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Biocontrol Agents of Three Lepidopterous Insect Pests on Some Crops during Summer Season at Khafr-Elshikh Governorate

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ABSTRACT

This work was carried out at the farm of Sakha Agricultural Research Station Kafr El-Sheikh Governorate during two successive seasons, 2005 and 2006 to evaluate the biocontrol agents of the cotton bollworms, *Pectinophora gossypiella* (Sound) and *Earius insulana* (Biosd.) as well as the cotton leafworm, *Spodoptera littoralis* (Boisd.). Six insect predators were recorded, *Coccinella undecimpunctata* L., *Scymnus interruptus* Goez, *Paederus alfierii* Koch. *Syrphus* spp. *Orius* spp. and *Chrysoperla carnea* (Steph). *C. undecimpunctata* was highly significant in correlation with *S. littoralis* eggs during June in 2005 and only positive in 2006. Also, *C. undecimpunctata* was related with *S. littoralis* larvae during July and August. Highly significant correlation was recorded between both *P. alfierii*, *Ch. carnea, Syrphus* spp. and *P. gossyhpiella* larvae in July and September, respectively. No parasitism was recorded on *P. gossypiella* and *E. insulana* larvae in 2005, while only one larva of *P. gossypiella* was found to be parasitized by *Goniozus* sp. on August 14 (2006). No parasitism was recorded on *S. littoralis* eggs during the two study seasons. The overall mean parasitism of *S. littoralis* was 3.1 and 6.5% in the two seasons, respectively. No entomopathogens were recorded on *S. littoralis* in the first season, while 5.1 and 15.4% of larval mortality were recorded by bacterial disease and virus (NPV) in 2006, respectively. On maize plants, the overall mean of parasitism on *S. littoralis* larvae was 0.4% by *Bracon* parasitoid in 2005 season, while it was 0.6% in 2006 season. The overall means of *S. littoralis* larval mortality in 2005 was 5.0, 37.3 and 1.1% by bacteria, virus and fungus, respectively. These rates were 3.9, 31.4 and 1.1%, respectively in 2006 season. The highest mortality rates on *S. littoralis* larvae on soybean was recorded by fungus, *Beuvaria basiana* in August, where it was 28.3 and 21.6% in the two seasons, respectively, followed by virus and bacteria, 17.9 and 16.6% in 2005 and 22.4 and 18.7% in 2006 season, respectively The overall means with parasitism, bacteria, virus and fungus were 0.7, 12.3, 14.1, 16.3 and 0.8, 14.0, 17.3, 14.8% in 2005 and 2006 seasons, respectively. The highest biomortality agent of *S. littoralis* larvae on cowpea was bacterial disease, where the overall mean was 14.9 and 14.6% in 2005 and 2006, respectively, while the parasitism and virus were represented with 0.4% of both in 2005 and 0.6 and 0.9% in 2006 season, respectively.

Key Words: Cotton, maize, soybean, cowpea, pests, natural enemies.

INTRODUCTION

The pink bollworm (PBW), *Pectinophora gossypiella* (Saunds.) is one of the principal pests of the cotton in Egypt, as indicated by fact that 84% of insecticides used on cotton is directed against this pest. The spiny bollworm (SBW) *Earias insulana* (Boisd.) is the most significant as a pest more or less in southern cotton growing areas, where it may be of equal importance to the pink bollworm (Moawad *et al.,* 1991).

These pests cause great reduction in the quantity and quality of the yield, whoever they attack squares and bolls. The cotton leafworm *Spodoptera littoralis* (Boisd.) is one of the most destructive pests on several crops and vegetables in Egypt. This pest cause great damage to cotton, maize, soybean, cowpea and sugar beet.

In the last two recent decades; the ministry of Agricultural and Land Reclamation emphasize to spread the philosophy of integrated pest management (IPM) among farmers. Among these is the understanding for the role of natural enemies in the agro-ecosystem to preserve and encourage their presence and use in suppressing pest populations as a corner stone within the IPM strategies.

This work aimed to shed light upon the natural biological agents of three lipedopterous pests on cotton. On the other hand, through the former work of Mesbah (2007) on cotton plants pointing highly significant correlation between *P. gossypiella* moths in the pheromone traps and the larval infestation in green bolls especially in late season and in case of *S. littoralis*, in spite of high numbers of *S. littoralis* moths in the pheromone trap there was no infestation in the cotton plants (August-September) and in that time there was a highly infestation with *S. littoralis* larvae in bordering crops (early sugar beet and clover). So, the second object of this work is to shed light upon the *S. littoralis* infestation of the late season on the bordering crops of the cotton fields.

