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OCCURRENCE, DENSITY AND INJURY OF CERTAIN INSECTS INFESTING BRUSSELS SPROUTS AND ONION CROPS IN THE DESERT LANDS AT EL- NOUBARREIA, BEHERA GOVERNORATE

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ABSTRACT

This work was conducted at the Experimental and Production Farm of the National Research Center at El-Noubarreia, Behera Governorate during two seasons 2005/2006 and 2006/2007, in response to lack of information about insect species infesting Brussels sprouts and onion crops in the newly desert land, population density and final injury caused by certain insect species. Results indicated that Brussels sprouts are infested by *Brevicoryne brassicae* L., *Bemisia tabaci* (Genn.) and *Plutelta xylostella* L. *Thrips tabaci* (L.) is the main insect pest on onion plants.

Winged adults of *B. brassicae* on Brussels sprouts plants had two and three peaks of activity during the seasons of 2005/2006 and 2006/2007, respectively. Also winged adults caught by sticky traps had 2-3 peaks of activity. Wingless individuals of aphid (adults + nymphs) passed by 3 peaks during experimental period. The highest increase quotients in the population density of aphids in the 1st season were 2.38 and 2.54 on January 5 and March 16, respectively; in the 2nd season the highest increase quotients were 13.78 and 7.93 on November, 28 and January 23, respectively. Parasitism by *Diaeretiella rapae* on *B. brassicae* reached its highest at 30.6% .

Whitefly adults showed two peaks of activity on Brussels sprouts in the first season. Nymphs had one peak of activity, with highest counts (112.8 nymphs/ leaf) at temperature 15.7° C and relative humidity 70.32%, but it had low numbers in the 2nd season.

T. tabaci had 1-2 peaks / season, with the highest counts (88.8 and 72.13 individuals/ plant) at temperature 19.8 & 18.37° C and relative humidity 61.3 & 59.7% in 2006 and 2007, respectively.

The final injury by *B. brassicae* on Brussels sprouts heads represented in 60.0, 40.0 & 0.0% and 13.3, 20.0 & 66.7% of heads had severe, medium and light infestation in the lower and upper half level of the stem, respectively. Also 53.3 & 46.7% and 43.3 & 56.7% of the heads suffered from partial eating and holes in their leaves by *P. xylostella* larvae in the lower and upper half levels of the stem, respectively.

Key words: *Bemisia tabaci, Brevicoryne brassicae, Brussels sprouts, Diaeretiella rapae, final injury, onion, peak of activity, Plutella xylostella, Thrips tabaci.*

1. INTRODUCTION

Brussels sprouts (*Brassica oleraceae* L. *gemmifera*) is a new cruciferous crop in Egypt; also the onion *Allium cepa* L. plays an important role in agricultural income. These crops are important in feeding, processing and exporting. These crops are infested and injured by many insect pests. Salem (2002) showed that cabbage seedlings are infested with insect species *Brevicoryne brassicae* L., *Thrips tabaci* (Lind.), *Bemisia tabaci* (Genn.), *Liriomyza brassicae*, *Artogeia rapae* (L.) and *Phyllotreta crucifera* (Goezel) in Giza Governorate. Badens–Perez and Shelton (2006) in Kenya and India mentioned that cruciferous vegetables are infested by the diamondback moth *Plutella xylostella*, *Agrotis ipsilon, Pieris brassicae*, cabbage aphid *Brevicoryne brassicae, Lipaphis erysimi, Myzus persicae, Heliothis armigera* and *Delia radicum. B. brassicae* and *M. persicae* were the most widespread aphids on cruciferous crops in Iran (Farzadfar *et al.*, 2007). *T. tabaci* is the main insect on onion in New Zealand (Martin *et al.*, 2006).

El-Gindy (1997) and Salem (2003) found that *B. brassicae* had two peaks of activity on cabbage plants during the winter season. Perry *et al.*(1998) estimated the population of *B. brassicae* (L.) on Brussels sprouts plants on the basis of biweekly samples during 1996 in 2 ha blocks. Yield losses caused by *B. brassicae* on canola plants can exceed 50% in Poland, India, China, Australia and New Zealand (Bakhetia, 1983; Kelm and Godomski, 1995). *Diaeretiella rapae* (M'Intosh) parasitized on *B. brassicae* in cabbage and turnip

crops at higest percents (40.20% and 32.64%), respectively (Bayhan *et al.*, 2007). Farag (1995) found that the highest percentage of aphid population at Giza and Qualubia was 27%, and it was 32% at Sharkia Governorates.

