Spunta potato alone was the most infested with whitefly (36.6 insect/month) followed by Spunta associated with onion (20.8 insect/month); Spunta with garlic plants showed the lowest infestation of whitefly (15.4 insect/month). So the, Spunta potato alone or associated with onion or garlic showed higher infestation with white-fly than Nicola alone or intercropped with onion or garlic plants.

The activity of thrips (*Thrips tabaci* Lind.) throughout months of the season (2003-2004 and 2004-2005) on varieties Nicola and Spunta potato plants was recorded in Table (1). The lowest average number of insects was recorded on Spunta potato + garlic plants (6.2 insect/month), while Spunta potato alone was the most infested with thrips followed by Spunta potato + onion plants (14.4 and 15.8 insects/month), respectively. The same trend was recorded in Nicola potato; infestation in Nicola potato alone (17.8 insects/month) and in Nicola + onion plants (19.4 insects/month) were higher than Nicola potato + garlic plants (6.4 insects/month) infestation.

In general, Nicola potato alone or intercropped showed less infestation with thrips than in case of Spunta potato.

The potato leaf hoppers (*Empoasca discipiens* Paoli) appeared in December and was increased during February to April.

Spunta potato + gerlic was the least infested with potato leaf hoppers (4.8 insects/month) followed by Spunta potato + onion plants (12 insects/month), while Spunta potato alone was (15.8 insects/month). Moreover, Nicola potato + garlic plants recieved lesser infestation with potato leaf hopper (6.4 insects/month) than Nicola + onion plants (9.6 insects/month). Nicola alone was the most infested with potato leaf hopper (12.6 insects/month).

Thus, varieties of Nicola and Spunta alone showed higher infestation with potato leaf hoppers than those intercropped, while Nicola + garlic plants and Spunta potato + garlic were least infested with the leaf hopper.

Concerning the activity of potato aphids (*Myzus persicae* Sulzer), data in Table (1) revealed that varieties of Nicola or Spunta potato alone have considerable average numbers of potato aphids (2.8 and 3.0 insects/month), respectively. However, Spunta potato or Nicola potato intercropped with onion or garlic plants were less infested with the aphids and showed respective ranges between 1.0 - 1.8 insect/month.

With the same trend, field experiments were conducted by Potts and Gunadi (1991) in Indonesia to investigate the effects of intercropping a potato crop with *Allium cepa* or *A. sativum* on insect populations and found that intercropping reduced populations of *Myzus persicae*, *Aphis gossypii* and *Empoasca* spp.

TABLE (I)

Insect population collected from yellow sticky traps from intercropped and solo potato plants at Al-Arish province North Sinai Governorate (2003-2004 and 2004-2005).

Crop combination	Insect pest	Average number of insects caught by sticky traps							Significant F-values
		December 2003 and 2004	January 2004 and 20051	February 2004 and 2005	March 2004 and 2005	April 2004 and 2005	Total	Monthly average	
"Nicola" potato	*B.tabaci*	80	15	10	2	0	107	21.4	1.03 (-)
	T.tabaci	6	10	16	21	36	89	17.8	
	E.discipiens	7	10	12	14	20	63	12.6	
	*M.persicae**	4	3	3	2	2	14	2.8	
"Nicola" potato + onion	*B.tabaci*	28	19	7	1	0	55	11.0	2.89 (-)
	T.tabaci	8	7	19	23	40	97	19.4	
	E.discipiens	2	6	11	13	16	48	9.6	
	*M.persicae**	2	3	2	1	1	9	1.8	
"Nicola" potato + garlic	*B.tabaci*	39	11	3	0	0	53	10.6	0.85 (-)
	T.tabaci	3	6	6	9	12	36	7.2	
	E.discipiens	1	2	7	10	12	32	6.4	
	*M.persicae**	2	3	3	1	0	9	1.8	
"Spunta" potato	*B.tabaci*	140	37	6	0	0	183	36.6	1.05 (-)
	T.tabaci	7	10	12	18	25	72	14.4	
	E.discipiens	2	9	20	23	25	79	15.8	
	*M.persicae**	4	5	3	2	1	15	3.0	
"Spunta" potato + onion	*B.tabaci*	63	30	9	2	0	104	20.8	1.741
	T.tabaci	5	11	14	21	28	79	15.8	
	E.discipiens	3	9	15	16	17	60	12.0	
	*M.persicae**	1	2	1	1	0	5	1.0	
"Spunta" potato + garlic	*B.tabaci*	45	24	8	0	0	77	15.4	1.60
	T.tabaci	1	2	4	8	16	31	6.2	
	E.discipiens	Zero	1	5	6	12	24	4.8	
	*M.persicae**	2	3	2	1	1	9	1.8	

