

FURTHER STUDIES ON THE MAIN ONION INSECT PESTS IN STORE AND THEIR EFFECT ON YIELD LOSS IN FAYOUM, GOVERNORATE

SABRA, I. M., H. A. SALEH AND I. A. EL SAPPAGH

Plant Protection Research Institute, ARC, Dokki, Giza, Egypt

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Abstract

An experiment was conducted on stored onion pests in Fayoum governorate to determine the main insect pests, symptoms of damage, population fluctuation to evaluate its effect on yield loss throughout 2008/09 and 2009/10 seasons. The results revealed that *Eumerus amoenus* Loew, *Ephestia cautella* (Walker), *Carpophilus immaculatus* Luc., *C. hemipterus* F., and *Athrigona orientalis* Schin were the main insect pests of onion bulbs in store. The symptoms of damage for *E. cautella* and *Carpophilus spp* were described and population of obtained pests were studied. The roles of these pests in yield loss were considered by weight or either number of infested bulbs (% infestation). The detected pests were arranged descendingly according to the infestation percentage in 2008/09 and 2009/10 seasons as: *E. amoenus* (10.8& 8.3%), *E. cautella* (8.8&7.7%), *Carpophilus spp.* (7.2&6.0%) and *A. orientalis* (2&1.5%). The observed pests often destroy the infested bulbs completely except *E. cautella*. The weight loss percent caused by the insect pests ranged 25.78 and 24.10% of the total weight loss.

INTRODUCTION

Onion, *Allium cepa* L., is an important exported field crop. It cultivated frequently as a main winter crop in Fayoum in a large area. It used as fresh green onion, onion bulbs or food industry. At the end of the growing season, after bulbs formation, the onion bulbs are attacked with many insect pests and the infestation continued in the stores which reduces the quantity and quality of storage bulbs. In Egypt, Mahmoud (2008) observed *Eumerus amoenus* Loew, *Ephestia cautella* (Walker), *Carpophilus hemipterus* F., *C. immaculatus* Luc., and *Athrigona orientalis* Schin infesting onion in the store. Also, Massry (2002) reported that, the percent of *E. amoenus* in store varied from 5 to 30%. El-Sherif and Mahmoud (2008) reported that, the larvae of the onion bulb fly (*E. amoenus*) was the most serious pest threatening stored onion bulbs throughout the storage period extended from early June to early November. In India, Gupta *et al*, (1991) reported that, *A. orientalis* and *C. obsoletus* infest onion bulbs in store.

The present study aims to determine the main harmful insect pests of onion bulbs in store under Fayoum conditions and throw the light on their population and

infestation symptoms. Also, to assess the effect of these pests on the weight after storage period.

MATERIALS AND METHODS

To survey the main insect pests of onion bulbs in the store and to clarify their effects on the yield, an experiment was carried out in Fayoum Governorate on stored onion bulbs (Giza 20 variety) throughout 2008/9 and 2009/10 seasons.

A- Survey Studies

The experiment was carried out in open onion field stores (trade stores) in piles each measured 2 m. wide x 10 m. long x 70 cm. height and covered with dry rice straws. Monthly five samples each 100 bulbs were randomly collected from June to October. The samples were directly transferred to the lab. to dissect the bulbs and collect the insects. The specimens of insects were identified by Taxonomy Department of Plant Protection Research Institute.

B-Population Studies

To study the population of onion insects, one tone of Giza 20 variety was stored from May to next April and exposed to the natural infestation. Monthly five samples of 100 bulbs each were collected and examined to record the counts and the infestation percent.