Hegab and Helaly (1989) recorded two peaks of *B. tabaci* adults on cabbage and cauliflower plants at Sharkia Governorate. Yellow sticky traps were used for monitoring adult populations of *B. tabaci* (Ohnesorge and Rapp, 1986).

Population density of *T. tabaci* on onion plants reached its highest at 130 and 158 days after planting (Kalafchi *et al.*, 2006). The highest abundance of *T. tabaci* on leek plants was in late July 2004 and early August 2005 (Douchovskiene, 2006).

In accordance with the increase of demands, the main aim of this work was to determine the following: insect species that may infest Brussels sprouts and onion crops, their density in the desert, the potential injury caused by these insects, and the value of this injury.

2. MATERIALS AND METHODS

2.1. Culture

This work was conducted during two seasons (2005/2006 and 2006/2007) in the Experimental and Production Farm of the National Research Center at El–Noubarreia district, Behera Governorate, along the Alexandria desert road, about 170 km from Cairo. Seedlings of Brussels sprouts cv. Jud Cross and onion cv. Giza 20 (7 weeks old) were transplanted on 15 October 2005 and 12 October 2006 for Brussels sprouts and on 15 January 2006 and 28 December 2006 for onion plants in the two successive seasons. Seedlings were transplanted in rows, each 40 m. long; drip irrigation was used. The experimental area of each crop was divided into three plots used as replicates. Plots were kept free of pesticides. Number of rows / plot differed by crop and seasons: at least 8 rows in Brussels sprouts, 14 for onion. The distance between rows was 1 m. The total experimental area of Brussels sprouts was at least 450 m^2; and it was about 700 m^2 for onion.

2.2. Insect monitoring

Random methods were followed by examining 15 leaves (5 leaves / plot) directly on plants by hand lens to count the winged adults of cabbage aphid and whitefly; the same leaves were picked gently, put in polyethylene plastic bags and transferred to be examined in the laboratory by binocular microscope to count whitefly nymphs, wingless individuals of aphids (adults and nymphs), and aphids (mummies) parasitized by *Diaeretiella rapae* (M' Intosh). Also the numbers of diamondback moth larvae were considered. Samples were taken biweekly according to Perry *et al.*, 1998). The same method was follwed to sample thrip counts on 15 onion plants (5 plants / plot) , examined directly in the field. Four yellow sticky traps were used for monitoring whitefly adults and winged adults of aphids on Brussels sprouts according to Hirano *et al.* (1993) and Ohnesorge and Rapp (1986). These traps were replaced biweekly by new ones; and the insects caught on sticky cards were defined and counted by binocular microscope.

2.3. Analysis and calculations

Readings of temperature and relative humidity were obtained from the Central Laboratory for Agriculture Climate (Agricultural Research Center, Giza). Simple correlation coefficient and regression were calculated between the total counts of insects and means of climatic factors (Gomez and Gomez, 1984). Also the quotient of increase in aphid population was calculated according to Bodenheimer (1951).

The quotient of increase=

$$\frac{\text{Population of one month}}{\text{Population of preceding month}}$$

The percentage of parasitism by *D. rapae* on aphid population was calculated as

Percentage of parasitism=

$$\frac{\text{Number of mummies}}{\text{Total population of aphids}} \text{ X100}$$

2.4. Injury assessment

To assess the final injury caused by cabbage aphid and diamondback moth larvae on the heads and leaves of Brussels sprouts during the 2006/2007 season at harvest, fifteen heads were picked up randomly from the lower half of stems and another 15 heads from the upper half. Each of them was sacked and transferred to the laboratory to dissect. Parameters referring to injury were recorded. Parameters of aphid injury were: aphid counts / head, number of heads with honeydew & exuviae; on the basis of these parameters four degrees of infestation were established. Severely infested heads (60 – 100% of head leaves were injured), medium infested heads (25 ≤ 60% of head leaves were injured), light infested heads (< 25% infested leaves), and healthy heads. Parameters of diamondback moth injury were: larval counts / head, heads with faeces, heads with partial eating, heads with holes in their leaves, and healthy heads. Counts of heads in every parameter were converted into percentage. The final injury on Brussels sprouts leaves was assessed by the same

manner on 30 leaves, which were picked randomly at harvest time.

