

**THE POPULATION DENSITIES OF TWO MAJOR INSECT PESTS OF ONION; THE ONION THIRPS (*Thrips tabaci* Lindeman ) IN FIELDS AND THE ONION BULB FLY (*Eumerus amoenus* Loew.) IN STORES**

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**ABSTRACT**

Onion plantations and stored onion bulbs are subjected to infestation with a variety of insect pests that considerably affect crop quality and quantity. Among these pests dominate the onion thrips *Thrips tabaci* (Thysanoptera: Thripidae) in the field and the onion bulb fly *Eumerus amoenus* (Diptera: Syrphidae) on stored bulbs. Population density of *T. tabaci* in onion fields studied throughout 3 successive growing seasons (2002/2003-2004/2005) at Assiut Governorate indicated that the pest's larvae and adults prevailed from early January until late May with 2 to 3 overlapping broods. The 1<sup>st</sup> brood elapsed about 3 months extending from early January to early April, the 2<sup>nd</sup> brood covered a period of about 2 months from early March until mid-April and the 3<sup>rd</sup> brood lasted for about 2.5 months from mid-March until the end of May. Both the 1<sup>st</sup> and the 3<sup>rd</sup> broods were of definite annual occurrence while the 2<sup>nd</sup> brood might or might not occur. The follow up of the population density of *E. amoenus* in onion stores throughout 3 successive storage seasons (2003-2005) revealed its frequent occurrence throughout the whole storage period which extended from June until November. The mean percentage of onion bulbs infested with *E. amoenus* was generally low (2.6%) in June, moderate (7.3%) in July, relatively high 12.2% in August and September 10.9% then moderate again (7.3%) in October and low (4.0%) in November. The pest underwent 4 successive overlapping generations throughout the storage period and the generation duration ranged from 7 to 9 weeks. The 1<sup>st</sup> to the 4<sup>th</sup> generations peaked by late July, the 2<sup>nd</sup> half of August, the 2<sup>nd</sup> half of September and throughout October. The 1<sup>st</sup> generation was relatively weak while the 2<sup>nd</sup> and 3<sup>rd</sup> generations were quite strong and the 4<sup>th</sup> generation was the weakest.

**Key words:** *Eumerus amoenus*, onion fields and stores, population densities, *Thrips tabaci*.

**1. INTRODUCTION**

In Egypt, onion (*Allium cepa* L.) is an important field crop for both local consumption and exportation. Onion plantations and stored onion bulbs are often subjected to infestation with a variety of insect pests that considerably affect crop quality and quantity (Mahmoud, 2008). Onion plantations usually suffer insect attacks throughout their different growth stages from immediately after transplanting in December until harvest-time by May. During this period onion thrips *Thrips tabaci* (Thysanoptera: Thripidae) dominates as the most destructive threat. In onion stores, the dominant insect pest on stored onion bulbs throughout the storage season- which extends from May until November- is the onion bulb fly *Eumerus amoenus* (Diptera: Syrphidae).

Previous investigations on the population density of *T. tabaci* in onion plantations in Egypt include the works of Karaman (1970), Khalil *et al.* (1971), Haydar and Sherif (1987) and El-Gendi (1998). Relevant investigations abroad include the studies of El-Serwi *et al.* (1985) in Iraq, Edelson *et al.* (1986) in USA, Lu and Lee (1987) in Taiwan and Kalafchi *et al.* (2006) in Iran. As for the population density of *E. amoenus* throughout the storage period in Egypt, reference is made to the studies of El-Sherif (1971), Mikhael (1978), Abd-El-Fattah (1980), Ismail *et al.* (1990) and Massry (2002). Literature on the population density of the species *E. amoenus* abroad is, apparently, very scanty.

Mahmoud (2008) reported that in Egypt, the most economically important insect pests in onion

fields and stores are *T. tabaci* and *E. amoenus*, respectively. Therefore, the present work investigated the population densities of these pests at Assiut Governorate which is considered one of the country's biggest onion production areas. It is hoped that such contribution might help establishing feasible recommendations for the management of the two considered pests.

