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THE EFFECT OF INTERCROPPING BROAD BEAN WITH TERMIS ON THE CORRESPONDING PEST INFESTATION AND PREDATORS ABUNDANCE IN EL-MENOFIA GOVERNORATE, EGYPT

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ABSTRACT: Field trials were conducted at Ashmoun region, El-Menofia Governorate during the two broad bean cultivated seasons 2005/2006 and 2006/2007 for studying the impact of intercropping of broad bean with termis on pest infestation and the related predators. The intensity of attack to broad bean differed greatly during the two growing seasons based on cropping pattern. It appears that termis is a preferable host had decreased aphids and spider mites population but increased the population of whitefly under different tested intercropping systems during the tested seasons. Also Termis showed alone less attractive than broad bean to jassids infestation. The population of the collected predaceous insects showed light increase under intercropping systems of broad bean with termis in 2005/2006 than 2006/2007 season. Highly significant values for the effect of system to the related predaceous insects abundance, but the interaction between systems and the tested seasons demonstrates reliable effect. The number of predaceous mites (Phytoseiidae and Tydeidae) was obviously higher on leaflets of broad bean intercropped fields with termis than in pure broad bean. The intercropping system for broad bean with termis also increase the abundance of spiders which were belonging to six dominanted families, namely Miturgidae,Thomisidae, Philodromidae, Salticidae, Theridiidae and Gnaphosidae

INTRODUCTION

Intercropping consideres the agricultural practice of cultivating two or more crops in the same habitat. It is commonly used in tropical zones, Altieri, 1991, but in Egypt is far or less widespread. Intercropping may demonstrates reliable crop yield or the treatment of related pests. Intercropping of compatible plants also encourages biodiversity, by providing a habitat for a varity of insects and soil bio-comonents that would not be occured in a single crop inhabiting selected environment

This biodiversity can in turn help to limit outbreaks of crop pests, Altieri, 1994 by increasing the diversity of abundance of related natural enemies, such as spiders or parasitic wasps. Such method demonstrates good results in Fayoum eco-system, based on wheat and clover, Ghabbour *et al.*, 1994, when using tomato and faba bean and tomato and termis, Rizk and Mikhail, 2000. Several advantages have been attributed to this polyculture system, one of them harbour lower susceptibility to pests and diseases infestation, Trenbath, 1974, and Dash *et al.*, 1987. Disadvantages of intercropping was reported by Tantawi *et al.*, 1992, who reported that certain crop combinations in the intercropping systems may increase damage losses. Jones and Gillett (2005) indicated that sunflower plantings within rows of vegetable crops may indeed be an effective way to attract beneficial insects inhabiting cropped fields. Faba bean, *Vicia faba* L. is one of the most important leguminous crops as a source of plant protein in Egypt. In the field, faba bean plants are attacked by several insects and mites. The most important sucking pests were mainly, leguminous aphid, *Aphis craccivora* (Koch) and to a certain extent jassids, *Empoasca* spp., Metwally *et al.*, 1997 and mite, *Tetranychus urticae* Koch, Taha *et al.*, 2002. These pests cause distinict injury to faba bean by sucking plant sap. The widespread use of pesticides for control of these pests create several problems i.e. environmental pollution, destruction of related beneficial insects, mites and true spiders and resistance to many pesticides. Consequently, it has indicated that urgent need for an Integrated Pest Management (IPM) strategy for their control. So faba bean was cultivated for evaluating the intercropping system with termis on the abundance and the population of the main phytophagus pests and their associated predators inhabiting El-Menofia district during 2005 / 2006 and 2006 / 2007 broad bean cultivated growing seasons, and this would help understand the advantages of intercropping over monocropping with regard to pest infestation and predators abundance on broad bean plants.

MATERIALS AND METHODS

Field trials was carried out at Ashmoun District, El-Menofia eco-system, during the 2005/2006 and 2006/2007 broad bean growing winter seasons. A field of one feddan was divided into three equal areas. The broad bean tested Varity was Giza 716. Seeds were sown in November 20^{th} , 2005 and 24^{th} , 2006 in complete randomized blocks. Each area included four similar replicates. Broad bean seeds were planted in hills with 3 cm depth and 25 cm appart. The natural agricultural practices were

counted including wedding, no insecticides used and irrigation was every 3 weeks. Phosphorien, (phosphate soluble bacteria) was sprayed 4 days after first irrigation. Then chemical fertilizers used 150 kg / feddan super phosphate (for land preparation), 150 kg / feddan calcium nitrate (for plant nutrition) and 50 kg / feddan potassium sulphate (for fruiting) as three different fertilization stages before the first three irrigations, respectively. Samples of 10 leaflets per plot were randomly taken at 7 days intervals when the age of plants was about 5 weeks, because the mite population was lower in samples of new leaves than those of old ones, Mohamed, 1964.