3. RESULTS AND DISCUSSION

3.1. Occurrence and density of Brussels sprouts insects

Cabbage aphid: The winged adults of *Brevicoryne brassicae* L. had two peaks of abundance, lasting from October, 27 to February, 2 and from February, 2 to March, 16 (Fig.1), with the highest rates of 1.33 and 15.53 individuals/ leaf at the end of November and end of the 2005/ 2006 season when temperatures were 23.85 and 17.95 ° C and relative humidity 64.35 and 62.5%, respectively (Table 1). Two peaks were obtained by yellow sticky traps, with the highest counts (14.25 and 12.7 adults / trap) at the same dates mentioned previously. In the 2nd season, the highest number of winged adults (Fig. 1) was 5.07 individuals / leaf at the mid of the season. The highest number of adults caught by sticky traps was 32.7 / trap, at the end of January.

Activity of wingless individuals of cabbage aphid was represented in three periods during the winter of 2005/2006 (October, 27- December, 8), (December, 8 – February, 2) and (February, 2 – March, 16); and three periods during 2006/2007 (October, 31 – December, 26), (December, 26 – February, 6) and (February, 6 – March, 20) (Fig .1). The highest numbers recorded in the 1st and 2nd seasons were 151.4 and 180.6 individuals / leaf, respectively.

The virtual increase in the population density of aphid could be deduced by calculating the quotient of increase (Table 1); its value during the 1st season reached the maximum (2.38 and 2.54) on January 5 and March 16 when temperatures were 15.7 & 17.95 º C, and relative humidity was 70.32 & 62.5% respectively. Values of these parameters in the 2nd season were the highest at 13.78 and 7.93 on November, 28 and January, 23 when temperature was 14.3 and 14.12 º C and relative humidity 65.8 and 67.75%, respectively. These results corresponded with the results of El–Gindy (1997) and Salem (2003) who found that *B. brassicae* had two peaks of abundance on cabbage plants during winter seasons.

Percentage of the aphids (mummies) parasitized by the aphid parasite *Diaeretiella rapae* (M, Intosh) was low at the beginning of both seasons and accumulated gradually to become 30.6 and 12.35% near the end of 2005 / 2006 and 2006/2007, respectively. This agrees with the results of Farag (1995) who mentioned that this percentage was 27%, and Bayhan *et al*. (2007) who found that the highest percentage of parasitism by *D. rapae on B. brassicae* was 40.2%.

Cotton whitefly: Data in Table (1) show that *B. tabaci* adults had two peaks of activity during the 1st season. The first peak occurred directly after transplantation with a rate of 18 adults / leaf. The 2nd one occurred almost at the last half of the season with rate of 11.8 adults / leaf. The same trend was obtained by using sticky traps, where the highest counts were 21 and 13 adults / trap. Nymphs had one peak of activity during the same season and reached its highest 112.8 nymphs / leaf at the beginning of January (15.7ºC, 70.32% R.H.). However in the 2nd season, both adults and nymphs had low numbers (Table 1). This may be attributed to the relatively colder weather in the 2nd season than in the 1st one, and to crop structure differences. In the 1st season potato and beet plantation was dominant in the region, whereas wheat was the dominant crop in the 2nd season.