+ Significant at F (0.05)
(-) Not significant.
*Winged aphids.

b) Oam-Shyhan area:

As for Oam-Shyhan area, data in Table (2) revealed that Nicola potato + garlic plants showed less infestation with whitefly (5.2), cotton or onion thrips (13), potato leaf hoppers (8.8) and potato aphids (0.6 insect/month) than Nicola potato + onion plants which showed 11.2 for whitefly, 22.4 for thrips, 9.8 for potato leaf hoppers and 1 insect/month for aphids. However, Nicola potato alone was the most infested with whitefly (23.2), potato leaf hoppers (17.4) and potato leaf aphids (2.6). On the other hand, Spunta potato + garlic plants were less infested with thrips (8.6) followed by potato leaf hoppers (6.8) and aphids (0.4) than Spunta potato + onion plants in which the average number caught by yellow sticky traps was 14.6 for thrips; 11.2 for potato leaf hopper, 6.4 for whitefly and 0.8 for aphids; while Spunta potato alone showed highest infestation with the tested insect. The average number of insects per month reached 19.4 for leaf hoppers, 11.2 for thrips, 9.8 for whitefly and 2 for aphids.

The potato varieties (Nicola & Spunta) intercropped with garlic plants were less infested with *T. tabaci* than the same varieties of potato (alone or associated with onion). The results are in agreement with Sharaf El-Din *et al.* (1995) who found that intercropping of onion with cotton cultivated in ridges was the most suitable cultural system for reduicng the infestation of *T.tabaci, A. gossypii* and *B. tabaci* on onion plants.

Based on the foregoing data, it was concluded that Nicola potato alone and Spunta potato alone was found to have higher infestation with whitefly, thrips, leaf hoppers and aphids than those intercropped with onion.

Both varieties of potato (Nicola & Spunta) associated with garlic plants were less infested with whitefly, thrips, leaf hopper and aphids than alone or associated with onion. The present results are in the same trend with those found by Parajulee *et al.*, (1997) who suggested that where cotton is grown without insecticides, relay intercropping aids the early arrival and continuous population increase of predators in cotton, thereby reducing number and postponing the initial population increase of *A. gossypii.*

The role of integration system (intercropping-sticky traps) on the yield of potato varieites (Nicola & Spunta) :

Data in Table (3) indicated that highest yield of potato tubers was 6857.1 kg/ha both in Oam Shyhan and in Al-Arish area in the potato plants of Spunta variety associated with onion and it was followed by the association of garlic plants (5142.9) when compared to 3142.9 kg/ha. in Spunta potato alone (in Oam Shyhan

TABLE (II)

Insect population collected from yellow sticky traps installed in intercropped and mon-cultured potato crops at Oam Shyhan province, North Sinai Governorate (2003-2004 and 2004-2005)

Crop combination	Insect pest	Average number of insects caught by sticky traps							Significant F-values
		December 2003 & 2004	January 2004 & 2005	February 2004 & 2005	March 2004 & 20051	April 2004 & 2005	Total	Monthly average	
"Nicola" potato	*B.tabaci*	77	32	7	0	0	116	23.2	1.17 (-)
	T.tabaci	7	8	16	20	32	83	16.6	
	E.discipiens	2	10	20	25	30	87	17.4	
	*M.persicae**	3	2	2	2	4	12	2.6	
"Nicola" potato + onion	*B.tabaci*	50	4	2	0	0	56	11.2	2.41 (-)
	T.tabaci	10	14	10	31	37	112	22.4	
	E.discipiens	2	5	11	15	16	49	9.8	
	*M.persicae**	1	2	2	0	0	5	1.0	
"Nicola" potato + garlic	*B.tabaci*	20	4	2	0	0	26	5.2	4.78 (*)
	T.tabaci	7	10	14	16	18	65	13.0	
	E.discipiens	2	7	8	12	15	44	8.8	
	*M.persicae**	1	1	1	0	0	3	0.6	
"Spunta" potato	*B.tabaci*	25	21	2	1	0	49	9.8	2.26 (-)
	T.tabaci	2	5	11	17	21	56	11.2	
	E.discipiens	2	10	15	30	40	97	19.4	
	*M.persicae**	3	3	2	1	1	10	2.0	
"Spunta" potato + onion	*B.tabaci*	16	13	3	0	0	32	6.4	3.82 (*)
	T.tabaci	4	10	16	18	25	37	14.6	
	E.discipiens	3	6	8	16	23	56	11.2	
	*M.persicae**	2	1	1	0	0	4	0.8	
"Spunta" potato + garlic	*B.tabaci*	49	8	2	0	0	59	11.8	0.89 (-)
	T.tabaci	2	7	10	11	13	43	8.6	
	E.discipiens	0	0	7	10	17	34	6.8	
	*M.persicae**	1	1	0	0	0	2	0.4	