C- Loss assessment

Infestation with any of *E. amoenus*, *Carpophilus spp*, *A. orientalis* causes a complete destruction of the bulbs which were completely lost. Most of the infested bulbs have mixed individuals of these pests. On the other hand the infestation with *E. cautella* not combined with the other insects and causes drying of the outer peels of bulb, so their effect on yield was studied separately. In this respect, Mahmoud (2008) found that, yield loss reach maximum (88.3%) at 100 bulb infestation with *E. amoenus*. According to this fact, weight the infested bulbs is difficult and not true, so the weight loss of stored onion in this paper, was considered by either percent of infested bulbs or their lost weight. Weight loss assessment was done through an experiment carried out in an open field store, contained fresh bulbs, during June and exposed to the natural infestation. Ten samples of 100 healthy bulbs, each were collected and weighted before storing. At the end of storing, in October, ten samples of 100 bulbs each were randomly collected and screened to separate the infested bulbs than that of healthy ones. Onions of each sort were weighted to obtain total loss, natural loss as a result of moisture reduction and loss caused by insect pests. The loss was calculated according to the following equation.

$$\text{Total loss\%} = \frac{\text{Weight before storage} - \text{weight after storage}_\times}{\text{Weight before storage}} \times 100$$

$$\text{Natural loss\%} = \frac{\text{W. of 100 bulbs before storage} - \text{W. of 100 healthy bulbs after storage}}{\text{W. of 100 bulbs before storage}} \times 100$$

$$\% \text{ Loss caused by insect pests} = \text{Total loss} - \text{Natural loss}$$

RESULTS AND DISCUSSION

A- Survey Studies

Survey of bulb insects found in onion stored at Fayoum governorate during the period from June, 2008 to May, 2010 revealed the existence of five injurious species belonging to four genera, *Eumerus amoenus* Loew, *Ephestia cautella* (Walker), *Carpophilus hemipterus* F. and *Carpophilus immaculatus* Luc., and *Athrigona orientalis* Schin.

Carpophilus spp.

This study revealed that, the two species of dried fruit beetles, *C. hemipterus* and *C. immaculatus* attack onion bulbs in the field after completing the bulb formation and also at harvest. Larvae of the two species are nearly similar and their infestation symptoms may combine, so they are studied as one genus. The infestation continued in store all over storage period. Large numbers of larvae feed internally on bulb tissues while the adults dig bits on the outer leaves of the bulbs. Their infestation may combine with onion fly *E. amoenus* and the beetle may carry yeast cells, fungi and bacteria into the bulb causing sour rot which completely destructed the bulb.

***E. cautella* (Walker)**

The almond moth *E. cautella* (Walker) is a major worldwide pest of stored foods. Survey studies revealed that, its larvae feed externally on bulbs under the outer peels of onion only in store. The larvae enter the bulb by digging a small entry holes (about 1/2-1 m.m) or throw the top of the bulb. The infestation causes a partial drying for bulbs outer leaves or rarely causes a complete drying and the leaves color become black or dark brown. Therefore, the growing point not developed and these bulbs become unmarketable. The infested bulbs with *E. cautella* not infested with other insect pests or rot causes yet. The larvae pupate in silky cocoons under the external dry leaves of bulbs.

B- Population Studies

Data presented in table (1) revealed that, three of the previous insect pests of onion bulbs, *Carpophilus spp*, *E. amoenus* and *E. cautella* were present in the store all over the year, while *A. orientalis* was only detected from May til September.

Population density of *E. amoenus* being considerably higher in 2008/9 than in 2009/10 season. The infestation in both seasons started in moderately level in May and increased reaching its highest density at August being 328 and 208 individuals/100 bulbs, respectively. The infestation then gradually decreased until March of the first season and February of the second one being 20 and 22 individuals/100 bulbs, respectively. In this respect, Ismail, *et al*, 1990, reported that, the larvae of *E. amoenus* reach its peak (153/10 bulbs) during the first week of July and another peak at mid August (120/10 bulbs). El-Sherif and Mahmoud (2008) reported that this insect frequently occurred throughout the whole storage period (from June to November) on onion. Also, Haydar and El-Sherif (1997) mentioned that, the activity of *E. amoenus* started by early February and reached its maximum during April, May and June.