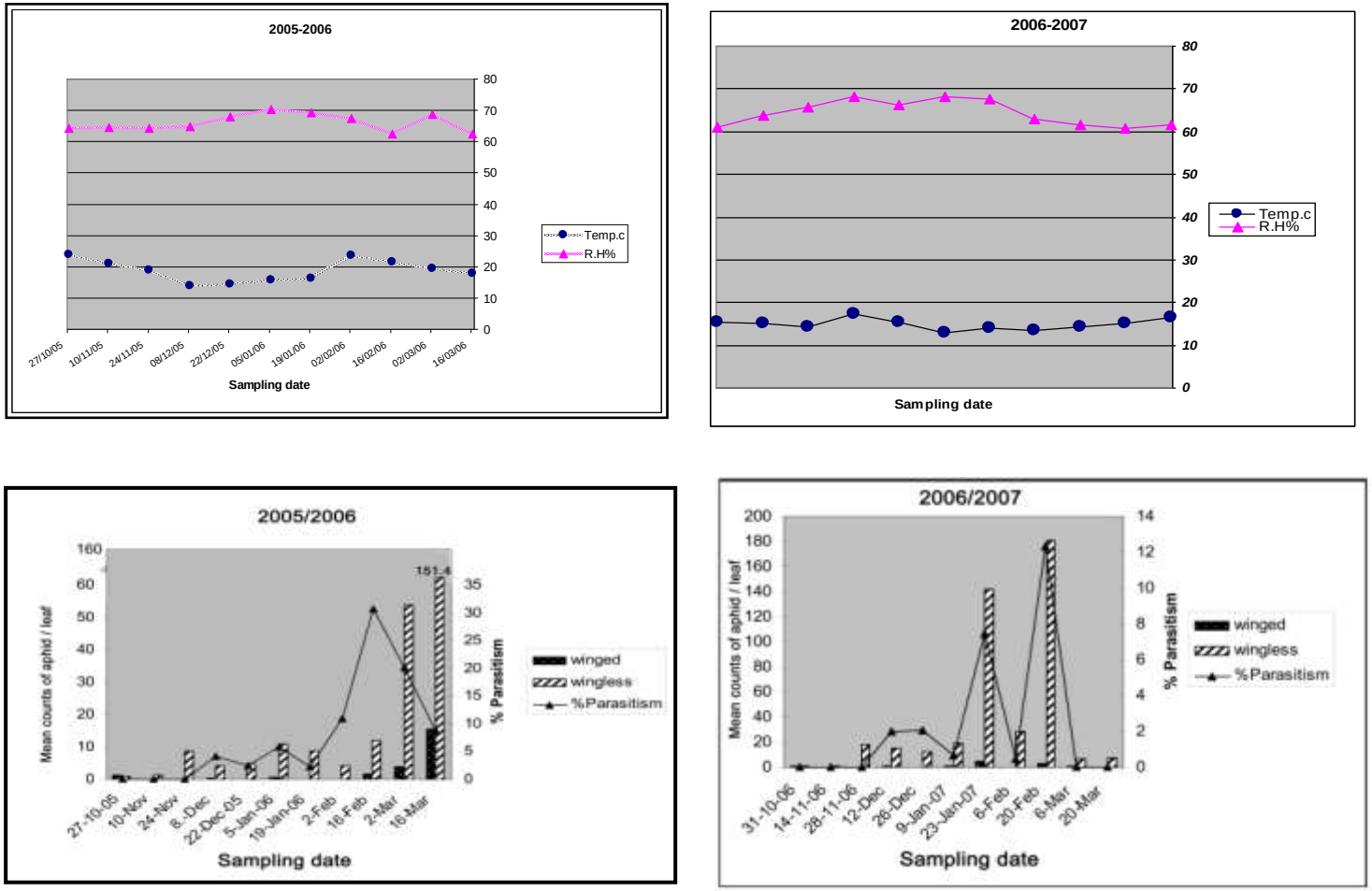
This agrees with the results obtained by Hegab and Helaly (1989) who reported two peaks of *B. tabaci* adults on cabbage and cauliflower plants in Sharkia Governorate. Larvae of *P. xylostella* were noticed with little numbers on Brussels sprouts leaves in both seasons (Table 1).

3.2. Occurrence and density of onion thrips

Data in Table (2) show that *Thrips tabaci* attacked onion plants in the first season with the highest numbers (88.8 individuals / plant) on April 18, 2006 at a temperature19.8 ºC and relative humidity 61.3%. In the 2nd season, thrips had two periods of activity that lasted from January 9 to March 20 and from March 20 to May 15. The second period had the highest peak (72.13 individuals / plant) at a temperature of 18.37 ºC and relative humidity 59.7%. This result corresponds with the findings of Kalafachi *et al.* (2006) who reported that the population density of thrips had two peaks of activity on onion plants.

3.3. Effect of temperature and relative humidity on the investigated insects

As shown in Table (3), the calculated values indicate that an insignificant correlation was obtained between climatic factors and either cabbage aphid, whitefly or thrips. This agreed with results of Salem (2003) who found that temperdture and relative humidity had insignificant effects on nymphs and adults of *B. brassicae* infesting cabbage plantations. The same climatic factors had insignificant effects on *T. tabaci* infesting cabbage and faba bean (Salem *et al.,* 2004). Hirano *et al.* (1993 & 1995) mentioned that climatic factors did not play a major role in population fluctuations of *B. tabaci*.