+ Significant at F (0.05).
(-) Not significant.
*Winged aphids.

TABLE (III)

Effect of intercropping with potato and use of yellow sticky traps on the yield of potato at Oam Shyhan area, and Al-Arish area during 2003-2004 and 2004-2005.

Treatments	Oam Shyhan area		Al-Arish area	
	Average yield (kg/ha.)			
	Monocropping*	Intercropping**	Monocropping*	Intercropping**
"Nicola" potato	628.6	-	628.6	-
"Nicola" potato+ onion	-	3142.9	-	1714.3
"Nicola" potato + garlic	-	2323.8	-	1761.9
"Spunta" potato	3142.9	-	2409.5	-
"Spunta" potato + onion	-	6857.1	-	6857.1
"Spunta" potato + garlic	-	5142.9	-	6571.4

*Monocropping : Potato crop without intercropping and instalation of yellow sticky traps.

**Intercropping : Potato crop grown as intercrop and instalation of yellow sticky traps for insect collection.

area); their respective values were 6571.1 and 2409.5 kg/ha. (in Al-Arish area). The yield of Nicola potato was lower in monocropping system than in intercropping system in both of Oam Shyhan and Al-Arish area. The same trend was observed in the yield in Spunta potato (alone or associated). These results revealed that average yield of potato tubers in the tested varieties (Nicola & Spunta) grown alone was lower than those produced in intercroping system. The obtained results were supported by Coaker (1990) in UK, Cambridge University who concluded that intercropping which is a traditional method of crop production in the tropics, has potential for insect pest suppression in low-input farming in temperate regions.

In general, the obtained results supported the findings of many previous studies that the intercropping culture of the plants strongly influence insect population within agricultural field.

SUMMARY

A field experiment was conducted during the winter season (from December to April) of 2003-2004 and 2004-2005 at Oam Shyhan area, and Al-Arish area, North Sinai Governorate, Egypt. Tubers of potato varieties Nicola and Spunta were planted in alternate rows of each associated crops, viz onion (*Allium cepa* L.) and garlic (*Allium sativum* L.). The sticky paper traps were erected in experimental field to catch the cotton whitefly, *Bemisia tabaci*

(Gennandius), cotton or onion thrips, *Thrips tabaci* Lind., green peach aphid, *Myzus persicae* Sulzer and potato leaf hopper, *Empoasca discipiens* Paoli.

The potato varieties (Nicola & Spunta) when raised as intercropped had lesser infestation of cotton whitefly, cotton thrips, potato aphids, and potato leaf hoppers than the same varieties of potato grown alone. Intercropping potato plants with onion or garlic consistently produced the lowest infestation levels in Al-Arish and Oam Shyhan areas.

Based on the yield data, the impact of intercorpping of potato varieties in descending order could be arranged as Spunta + onion (6857.1 kg/ha.), Spunta + garlic (5142.9 kg/ha – 6571.4 kg/ha) followed by Nicola + onion (3142.9 kg/ha.). However, intercropping of Nicola variety with onion or garlic in Al-Arish area produced yield lasser than in Oam Shyhan area.

The average yield of potato tubers in the plots of potatoes grown alone reached 628.6 kg/ha for Nicola and was 2409.5 kg/ha for Spunta. The data clearly revealed that average yield of potatoes was significantly higher in intercropped plots compared to mono- cultured potatoes.

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