The examination of samples was carried out as follows :

1- Aphid, *Aphis craccivora* (Koch), samples of 10 leaflets were directly investigated early in the morning. The number of immature stages (nymphs and adults) inhabiting these stratum (plant levels)was counted and recorded.

2- Whitefly, *Bemesia tabaci* (Genn), samples of ten leaflets were inspected early in the morning from each replicates. The number of immature stages (larvae and pupae) was counted and recorded using the aid of a stereomicroscope.

3- Two-spotted spider mite, namely *Tetranychus urticae* Koch, samples of 10 leaflets were inspected early in the morning. The number of larvae, nymphs and adults were counted and recorded using the aid of a stereomicroscope.

Although the distribution on the plants might depend on species, but early infestation of spider mites are more frequently observed on older, more foliage than on younger tender foliage, the investigation occurred on the different foliage on all levels of the plants.

4- Jassids : *Empoasca* spp. The D-Vack suction machine was used for sampling jassid individuals. The samples were collected into bags, identified, counted and recorded in the same day of collection.

5- The beneficial insects, *Crysopa carnea*, *Orius* spp., and *Coccinella undecimpunctata* were collected in the same period of collecting the previous insects using the D-Vack suction machine. All active tested forms of the insects and mites were recorded on the lower surface of the leaflets.

6- The spiders: The spider lives on the foliage were collected by shaking the plants on a cloth or a shake sheet. This method is referred as the drop cloth method, Sallam, 2002. Five plants of each host were shacked over the shaking white cloth (1 m x 1 m) twice monthly during the surveying period. The surveyed spiders were kept in glass vials containing 75 % ethyl alcohol and droplets of glycerin. Living specimens were collected by camel hair brush (000) and examined by using stereomicroscope and Duncan's multiple range test (1955) at 5 % level was used to reveal significance among the means of the tested mites, insects and spiders on the tested areas.

RESULTS AND DISCUSSION

In this experiment, monitoring the effect of broad bean intercropping with termis was considered based on on the population densities and the rates of infestation of phytophagus pests and their associated predators. The results are presented in Tables (1 - 3).

Table (1) : Mean number of aphid and whitefly pests per 10 tillers (4 replicates) on broad bean under different intercropping systems during 2005/2006 and 2006/2007 seasons

Intercropping system		Accumulative mean of individuals during the season							
		Aphid				Whitely			
		10 leaflets broad bean		10 leaflets termis		10 leaflets broad bean		10 leaflets termis	
		T. N.	Av.	T. N.	Av.	T. N.	Av.	T. N.	Av.
2005 / 2006 season									
B. b. alone		480.25^{a} +3.69	476–485	-	-	319.25^{c} +2.2	316-321	-	-
B.b. +T.(1:1)		418.75^{b} +3.26	417– 420	350.25^{b} +1.71	348 - 352	344.75^{b} +1.3	343-346	489.75^{a} +2.1	487-492
B.b. + T.(1 :2)		373.75^{c} + 3.86	370–378	340.26^{c} +1.14	339- 342	359.25^{a} +1.7	357-361	410.5^{b} +1.7	408-442
T. alone		-	-	360.0^{a} +0.82	359- 361	-	-	389.5^{c} +1.7	387-391
2006 / 2007 season									
B. b. alone		430.0a + 3.63	428-432	-	-	310.0^{c} +1.63	308-312	-	-
B.b. +T.(1:1)		400.5^{b} + 4.58	400-401	332.25^{a} +1.7	330-334	339.75^{b} +2.63	336-342	498.5^{a} +3.0	494-500
B.b. +T.(1 :2)		351.0^{c} + 3.82	350-352	309.25^{b} +3.0	306-313	354.5^{a} +1.732	352-356	401.5^{b} +2.38	400-405
T. alone		-	-	299.0^{c} +3.46	294-302	-	-	383.75^{c} +2.63	380-386
L.S.D. at 0.05	Syst.	2.1195	-			1.7113	-		
	Seas	1.4988	-			1.2101	-		

Means with the same superscript in the same stage are not significant ($p > 0.05$) by Duncan's multiple range test

+ S.D. T. N. = total number Av. = Average B.b. = Broad bean T. = Termis

Table (2) : Mean number of spider mite and jassids per 10 tillers (4 replicates) on broad bean under different intercropping systems during 2005/2006 and 2006/2007 seasons