(a) (b)

Fig (1): Mean counts of winged &wingless individuals of *Brevicoryne brassicae* L. on Brussels sprouts and percentage of parasitism by *Diaeretiella rapae* (M. Intosh) during the winter seasons of 2005/2006 (a) and 2006/2007(b) at El-Noubarreia, Behera Governorate.

Table (1): Counts of cabbage aphid (*Brevicoryne brassicae* L.), cotton whitefly (*Bemisia tabaci* (Genn.) and diamondback moth *(Plutella xylostella* L.) per leaf of Brussels sprouts corresponding to biweekly average temp. (°C) ; & R.H. (%) during the two seasons at El-Noubarreia, Behera Governorate.

Season	Sampling date	Aphid counts			Whitefly counts			Diamondback moth larvae counts/leaf	Climatic factors	
		Winged adults/ trap	Total population / leaf	Quotient of increase	Adults /leaf	Adults /trap	Nymphs		Temp.°C	R.H%
2005/2006	October 27	—	2.33	—	18.0	—	2.0	0.2	23.85	64.35
	November 10	12.75	1.33	0.57	13.0	21.0	8.33	0.0	20.96	64.5
	24	14.25	8.8	6.62	7.4	18.25	15.35	0.13	18.82	64.18
	December 8	9.25	4.94	0.56	5.4	7.5	23.53	0.0	13.95	64.8
	22	2.0	5.2	1.05	3.8	5.0	89.87	0.07	14.47	67.9
	January 5	4.25	12.39	2.38	4.8	8.0	112.8	0.0	15.7	70.32
	19	2.0	8.87	0.72	2.87	10.75	16.0	0.0	16.2	69.3
	February 2	0.0	4.86	0.55	11.8	13.0	0.33	0.0	23.5	67.4
	16	0.0	19.6	4.03	6.2	3.0	2.0	0.0	21.5	62.3
	March 2	10.75	72.2	3.68	0.2	2.0	2.5	0.0	19.3	68.6
	16	12.75	183.2	2.54	0.2	1.5	3.33	0.2	17.95	62.5
2006/2007	October 31	—	2.0	—	5.0	—	1.0	0.2	15.5	61.1
	November 14	10.25	1.33	0.67	3.0	3.5	0.0	0.0	15.12	63.8
	28	17.25	18.33	13.78	1.27	2.0	0.0	0.2	14.3	65.8
	December 12	15.25	16.26	0.89	1.33	2.0	1.87	0.07	17.4	68.2
	26	4.25	13.13	0.81	0.53	0.5	2.46	0.0	15.3	66.2
	January 9	6.25	20.0	1.52	0.2	1.0	0.33	0.07	12.8	68.14
	23	32.75	158.67	7.93	0.13	0.0	0.33	0.13	14.12	67.57
	February 6	25.75	28.93	0.2	0.0	0.0	0.07	0.2	13.6	62.9
	20	14.75	208.93	7.22	0.0	0.0	0.0	0.2	14.2	61.6
	March 6	7.0	6.86	0.03	0.0	0.0	0.0	0.4	15.2	60.7
	20	9.0	7.47	1.09	0.0	0.0	0.0	0.07	16.46	61.71

Table (2): Mean counts of onion thrips *(Thrips tabaci* **(Lind.)) on onion plants corresponding to biweekly average of temp. (ºC)° & R.H. (%) during the two seasons at El-Noubarreia, Behera Governorate.**

Season	Sample date		Thrips counts/ plant	Climatic factors	
				Temp. ºC	R.H%
2006	February	7	0.13	23.9	66.23
		21	0.4	20.53	64.43
	March	7	0.47	18.6	66.0
		21	3.27	18.9	60.7
	April	4	16.13	19.2	65.9
		18	88.8	19.8	61.3
	May	2	38.67	23.25	61.1
		16	37.13	28.6	59.8
		30	13.67	32.45	58.43
	June	13	3.0	27.1	59.1
2007	January	9	0.13	12.8	68.14
		23	0.93	14.12	67.57
	February	6	2.2	13.6	62.9
		20	28.34	14.2	61.6
	March	6	53.47	15.2	60.7
		20	37.53	16.46	61.71
	April	3	72.13	18.37	59.7
		17	56.87	19.0	65.6
	May	1	22.13	19.2	65.43
		15	8.87	23.72	66.14