Infestation with *Carpophilus spp* was moderate and its level was relatively higher in 2008/9 than 2009/10 season. The highest population was recorded in September being 84 and 69 individuals/100 bulbs, while the lowest density was in March or April being 3 and 4 individuals/100 bulbs per both seasons, respectively. In this respect, Abu-Hashish, (1998), found that the highest population of *C. hemipterus* was in August (212) and the lowest was in February (6) .

Also, a moderate infestation level with *E. cautella* was detected all over the year and the highest density was 22 and 30 individuals/100 bulbs in November, 2008/9 and October, 2009/10, respectively. The lowest population density was in June being 3 and 4 individual/100 bulbs during the 1st and 2nd year, respectively . In this respect, Venkatesh and David (2001) found that, the *C. cautella* infestation in storage increased with storage length, probably with decrease in relative contents of moisture, pyruvic acid and total sulfur.

The present study revealed that, the population density of *A. orientalis* had nearly a similar trend in both seasons and was found only from April until September. The maximum population density was recorded in July and June for the first and second season being 73 and 61 individuals/100 bulbs, respectively. In this respect, Gupta *et al*, (1991) reported that, *A. orientalis* and *Carpophilus obsoletus* infest onion bulbs in store in India. Also Mahmoud (2008), found that, *A. orientalis* attack onion bulbs in Assiut only from July until October.

Table 1. Monthly counts of onion insects/100 bulbs in store, during 2008/9 and 2009/10 seasons.

Month	<i>E. amoenus</i>		<i>Carpophilus spp</i>		<i>A. orientalis</i>		<i>E. cautella</i>	
	2008/9	2009/10	2008/9	2009/10	2008/9	2009/10	2008/9	2009/10
May	38	96	33	26	22	18	8	3
June	74	206	52	40	39	61	3	4
July	179	161	80	62	73	36	5	8
August	328	208	64	44	26	24	7	13
September	184	89	84	69	24	36	16	13
October	236	86	56	48	-	-	18	30
November	142	58	38	36	-	-	22	14
December	80	56	19	12	-	-	18	13
January	64	24	7	8	-	-	12	5
February	40	22	4	7	-	-	13	3
March	20	28	3	5	-	-	5	7
April	32	62	5	4	26	20	11	5
Total	1417	1096	445	361	210	195	138	118
Mean	118.1	91.3	37.1	30.1	17.5	16.3	11.5	9.8

C- Loss assessment

1- Infestation percent

As shown in Table (2), the observed species could be arranged in a descending order according to the total percentage of infestation as: *E. amoenus* (onion bulb fly), *E. cautella* (almond moth), *Carpophilus spp.* (dried fruit beetle), and *Athrigona orientalis*.

The maximum infestation percent for *E. amoenus* was in August ranged 20 - 22%, while the lowest was 3% in March of both seasons. In Assiut El-Sherif and Mahmoud (2008) found that, the infestation of onion bulbs with *E. amoenus* was generally low (2.6%) in June, moderate (7.3%) in July, relatively high (12.2%) in August and (10.9%) in September. The infestation decreased again (7.3%) in October, and became low (4.0%) in November.

As for the infestation with *E. cautella*, it reached the highest level, 17 - 20 % in October and November. Its lowest record (3%) was found in June for both seasons.

The highest infestation percent with *Carpophilus spp.* was recorded in October being 15 and 11% for both seasons, while the lowest percent was 2% in March.

A. orientalis infestation started weakly and similarly continued between 2 – 7% in both seasons from April to September.

In general, regardless the insect species, the percent of infestation onion was relatively higher (2 – 10.8%) in the first season than that (1.5 – 8.3%) in the second season. At the same time, the infestation results pointed to that Giza 20 onion variety seemed to be a more favorable food for the two species of *E. amoenus* and *E. cautella* than the other species, Table (2).

Table 2. Infestation percent with onion insects in store, during 2008/9 and 2009/10 seasons.