Intercropping system	Accumulative mean of individuals during the season							
	Spider mite				jassids			
	10 leaflets broad bean		10 leaflets termis		10 leaflets broad bean		10 leaflets termis	
	T. N.	Av.	T. N.	Av.	T. N.	Av.	T. N.	Av.
2005 / 2006 season								
B. b. alone	$432.25^{a} \pm 2.06$	430-435	-	-	$105.0^{c} \pm 4.76$	100-110	-	-
B.b. +T.(1:1)	$378.25^{b} \pm 2.87$	374-380	$274.0^{a} \pm 10.23$	259-281	$91.06^{b} \pm 4.54$	86-97	$60.5^{b} \pm 2.5$	58-64
B.b.+ T.(1 :2)	$348.0^{c} \pm 5.16$	342-354	$271.75^{a} \pm 4.92$	268-279	$82.0^{a} \pm 3.16$	79-86	$64.5^{a} \pm 3.69$	60-69
T. alone	-	-	$256.75^{b} \pm 6.6$	249-265	-	-	$57.8^{c} \pm 6.34$	49-64
	2006 / 2007 season							
B. b. alone	$408.25a \pm 6.65$	400-415	-	-	$87.75^{a} + 6.0$	78-94	-	-
B.b. +T.(1:1)	$397.25^{b} \pm 5.5$	389-400	$276.75^{a} \pm 10.7$	267-287	$81.5^{b} \pm 2.38$	80-85	$52.75^{a} + 3.2$	50-56
B.b. +T.(1 :2)	$358.0^{c} \pm 3.65$	354-362	$251.25^{b} \pm 4.5$	245-255	$77.5^{c} \pm 5.8$	69-82	$50.5^{b} + 2.52$	48-54
T. alone	-	-	$244.5^{c} \pm 3.11$	240-247	-	-	$45.25^{c} + 2.5$	42-48
L.S.D. Syst.	4.112				4.3105			
at 0.05 Seas	2.907				3.0480			

Means with the same superscript in the same stage are not significant ($p > 0.05$) by Duncan's multiple range test.

$\pm$ S.D. T. N. = total number Av. = Average B.b. = Broad bean T. = Termis

Table (3) : Mean number of natural enemies on broad bean under different intercropping systems with termis during 2005/2006 and 2006/2007 seasons

Intercropping system		Accumulative mean of individuals during the season / 10 broad bean plants					
		Predacous mites		Predacous insects		True spiders	
		T. N.	Av.	T. N.	Av.	T. N.	Av.
2005/2006 season							
B.b. alone		118.0	115-121	89.0	87-91	24.5	24-25
B.b. + T. (1 : 1)		122.0	120-124	93.0	90-96	34.0	33-35
B.b. + T. (1 : 2)		143.0	140-146	102.0	100-104	49.0	48-50
T. alone		-		-		-	-
2006/2007 season							
B.b. alone		124.0	118-130	84.0	79-89	20.5	20-21
B.b. + T. (1 : 1)		131.0	127-135	89.5	88-91	37.0	36-38
B.b. + T. (1 : 2)		149.0	147-151	92.5	90-95	46.5	45-48
T. alone		-	-	-	-	-	-
L.S.D. at 0.05	System	2.89	-	2.59	-	3.21	-
	Season	2.63	-	1.46	-	2.64	-

1- Aphid: The intensity of attack of broad bean plants by *A. craccivora* differed in the two seasons, Table (1). The levels of infestation on broad bean under monocrop system harboured 480.25 insect during 2005/2006 season compared with 340 individuals in 2006/2007 season. During 2005/2006, the infestation of broad bean with aphids was 418.75 and 373.75 insect at the intercropping pattern (1:1) and (1:2) with termis. In 2006/2007, however, the infestation with *A. craccivora* decreased greatly than that of 2005/2006 recorded 430, 400.5 and 351 individuals with the intercropping systems mentioned before, respectively.

2- Whitefly: The whitefly, *B. tabaci* has become a dominant pest of a wide range of warm climate crops in many parts of the world. The population dynamics of the pest is affected by multiple crop interactions. It was noticed that the population level of whitefly slightly lower in the second season 2006/2007 than the first one 2005/2006, Table 1. Termis was more attractive than broad bean to *B. tabaci* infestation alone. broad bean wit termis (1:1) and broad bean with termis (1:2), respectively during 2005 / 2006 season changed to 310.2 and 340 and 355.5 individuals, respectively during 2006 / 2007. On the other hand, the number of *B. tabaci* counted on termis recorded 490.41 and 390 during 2005/2006 and 500.4, 400.5 and 385.2 individuals during 2006/2007 on termis when broad bean was intercropped with termis (1:1), (1:2) and termis alone, respectively. The obtained results are disagree with those obtained by Omar *et al.*, 1993. The authors stated that the infestation of

cotton with whitefly under the cotton-cowpea system was slightly higher than that of cotton alone.