3.4. The potential injury on Brussels sprouts heads

Data in Table (4) show that heads present on the lower half of the plant stem harboured higher counts of aphid (36.1 individuals / head) than heads of the upper half which harboured 9.9 individuals / head. A percentage of 93.3% of the lower heads was contaminated with honeydew and exuviae, 60.0% of the lower heads were severly infested, 40.0% of them had medium infestation and no heads had light infestation or were healthy, in comparison with 93.3% of the upper heads contaminated with honeydew and exuviae; only 13.3% of the upper heads were severly infested by aphids, only 20% of them had medium infestation; 66.7 of the heads had light infestation; and none of the heads were healthy. This agrees with results of Bakhetia (1983) and Kelm & Godomski (1995) who found that yield losses in canola crop caused by *B. brassicae* can exceed 50% in Poland, India, China, Australia and New Zealand.

Data in Table (4) show that heads presented on the lower half of the plant stem were more susceptible to infestation with *P. xylostella* L. than those present on the upper half of the stem. Thus, the larval content / head in the lower half was 3.97 larvae in comparison with 1.5 larvae / head in the upper half. Accordingly, 53.3% and 46.7% of heads were partially eaten by worms or had holes in their leaves in the lower half of the stem; compared with 43.3 and 56.7% in the upper half. No healthy heads remained on the whole plant stem. Contaminated heads with faeces were 96.8 and 73.3% of the total heads in the lower and upper halves of the stem, respectively (Table 4). This is in accordance with results of Vail *et al., (*1989) who found that feeding by *P. xylostella* on broccoli plants can physically damage the inflorescence during heading. Also contamination by frass, exuviae, living and dead larvae or pupae had a greater economic importance.

3.5.The potential injury on Brussels sprouts leaves

The cabbage aphid injured Brussels sprouts leaves, causing severe, medium and light infestations (Table 4) of 26.7, 33.3 and 30%, respectively, at the end of season. Only 10% of the leaves were healthy under the natural infestation (78.54 aphids / leaf) during the season.

The diamond back moth larvae injured Brussels sprouts leaves causing partial eating to 50% of leaves, holes to 40% of leaves; only 10% of the leaves remained healthy under the seasonal counts of 0.15 larvae / leaf. This result agrees with the result of Vail *et al.* (1989), who reported that foliar feeding by *P. xylostella* on broccoli plants impacts indirectly on yield.

Table (3): Simple correlation (r) and regression (b) between average of the population densities of different insects and two climatic factors during the investigation periods.

Source of variance	Host plant	Temp. (ºC)		R.H.(%)	
		r	b	r	b
Population density of *B. brassicae* during 2005/2006	Brussels sprouts	-0.063ns	-1.002	-0.301ns	-5.92
Population density of *B. brassicae* during 2006/2007	Brussels sprouts	0.413ns	- 35.04	-0.37ns	-16.42
Population density of *B. tabaci* during 2005/2006	Brussels Sprouts	-0.55ns	- 6.01	0.56ns	7.53
Population density of *B. tabaci* during 2006/2007	Brussels Sprouts	0.17ns	0.204	0.14ns	0.08
Population density of *T. tabaci* during 2006	Onion	0.04ns	0.24	-0.30ns	–2.82
Population density of *T. tabaci* during 2007	Onoin	0.26ns	1.99	-0.69ns	-5.99

Temp. = Temperature R.H, = Relative humidity ns = Not significant.

Table (4): Percentage of heads and leaves of Brussels sprouts suffering from different injury the degrees caused by *Brevicoryn brassicae* **and** *Plutella xylostella* L**. at El – Noubarreia, Behera Governorate during 2006/2007 season.**

Plant part	Position on stem	Cabbage Aphid						Diamondback moth				
		Aphid counts	Parts with honeydew & exuviae	Injury Degrees				Larval content	Parts with faeces & exuviae	Injury degrees		
				Severe	Medium	Light	Healthy			Partially eaten	With holes	Healthy
Heads	Lower	36.1	93.3%	60.0%	40.0%	0.0%	0.0%	3.97	96.8%	53.3%	46.7%	0.0%
	Upper	9.9	93.3%	13.3%	20.0%	66.7%	0.0%	1.5	73.3%	43.3%	56.7%	0.0%
Leaves		78.54	90.0%	26.7%	33.3%	30.0%	10.0%	0.15	0.0%	50.0%	40.0%	10.0%

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التواجد والكثافة العددية والضرر النهائي لبعض الحشرات التي تصيب كرنب بروكسل و البصل في المناطق الصحراوية بالنوبارية، محافظة البحيرة.