MATERIALS AND METHODS

This work was carried out at Sakha Agricultural Research Station Farm, Kafr El-Sheikh Governorate during two successive summer seasons 2005 and 2006.

Cotton (variety Giza 86) was sown on March 28 in 2005 and March 21 in 2006 season in about 10 feddans. The field received the normal agricultural practices as well as the control program according to the Ministry of Agricultural recommend. For monitoring *Pecitnophora* and *Spodoptera* male moths, baited water pheromone traps were used in the cotton field. The numbers of moths were recorded every three days and the pheromone was replaced every 10 days (Mesbah, 2007). Direct counts of insect pests and associated predators were taken weekly from the first of June in cotton and from the first week of August for both maize and cowpea plants until the last week of September. Sampling on soybean started from the first week of July until the last week of August. Each sample represented 20 plants weekly. As for the parasitoids of *S. littoralis*, egg masses were collected daily from the first week of June until the first week of July. Egg masses were transferred to the laboratory and placed in Petri-dishes (12 cm diameter) until the emergence of host larvae or the parasitoid. *S. littoral* larvae were collected from the field and confined into plastic jars (10 larvae/jar). They were classified according to their instars, where every instar was confined alone and provided with fresh cotton leaves daily. The same technique was used for *P. gossypiella* and *E. insulana* larvae, where the infested green bolls, containing a larva of any of the bollworm species, *P. gossypiella* and *E. insulana* larvae were picked, twice weekly. In case of *E. insulana* larvae, fresh green bolls were added into the jar as food.

As for the larval diseases, any larvae showing a disease symptom were isolated and confined in the Petri-dishes to development of the disease and smears were microscopically examined. Data was statistically analyzed for correlation coefficient value (r) between numbers of biocontrol agents and concerned pests.

RESULTS AND DISCUSSION

1. Predators:

As shown in Table (1), six insect predators were found associated with *Pectinophora gossypiella, Earius insulana* and *Spodoptera littoralis. i.e., Coccinella undecimpunctata* L., *Scymnus interruptus*, Goez, *Paederus alfierii* Koch, *Syrphus* spp., *Orius* spp. and *Chrysoperla carnea* Steph.

Statistical analysis (Table 1) indicated highly significant positive correlations between *C. undecimpunctata* and *S. littoralis* egg in June 2005 ($r = 0.964^{**}$) that was only positive in 2006 (r = 0.658). The highest correlation was found between *C. undecimpunctata* and *S. littoralis* larvae in August 2006 ($r= 1.000^{**}$) and it was significant only with *E. insulana* larvae and positive with *P. gossypiella* larvae in September 2006 (r = 0.943* and 0.730, respectively) *P. alfierii* and *Ch. carnea* were the most active predators in July in the two seasons according to the (r) values (1.000^{**}, 1.000^{*}, 0.968 and 0.756, respectively) Table (1).

Orius spp. were highly significant correlated with *E. insulana* larvae in the late season of 205 ($r = 1.000^{**}$) and they were positive only in 2006 season (r = 0.001). *C. undecimpunctata* was highly significant correlated *with S. littoralis* larvae in August 206, r = (1.000^{**}). Data also showed significant correlation between *P. alfierri* and both *P. gossypiella* moth and larvae in 2005 season. Data indicated significant correlation between *C. undecimpunctata* and *S. littoralis* moths during September in the two study seasons ($r = 0.96^{*}$ and 0.975^{*}, respectively). It is noteworthy that in spite the correlation between some predator species and the previous pests through the of correlation coefficient values (r), the field observation indicated that these predators were presented mostly for other pests such as aphids.

As shown in Table (1), the predators seemed to play an important role against *S. littoralis* as well as bollworms *P. gossypiela* and *E. insulana*. The present data are in agreement with those of El-Heneidy *et al.*, 1997; El-Zanan *et al.*, 1998; El-Husseini *et al.*, 2000; Khalifa, 2005 and Mesbah, 2007.