3- Spider mites :As observed from Table 1, the population of the two spotted spider mite, *T. urticae* on broad bean under intercropping systems showed slight decreased than broad bean alone. The infestation with *T. urticae* on broad bean was 380 and 350 mites at the intercropping pattern with termis (1:1) and (1:2), respectively during 2005/2006 season changed to 400 and 360 mites at the same systems during 2006/2007 season. The broad bean alone was infested with 432 and 415 mites during the two tested seasons, respectively. The same table showed that the termis harbored less number of mites than broad bean during the two tested seasons.

4- Jassids: As shown in Table (2), the levels of infestation by *Empoasca* spp. on broad bean alone reached 110 individuals in 2005/2006 and 90 individuals in 2006/2007 seasons. Termis alone was less attractive than broad bean to *Empoasca* spp. infestation. This is expressed by 60 individuals in 2005/2006 season and 48 individuals in 2006/2007 season.

5- Natural enemies:

5-A.) Insects : The beneficial insects, *C. carnea*, *Orius* spp., and *C. undecimpunctata* were collected in this study but varied in numbers according to the period of infestation. As shown in Table (3), the population of the collected predaceous insects showed slight increase under intercropping systems of broad bean with termis in 2005/2006 than 2006/2007 season. The number of collected predaceous insects during this study was recorded 89.75, 93.25 and 102.5 and 84.0, 89.75 and 102.25 individuals on broad bean leaflets alone, (1:1) and (1:2), intercropping systems, during the two tested seasons respectively..

5-B) Mites: The obtained results indicated that the collected predaceous mites were belonging to families Phytoseiidae and Tydeidae only. As shown in Table (3), it was indicated that the number of predaceous mites was higher on leaflets of broad bean intercropped with termis than in pure broad bean. The number of collected mites was recorded 118.75, 122.75 and 143.5 mites during 2005/2006 season and 124.5, 131.75 and 149.75 individual during 2006/2007 season on broad bean alone, broad bean with termis (1:1) and broad bean with termis (1 :2), respectively.

5-C) Spiders: The collected spiders associated with broad bean leaflets in this study were belonging to six dominant families, namely Miturgidae, Thomisidae, Philodromidae, Salticidae, Theridiidae and Gnaphosidae. The first four families were recorded during the two seasons all over the tested periods, but the last two families were recorded only during March and April, 2007. As observed from Table (3), the intercropping system for broad bean with termis increase the abundance of spiders recorded 84.5, 94.0 and 109.0 individuals during 2005/2006 season at the system, broad bean alone, broad bean with termis (1:1) and broad bean with termis (1:2), respectively. However, these numbers recorded 80.5, 97.26 and 116.0 spider during 2006/2007, respectively. There have been many studies on the effects of the intercropping diversity on insect populations. Statistical analysis of obtained data, Table 3 showed that there was very highly significant difference for effect of system on the abundance of the collected predaceous insects abundance, but the intercropping between systems and the tested seasons have no any obvious effect.

The present results revealed that intercropping of broad bean with termis encourage a great number of natural enemies. Herrera, 1975 has stated that in mixed cropping a high level of insect diversity is produced and this tend to stabilize the build up of certain pests of particular crops. The obtained results were in agreement with those obtained By Ibrahim *et al.*, 1996 who showed that polyculture increased the population density of aphidophagous insects than in monocropping. On the other hand, the obtained results were disagreement with the findings of Helenius 1990. The author found that the incidence of natural enemies were not significantly affected by cropping.

In Conclusion, Intercropping offers farmers the opportunity to engage nature's principle of diversity on their farms. Insect pest management benefits can be realized from intercropping due to increased diversity. So, cultural control can make a contribution to IPM strategy with long term benefits some of economical and environmental costs of the present day pest control methods. Chemical composition of plants is of great importance in guiding the insect in the selection process. Volatile chemical conistituents may attract or repel insects from distance to other chemicals , may stimulate or deter feeding or egg laying . While chemical factor in non-hosts contributing to crop protection in intercropping system are considered to be transferable to monocultures than physical factor,