Month \ SP.	<i>E. amoenus</i>		<i>E. cautella</i>		<i>Carpophilus spp</i>		<i>A. orientalis</i>	
	2008/9	2009/10	2008/9	2009/10	2008/9	2009/10	2008/9	2009/10
May	4	11	8	3	4	3	2	2
June	12	10	3	3	11	8	4	5
July	21	15	4	6	12	9	7	4
August	22	20	6	10	9	10	6	2
September	17	9	9	12	12	9	4	3
October	17	9	11	17	15	11	-	-
November	13	6	20	12	9	8	-	-
December	5	5	16	11	4	5	-	-
January	5	3	9	4	3	2	-	-
February	6	3	10	3	2	3	-	-
March	3	3	3	6	2	2	-	-
April	5	6	7	5	3	2	1	2
Mean	10.8	8.3	8.8	7.7	7.2	6.0	2.0	1.5

2- Weight loss

As shown in Table (3) the data revealed that, the total loss of bulb weight was higher in 2008/2009 than 2009/2010 season being 32.36 and 29.67%, respectively. The insect pests, of *Carpophilus spp*, *E. amoenus* and *A. orientalis* caused most yield loss and may combine in the same bulb than *E. cautella*. The previous insect pests caused 25.78 and 24.1% of the total weight loss.

Table 3. Loss percent in stored onion weight due to infestation with insect pests during 2008/9 and 2009/10 seasons.

	Mean weight of 100 bulbs (kg.)			Weight reduction %		
	Before storage	After storage		Natural	Total	Insect pests*
	Healthy	Infested bulbs*	Healthy bulbs			
2008/9	11.71	7.92	10.95	6.49	32.362	25.78
2009/10	12.20	8.58	11.52	5.57	29.67	24.10
Mean	11.96	8.25	11.24	6.03	31.02	24.94

* Insect pests = *E. amoenus*, *Carpophilus spp*, *E. cautella* and *A. orientalis*

REFERENCES

1. Abu-Hashish, T. A. 1998. Monthly population density and laboratory rearing of *Carpophilus hemipterus* (L.) (Coleoptera: Nitidulidae) on onion prepared for exportation and dehydration. Ann. Of Agric. Sc., Moshtohor, 36 (3) 1969-1980.
2. El-Sherif, S. I. and H. H. Mahmoud. 2008. The population densities of two major insect pests of onion, the onion thrips (*Thrips tabaci* Lind.) in fields and the onion bulb fly (*Eumerus amoenus* Loew.) in stores. Bull. of Fac. of Agric., Cairo Univ., 59 (4) 326-332.
3. El-Sherif, S. I. and H. H. Mahmoud. 2008. Insect fauna of onion plants in seedbeds, fields and stores in Assiut Governorate. Bull. Fac. of Agric., Cairo Univ., 59 (4) 318-325.
4. Gupta, R. P., K. J. Srivastava and U. B. Pandey. 1991. Management of onion diseases and insect pests in India. Onion Newsletter for the Tropics. 3, 15-17.
5. Haydar, M. F. and L.S. El-Sherif. 1987. Ecological aspects and developing method of onion pest control. Bull. Soc. Entomol. Egypt, econ. Ser., 16: 119-126.
6. Ismail, I. I., M. .M. El Bolok and H. A. El Shabrawy. 1990. Population fluctuation of two onion bulb flies (*E. amoenus* Loew and *E. vestitus* Bez., Syrphidae, Diptera) and their parasites in the store. Bull. Soc. Entomol. Egypt, 69, 89-96.

7. Mahmoud, H. H. 2008. Ecological studies on certain insect pests of onion with special emphasis on the onion bulb fly *Eumerus amoenus* Loew. (Diptera : Syrphidae). Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.
8. Massry, S. H. D. 2002. Ecological and bio-control studies on some pests infesting onion and garlic crops. M. Sc. Thesis, Fac. Agric., Menoufia Univ., Egypt.
9. Sherif, S. I. and H. H. Mahmoud. 2008. The population densities of two major insect pests of onion, the onion thrips (*Thrips tabaci* Lind.) in fields and the onion bulb fly (*Eumerus amoenus* Loew.) in stores. Bull. of Fac. of Agric., Cairo Univ., 59 (4) 326-332.
10. Venkatesh, D. and P. M. M. David. 2001. Some observations on the fig moth, *Cadra cautella* (Wlk.) infesting onions in storage. Entomon. 26 (3/4) 323-326.