2. Prarasitoids and entomopathogen:

2.1. In bollworms, *P. gossypiella* and *E. insulana*:

Only one *P. gossypiella* larva (out of 345 collected in 2006) was found to be parasitized by the ectoparasitoid *Goniozus* sp. No other parasitoids were obtained during 2005 or 2006.

Table (1): Correlation coefficient values (r) between the insect predators and *Pectinophora gossypella*, *Earias insulana* and *Spodoptera littoralis* at Kafr El-Sheikh region during 2005 and 2006 season.

Month	Predators	*P. gossypiella*				*E. insulana*		*S. littoralis*					
		Larvae		Moth		Larvae		Larvae		Moth		Eggs	
		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
June	*C. undecimpunctata*	-	-	-0.665	0.735	-	-	-0.147	-0.250	0.539	0.869	0.964**	0.658
	S. interruptus	-	-	-0.792	-0.584	-	-	-0.401	-0.250	-0.423	0.232	-0.605	-0.250
	P. alfierri	-	-	0.773	-0.019	-	-	-0.250	1.000**	0.999**	-0.255	0.713	-0.439
	Syrphus spp.	-	-	0.373	-0.019	-	-	1.000**	1.000**	-0.212	-0.255	0.113	-0.439
	Orius spp.	-	-	0.773	0.189	-	-	-0.250	-0.451	0.999**	-0.545	0.713	0.459
	Ch. carnea	-	-	0.373	0.735	-	-	1.000**	-0.250	-0.212	0.869	0.113	0.658
	Total predators	-	-	-0.500	0.609	-	-	-0.464	-0.250	-0.085	-0.247	-0.706	0.774
July	*C. undecimpunctata*	0.746	0.315	-0.491	0.657	0.764	-0.385	-0.564	-0.385	-0.679	-0.758	-	-
	S. interruptus	0.399	-0.257	-0.219	0.793	0.399	0.342	-0.659	0.342	-0.596	-0.696	-	-
	P. alfierri	1.000**	1.000**	-0.306	0.333	1.000**	-0.250	-0.452	-0.250	-0.244	-0.492	-	-
	Syrphus spp.	0.772	-0.260	-0.188	0.645	0.772	0.938*	-0.769	0.938*	-0.514	-0.431	-	-
	Orius spp.	0.200	0.506	-0.228	0.561	0.200	-0.506	-0.594	-0.506	-0.689	-0.664	-	-
	Ch. carnea	1.000**	0.746	-0.306	0.636	1.000**	-0.401	-0.452	-0.401	-0.244	-0.791	-	-
	Total predators	0.623	-0.105	-0.266	0.902**	0.623	0.565	-0.710	0.565	-0.607	-0.776	-	-
August	*C. undecimpunctata*	-0.440	-0.810	-0.143	-0.714	-0.577	-0.662	-0.333	1.000**	0.992**	-0.240	-	-
	S. interruptus	-0.647	0.333	-0.838	0.050	-0.707	-0.132	0.816	-0.333	0.113	-0.423	-	-
	P. alfierri	0.968*	-0.875	0.980*	-0.951*	0.577	-0.937	-0.333	0.471	-0.394	-0.905	-	-
	Syrphus spp.	0.968*	-0.269	0.980*	-0.023	0.577	-0.187	-0.333	-0.471	-0.394	-0.565	-	-
	Orius spp.	-0.088	0.269	-0.388	-0.023	-0.577	-0.187	1.000**	-0.471	-0.210	-0.423	-	-
	Ch. carnea	-0.322	0.333	-0.640	0.050	-0.302	-0.132	0.870	-0.333	-0.422	-0.213	-	-
	Total predators	-0.598	0.487	-0.828	0.230	-0.591	0.048	0.837	-0.365	-0.045	-0.213	-	-
Sept.	*C. undecimpunctata*	-0.302	0.730	-0.075	0.002	-0.333	0.943*	-0.333	-0.333	0.961*	0.975*	-	-
	S. interruptus	0.048	0.572	0.122	-0.404	-0.577	0.985*	0.577	-0.522	-0.464	-0.935	-	-
	P. alfierri	0.795	-0.730	-0.740	0.849	-0.333	-0.471	-0.333	-1.000**	-0.358	0.519	-	-
	Syrphus spp.	-0.795	0.730	-0.740	0.002	-0.333	0.943	-0.333	-0.333	-0.358	-0.975*	-	-
	Orius spp.	0.247	-0.365	-0.066	-0.779	1.000**	0.001	-0.333	-0.333	-0.080	0.159	-	-
	Ch. carnea	-0.100	-0.224	0.465	-0.046	0.522	-0.886	0.522	0.001	-0.818	0.779	-	-
	Total predators	-0.006	0.658	-0.296	-0.395	-0.225	0.992**	0.676	-0.568	-0.949	-0.965*		

Table (2): Biocontrol agents which attack *Spodoptera littoralis* larvae on cotton plants at Kafr El-Sheikh region during 2005 and 2006 seasons.