such as camouflage; the latter may sometimes be modified sufficiently to permit their adoption in modern temperate cropping patterns. An example of this concern the effects on the visual response of aphids, (Perrin and Phillips, 1978). Also, Attractive plant volatile or their analogues have been used to monitor various pests. Polyculture of crops or intercropping systems increase natural enemies activities, by mixed flowering systems as nectar. Vandermeer, 1989 proposed the disruptive crop hypothesis to explain how vegetation diversity can directly affect herbivore population. His hyposis being equivalent to Root's 1973 resource concentration hypothesis stipulates that a second plant species disruptive the ability of an insect to efficiency attack its proper host. This work in the following two ways : 1) the insect is less likely to find its host plant because of some kinds of confusion (chemicals or physicals), 2). From the forgoing results, it can be concluded that intercropping is a new culture technology which can be introduced to farmer, but often studying the crops to be intercropped because it may decreased some pests or increase others. This is in accordance with the conclusion of Ali *et al.*, 1993 and Gabr and Sourial 2001, who reported that pests response to intercropping was variable and depend upon species of insects and cropping system employed. The effects of intercropping of maize (Pusa Composite-II) with pulses (soyabean cv. Pusa 22, cowpea cv. V-130 and green gram cv. Pusa-9561) and K rates (60, 80 and 100 kg/ha) on the incidence of *Chilo partellus* (Swinhoe) were studied in New Delhi, India, during kharif 1997 and 1998, Srinivas and Panwar (2003). Stem borer infestation was lowest (8.8%) when K was applied at 60 kg/ha and highest (17.1%) when K was applied at 80 kg/ha. Crop damage was lower in maize intercropped with green gram (9.7%), soyabean (11.6%) and cowpea (12.6%) than in monocropped maize (15.1%). Intercropping and K rates did not significantly affect the spider population in the area. The mean grain yield of maize was higher under intercropping with soyabean (4.75 kg per plot), cowpea (4.95 kg per plot) and green gram (4.72 kg per plot) than under monocropping (3.76 kg per plot). Maize grain yield did not significantly vary with the K rate. In their stuy about the effect of hedgerow intercropping systems , Girma *et al.*, 2000 noticed that spider catches during maize season were 77% greater in the presence of hedgerows than in their absence, but catches during other seasons were similar between the two cropping systems. Differences among hedgerow species were not significant for most of the arthropods monitored, except that beanfly infestation was greater with Gliricidia hedgerows. Their study indicates

that the effect of hedgerows on pest infestations of crops and their role as refugia for predators cannot be generalized but depends on the specific arthropods.

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الملخص العربي

أهمية تحميل الفول البلدي مع الترمس على الإصابة بالآفات وتواجد المفترسات في محافظة المنوفية – مصر

عصام محمد عبد السلام ياسين – جيهان محمد السيد سلام

نهلة على ابراهيم عبد العظيم

معهد بحوث وقاية النباتات- مركز البحوث الزراعية – دقى - جيزة

أجريت دراسات حقلية في منطقة اشمون– محافظة المنوفية فى موسمي زراعة الفول البلدي ٢٠٠٥/٢٠٠٦

و ٢٠٠٦/٢٠٠٧ لدراسة أهمية نظام تحميل نباتات الترمس مع الفول البلدي على تعداد أهم الآفات والمفترسات الموجودة حيث وجد أن إصابة الفول البلدي تختلف من موسم إلى أخر وحسب النظام المتبع. وأتضح من الدراسة أيضا أن نباتات الترمس تعتبر عائلا مفضلا حيث قلل تعداد كل من حشرات المن والحلم العنكبوتى وبالعكس فقد ادت الى زيادة تعداد الذبابة البيضاء في الموسمين .أيضا وجد ان الترمس بمفرده كان اقل جذبا لحشرات الجاسيد عنه الحال في الفول البلدي ولقد وجد أن المفترسات الحشرية زادت بصورة طفيفة تحت النظم المتبعة للفول البلدي مع الترمس فى الموسم الأول عنه الحال في الموسم الثاني وعموما وجد أن هناك فروقا عالية المعنوية لتأثير النظام المتبع على تواجد المفترسات الحشرية لكن التفاعل بين النظم المتبعة مع المواسم المختلفة لم يظهر له اى تأثير. ولقد دلت الدراسة أيضا على ان الاكاروسات المفترسة والتي تنتمي إلى فصيلتي Phytoseiidae و Tydeidae كانت عالية العدد على أوراق الفول البلدي المحمل مع الترمس أكثر منها على النباتات التي لم تخضع للتحميل مع الترمس. ولقد زاد أيضا نظام التحميل للفول البلدي مع الترمس من تعداد العناكب والتي كانت تنتمي إلى ست فصائل وهى Miturgidae و Thomisidae و Philodromidae و Salticidae و Theridiidae و Gnaphosidae .