دراسات عن أهم الآفات الحشرية التي تصيب البصل في المخزن وتأثيرها على الفقد في المحصول بمحافظة الفيوم

ابراهيم مخيم صبرة ، حسام احمد صالح ، ابراهيم عبدالحميد الصباغ

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقى - الجيزة

أجريت تجربة لتحديد أهم الآفات التي تصيب محصول البصل في المخزن تحت ظروف محافظة الفيوم وكذا دراسة أعراض الإصابة وتعداد هذه الآفات وتحديد نسبة وكمية الضرر الناتج عن الإصابة. وقد أتضح من الدراسة وجود خمسة آفات رئيسية تصيب البصل في المخزن وهم 1- ذبابة البصل الكبيرة (*Eumerus amoenus* Loew) 2- فراشة المواد المخزونة (*Ephestia cautella* (Walker)) 3- ، 4- خنفسى الفاكهة المجففة (*Carpophilus immaculatus* Luc. و (*C. hemipterus* F.)) 5- ذبابة الأزرجونا (*Athrigona orientalis* Schin.) وتم وصف أعراض الإصابة لكلا من *E. Cautella* و *Carpophilus spp.* وأظهرت دراسة التعداد أن الأربعة آفات الأولى تهاجم البصل في المخزن طوال العام بينما تهاجم ذبابة الأزرجونا الأبخصال في الفترة من شهر ابريل وحتى سبتمبر ووصلت ذبابة البصل لأعلى تعداد لها خلال شهر أغسطس (328 و 208 يرقة /100بصلة) وكان اقل تعداد خلال شهر مارس وفبراير (20 و 22 يرقة / 100بصلة) خلال موسمي 2009/2008 و 2010/2009 على الترتيب وكان أعلى تعداد لخنفسى الفاكهة المجففة خلال شهر سبتمبر (84 و حشرة 100/69بصلة) بينما سجل اقل تعداد خلال شهر مارس في الموسم الاول وشهر ابريل في الموسم الثاني (3 أو 4حشرة / 100بصلة) وكان أعلى تعداد لفراشة المواد المخزونة خلال شهر نوفمبر في الموسم الأول وشهر اكتوبر في الموسم الثاني (22 أو 30 حشرة /100بصلة) وكان اقل تعداد خلال شهر يونيو في الموسمين (3 أو 4 يرقة/100بصلة). وكانت أعلى كثافة لذبابة الأزرجونا خلال شهر يوليو في الموسم الأول وشهر يونية للموسم الثاني (73 و 61 يرقة/100بصلة).

وتم دراسة تأثير هذه الآفات على الفقد في المحصول بطريقتين:

1- نسبة الإصابة: وامكن ترتيب الحشرات طبقا لنسبة الإصابة كما يلي: ذبابة البصل الكبيرة (10.8 ، 8.3%) ، فراشة المواد المخزونة (8.8 ، 7.7%) ، خنفسى المواد المخزونة (7.2 ، 6 ، 2%) ، ذبابة الأزرجونا (2 ، 1.5%) خلال موسمي الدراسة وغالبا تقضى هذه الآفات على الأبخصال المصابة تماما فيما عدا فراشة المواد المخزونة لذا فأن نسبة الإصابة بهم تساوي نسبة الفقد في المحصول.

2- الوزن المفقود: أتضح من الدراسة تداخل الإصابة في نفس البصلة بكلا من ذبابة البصل الكبيرة و خنفسى المواد المخزونة وذبابة الأزرجونا بينما لا تتداخل مع فراشة المواد المخزونة وكانت نسبة الفقد الكلية في الوزن نتيجة الإصابة الحشرية 25.87 ، 24.10%.