Month	No. of larvae	Mortality							
		P	B	V	F	Total	Unde.	Pupae	Unde.
2005									
June	18	00.0	0	0.0	0.0	00.0	00.0	00.0	
%		00.0	0.0	0.0	0.0	00.0	00.0	00.0	
July	320	11.0	0	0.0	0.0	11.0	301	08.0	0
%		03.4	0.0	0.0	0.0	03.4	94.1	02.5	
August	78	01.0	0	0.0	0.0	01.0	056	21.0	0
%		01.3	0.0	0.0	0.0	01.3	71.8	26.9	
Total	414	12.0	0	0.0	0.0	12.0	357	29.0	
%		02.9	0.0	0.0	0.0	03.1	86.2	07.0	
2006									
June	07	00.0	0	0	0	0	3	4	0
%		00.0	0.0	0.0	0.0	0.0	42.9	57.1	0.0
July	25	01.0	2	1	0	4	0	19	2
%		04.0	8.0	4.0	0.0	16.0	0.0	76	8
August	14	02.0	0	5	0	7	3	4	0
%		14.3	0.0	35.7	0.0	50	21.4	28.6	0.0
Total	46	03.0	2	6	0	11	7	27	2
%		06.5	4.3	13.1	0.0	23.9	7.7	58.7	4.3

P = parasitoids, B = bacteria, V = virus, F = fungi, Unde. = Undefined

El-Barbary (2006) recorded 1.8 and 3.03% as a total parasitism in *P. gossypiella* and 1.5 and 2.1% in *E. insulana* during 2005 and 2006, respectively. He mentioned that the most parasitism was recorded in October, the number of parasitioids obtained ranged between 1-3, the parasitoids belonged to families, Bethylidae, Braconidae and Ichneumonidae; in case of *P. gossypiella* larvae and only Braconidae in case of *E. insulana* larvae. Hafez *et al.* (1969) recorded *Exeristes roborator* as the major parasitoid of *P. gossypiella* up to 9.7% parasitism and its active period during cotton season was relatively short (1-2 months). No entopathogenic agents were recorded for both insects kept in the laboratory.

2.2. The cotton leafworm *S. littoralis*:

2.2.1. On cotton:

No egg parasitoids were secured from *S. littoralis* eggs collected during the two study seasons.

The rate of parasitism on *S. littoralis* larvae was 2.9% in 2005 and 6.5% in 2006 Table (2). No pathogens were recorded through 2005, while 4.3% and 13.12% of the collected larvae were infected by bacteria and virus (NPV), respectively in 2006.

2.2.2. On maize:

Data in Table (3) show that the highest mortality of *S. littoralis* larvae was caused by virus disease in September in the two study seasons (37.3% and 31.4%, respectively). The overall mean of biomortality was 43.7 and 36.9% in the two seasons, respectively.

2.2.3. On soybean:

The entomophathogens were the most effective bioagents on *S. littoralis* larvae on soybean plants especially the mycotic diseases (*B. bassiana*) in August in both seasons, while the parasitism was represented with the lowest rate. The overall mean of the biocontrol agents during 2005 and 2006 was 43.4 and 46.9% respectively, Table (4).

The bacterial (*B. t.*) pathogen represented the highest morality in *S. littoralis* larvae on cowpea plants in this study especially in August 15.4 and 15.1% in the two seasons, respectively (Table 5). The overall means of bioagents were 16.5 and 18% during the two seasons, respectively.

2.2.4. On cowpea:

The presented data are agreement with those of Tawfik and El-Husseini (2002) who reported that no egg parasitoids were obtained from the *S. littoralis* eggs in cotton plants, while *Trichogramma evnaseens* and *T. minutum* were reported earlier by Kamal (1951). As for *S. littorals* larvae, our data are accordance with those of Hafez *et al.* (1969) who indicted that *S. littoralis* larvae were parasitized by braconid, tachinid and ichneumonid parasitoids. Also, Tawfik and El-Husseini (2002) reported that the parasitoids complex of *S. littralis* dose not play an important role in controlling this pest in Egypt due to the excessive use of pesticides.