حمدي عبد النبي سالم- شادية السيد عبد العزيز.

قسم آفات ووقاية النبات – المركز القومي للبحوث – الدقي – الجيزة- مصر.

ملـخص

أجرى هذا البحث بالمزرعة البحثية والإنتاجية للمركز القومي للبحوث بمنطقة النوبارية محافظة البحيرة خلال الموسمين 2006/2005 و 2007/2006 على محصولي كرنب بروكسل والبصل لتحديد الأنواع الحشرية التي تصيبها في الأراضي الصحراوية المستزرعة حديثًا، وكذلك تقدير كثافتها العددية والضرر المحتمل حدوثه نتيجة الإصابة الطبيعة بهذه الحشرات.

أوضحت النتائج أن كرنب بروكسل يصاب بمن الكرنب *Brevicoryne brassicae* والذبابة البيضاء *Bemisia tabaci* ودودة الفراشة ذات الظهر الماسي *Plutella xylostella*. كان تربس البصل *Thrips tabaci* هو الآفة الرئيسية التي تصيب نباتات البصل في منطقة الدراسة.

وجد أن الأفراد الكاملة المجنحة لمن الكرنب لها فترتى نشاط في الموسم الأول 2006/2005 وثلاث فترات نشاط في الموسم الثاني 2007/2006، كان للأفراد المجنحة 2-3 فترات نشاط مقدرة بالمصايد الصفراء اللاصقة. مرت الأفراد غير المجنحة (حوريات + أطوار كاملة) بثلاث فترات نشاط خلال فترة التجربة. كانت أعلى معامل زيادة في مجتمع المن خلال الموسم الأول 2.38، 2.54 (في 5 يناير، 16 مارس على التوالي) وكانت هذه الزيادة 13.78، 7.93 في 28 نوفمبر، 23 يناير في الموسم الثاني على التوالي. وصلت نسبة التطفل على أفراد من الكرنب بالطفيل *Diaeretiella rapae* أقصاها عند 30.6%.

أظهرت الأفراد الكاملة للذبابة البيضاء في الموسم الأول فترتى نشاط بينما أظهرت الحوريات فترة نشاط واحدة وصلت أقصى تعدادها 112.8 حورية / ورقة. انخفض تعداد الذبابة البيضاء في الموسم الثاني. كان تعداد يرقات الفراشة ذات الظهر الماسي على أوراق كرنب البروكسل بصفة عامة قليلاً.

سجلت أطوار تربس البصل (حوريات + أفراد كاملة) ذروة نشاط واحدة في الموسم الأول 2006 وكان أقصى تعداد لها 88.8 فرد / نبات عند درجة حرارة 19.8 °م ورطوبة نسبة 61.3% في 18 ابريل. بينما سجلت أفراد التربس فترتي نشاط في الموسم الثاني وكان أعلى تعداد 72.13 فرد / نبات خلال فترة النشاط الثانية عند حرارة 18.3°م ورطوبة نسبية 59.7%.

قدر الضرر النهائي بمن الكرنب على رؤوس كرنب البروكسل بنسبة 60%، 40%، صفر% من الرؤوس تعاني من إصابة شديدة، إصابة متوسطة وإصابة خفيفة في النصف السفلي للساق على التوالي وكذلك 13.3%، 20%، 66.7% في النصف العلوي للساق بنفس الترتيب السابق ولم توجد أي رؤوس خالية من الضرر عند الحصاد. قدر الضرر النهائي بيرقات الفراشة ذات الظهر الماسي على رؤوس كرنب البروكسل بنسبة 53.3%، 46% في النصف السفلي للساق ونسبة 43.3، 56.7% من الرؤوس في النصف العلوي للساق بها تأكل جزئي وثقوب على التوالي ولم توجد رؤوس سليمة عند الحصاد.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (61) العدد الأول (يناير2010):102-110.