Table (3): Biocontrol agents attack *Spodoptera littoralis* larvae on maize plants at Kafr El-Sheikh region during 2005 and 2006 seasons.

Month	Mortality								
	No. of larvae	P	B	V	F	Total	Unde.	Pupae	Unde.
				2005					
August	122	0	8	17	6	31	79	12	0
%		0.0	6.6	13.9	4.9	25.4	64.8	9.8	0.0
Sept.	436	2	20	191	0	213	200	23	0
%		0.5	4.6	43.7	0.0	48.9	45.9	5.3	0.0
Total	558	2	28	208	6	244	279	35	0
%		0.4	5.0	37.3	1.1	43.8	50.0	6.3	0.0
				2006					
August	93	0	6	8	7	21	64	8	0
%		0.0	6.5	8.6	7.5	22.6	68.8	8.6	0.0
Sept.	582	4	20	204	0	228	324	30	0
%		0.7	3.4	35.1	0.0	39.2	55.6	5.2	0.0
Total	675	4	26	212	7	249	388	38	0
%		0.6	3.9	31.4	1.1	36.9	57.4	5.6	0.0

P = parasitoids, B = bacteria, V = virus, F = fungi, Unde. = Undefined

Table (4): Biocontrol agents attack *Spodoptera littoralis* larvae on soybean plants at Kafr El-Sheikh region during 2005 and 2006 seasons.

Month	Mortality								
	No. of larvae	P	B	V	F	Total	Unde.	Pupae	Unde.
				2005					
July	140	0	4	8	0	12	95	10	23
%		0.0	2.9	5.7	0.0	8.6	67.89	7.1	16.4
August	307	3	51	55	73	182	87	8	30
%		1.0	16.6	17.9	23.8	59.3	28.3	2.6	9.8
Total	447	3	55	63	73	194	182	18	53
%		0.7	12.3	14.1	16.3	43.4	40.7	4.0	11.9
				2006					
July 2006	124	1	5	8	0	14.0	73	11	26
%		0.8	4.0	6.5	0	11.3	58.9	8.9	21.0
August	268	2	50	60	58	170	66	10	22
%		0.7	18.7	22.4	21.6	63.4	24.7	3.7	8.2
Total	392	3	55	68	58	184	19	21	48
%		0.8	14.0	17.3	14.8	46.9	35.5	5.4	12.2

P = parasitoids, B = bacteria, V = virus, F = fungi, Unde. = Undefined

Table (5): Biocontrol agents attack *Spodoptera littoralis* larvae on cowpea plants at Kafr El-Sheikh region during 2005 and 2006 seasons.

Month	Mortality								
	No. of larvae	P	B	V	F	Total	Unde.	Pupae	Unde.
				2005					
July	21	0	2	0	0	2	16	3	0
%		0.0	9.5	0.0	0	9.5	76.2	14.3	0.0
August	228	1	35	1	2	39	145	26	18
%		0.4	15.4	0.4	0.9	17.1	63.6	11.4	7.9
Total	249	1	37	1	2	41	161	29	18
%		0.4	14.9	0.4	0.8	16.5	64.7	11.6	7.2
				2006					
July	29	1	3	0	0	3	18	6	0
%		3.4	10.3	0.0	0.0	13.7	62.1	20.7	0.0
August	292	1	44	3	6	54	188	35	16
%		0.3	15.1	1.0	2.1	18.5	64.3	12.0	5.3
Total	321	2	47	3	6	58	206	4x	16
%		0.6	14.6	0.9	1.9	18.0	64.2	12.8	5.0

P = parasitoids, B = bacteria, V = virus, F = fungi, Unde. = Undefined

As for the entomopathogens, the present results indicated that they were the most effective biocontrol agents against *S. littoralis* larvae and the mortality rates differed from one crop to the other.

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الملخص العربى

عناصر المكافحة الحيوية الطبيعية لثلاث افات من حرشفيه الاجنحه خلال موسم الصيف فى محافظة كفرالشيخ

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تم هذا البحث فى المزرعة البحثية بمحطة البحوث الزراعية بسخا ــ كفرالشيخ خلال موسمي ٢٠٠٥، ٢٠٠٦ لتقييم عناصر المكافحة الحيوية الطبيعية وذلك لدودة اللوز القرنفلية *Pectinophora gossypiella* ودودة اللوز الشوكية *Earius insulana* وكذلك دودة ورق القطن *Spodoptera littoralis* خلال موسمين متتاليين. تم حصر ست أنواع من المفترسات الحشري وهى ابو العيد ١١ نقطة *Coccinella undecimpunctata* L.، اسكمنس *Scymnus interruptus* Goez، الحشرة الرواغة *Paederus alfierii* Koch. ، ذباب السرفس *Syrphus* spp. وبق الاوريس *Orius* spp. ثم أسد المن *Chyrsoperla carnea* (Steph). أوضحت النتائج وجود ارتباط عالي المعنوية بين أبو العيد ١١ نقطة وبيض دودة ورق القطن خلال يونيو فى موسم ٢٠٠٥ وموجب فقط فى موسم ٢٠٠٦ وبالنسبة لليرقات كان الارتباط موجبا خلال شهري يوليو وأغسطس. كذلك أظهرت النتائج وجود ارتباط عالي المعنوية بين كل من الحشرة الرواغة، يرقات السرفس، يرقات أسد المن وبين يرقات دودة اللوز القرنفلية خلال شهر يوليو وسبتمبر على التوالي. لم يسجل أى تطفل على يرقات دودة اللوز القرنفلية أو الشوكية خلال موسم ٢٠٠٥ بينما سجل طفيل واحد فقط على يرقة دودة اللوز القرنفلية فى ١٤ أغسطس فى موسم ٢٠٠٦ (*Goniozus* sp.). كما لم يسجل اى تطفل على بيض دودة ورق القطن على نباتات القطن خلال موسمي ٢٠٠٥، ٢٠٠٦ بينما كان المتوسط العام للتطفل على يرقات دودة ورق القطن هى ٣,١%، ٦,٥% خلال موسمي ٢٠٠٥، ٢٠٠٦ على التوالي. لم تسجل مسببات مرضيه على يرقات دودة القطن خلال موسم ٢٠٠٥ بينما فى الموسم التالي فكان ٥,١، ١٥,٤% من الموت فى اليرقات نتيجة الإصابة بالبكتريا والفيروس على التوالي. المتوسط العام للتطفل على يرقات دودة ورق القطن على نباتات الذرة هو ٠,٤% وذلك بطفيل البراكون فى موسم ٢٠٠٥ و٠,٦% فى ٢٠٠٦ أما مسببات الأمراض فكان المتوسط العام هو ٥ ، ٣٧,٣ و١,١% وذلك بالبكتريا، فيروس والفطر على التوالي وفى موسم ٢٠٠٥ كانت تلك النسب فى موسم ٢٠٠٦ هى ٣، ٩، ٣١,٤، ١,١% على التوالي. أعلى إصابة ليرقات دودة ورق القطن على فول الصويا حدثت بفطر *Beuvaria basiana* فى شهر أغسطس خلال موسمي الدراسة حيث كانت ٢٣,٨% ، ٢١,٦% على التوالي يليه الفيروس والبكتريا ٢٢,٤، ١٨,٧% فى موسم ٢٠٠٥ وموسم ٢٠٠٦ على التوالي. المتوسط العام للإصابة بالعناصر الحيوية السابقة على دودة ورق القطن على فول الصويا هى ٠,٧ ، ١٢,٣ ، ١٤,١ ، ٠,٨ ، ١٤ ، ١٧,٣ ، ١٤,٨ وذلك للتطفل ، البكتريا ، الفيروس والفطر خلال موسمي ٢٠٠٥ و٢٠٠٦ على التوالي. سجلت البكتريا اعلي نسبة موت ليرقات دودة ورق القطن على نباتات اللوبيا حيث كان المتوسط العام لنسب الموت هو ١٤,٩، ١٤,٦% خلال موسمي ٢٠٠٥، وفى ٢٠٠٦ على التوالي بينما التطفل والفيروس فكانتا ٠,٤% لكل منهما فى موسم ٢٠٠٥ وفى موسم ٢٠٠٦ كان المتوسط العام لنسبة الموت ٠,٦، ٠,٩% على التوالي للتطفل والفيروس.