**2. MATERIALS AND METHODS**

The study of the population density of *Thrips tabaci* was carried out in selected farmer fields planted with the commonly grown onion cultivar "Giza 6 Mohassan" at Assiut Governorate during the three successive onion growing seasons of 2002/2003 - 2004/2005. For each season, an area of 336 m<sup>2</sup> was divided into four plots (replicates), each measuring 7 x 12 m. (84 m.<sup>2</sup>) and transplanted with healthy onion seedlings by late November or early December. A random sample of 10 plants was taken from each replicate at quarter-monthly intervals, thus making a total sample size of 40 plants from the whole experimental field. Plant samples were taken between 3 p.m. and 5 p.m. from the beginning of January until the end of May. All plots were left to grow normally and no control measures were applied until harvest-time. Sampled plants were introduced into clean cloth bags, then transferred

seasons of 2003-2005 in a store located at Assiut Governorate and full of stored bulbs of onion cultivar "Giza 6 Mohassan". In each considered storage season, a random quantity of 400 Kg. of stored onion bulbs was kept into four separate heaps each weighing 100 Kg. and regarded as a replicate. The heaps were separated from each other by 2 m. distance and sampling from them was practiced at quarter-monthly intervals from the beginning of June until the beginning of November. At each date, a random sample of 25 bulbs was taken from each heap (replicate), thus the total size of the quarter-monthly sample was 100 bulbs. Sampled bulbs were carefully examined for infestation with *E. amoenus* and its existing larvae and / or pupae were counted.

**3. RESULTS AND DISCUSSION**

**3.1. The onion thrips, *T. tabaci***

The quarter-monthly population densities of thrips individuals (larvae and adults) in onion fields at Assiut Governorate throughout the three successive onion growing seasons (2002/2003-2004/2005) are graphically illustrated in Fig.(1). In 2002/2003, thrips individuals began to occur in relatively small numbers (246/ 40 plants) during the 2<sup>nd</sup> half of January and gradually increased in number throughout February and March until they reached a high peak of 2830/40 plants by mid

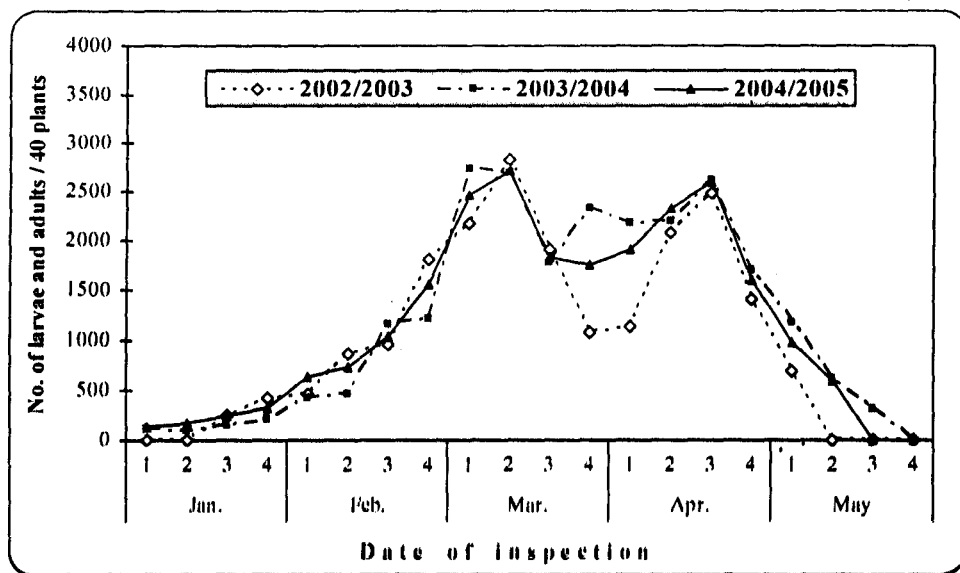


Fig. (1): Population densities of *Thrips tabaci* in onion fields at Assiut Governorate during three successive onion growing seasons (2002/2003 - 2004/2005).

to the laboratory where they were examined for the occurrence and count of thrips larvae and / or adults.

The population density of *E. amoenus* was studied during the three successive storage

March. Thrips counts tended to decrease during the 2<sup>nd</sup> half of March, then increased thereafter to reach another relatively high peak of 2485 individuals/ 40 plants. This second population peak was then followed by a noticeable decrease

of thrips count to 684 individuals/40 plants by early May. No thrips individuals could be recorded in onion plantations starting from mid-May. In 2003/2004, relatively small counts of thrips individuals occurred during January (103-203/ 40 plants). Starting from early February, the population density tended to increase gradually but rather rapidly during the 2<sup>nd</sup> half of the month. Population increase continued to a peak of 2686-2730 individuals/ 40 plants reached during the first half of March. This peak was followed by a drop in thrips count during the 3<sup>rd</sup> quarter of March then a second peak of 2331 individuals/ 40 plants occurred by the end of the same month. Generally population density was relatively high during April (1698-2610 / 40 plants) and a third peak count took place during the 3<sup>rd</sup> quarter of the month. The latter peak was followed by a gradual decrease of thrips population until onion plants became entirely free of infestation by the end of May. In 2004/ 2005, thrips individuals began to occur in relatively small counts by early January (138 /40 plants). Larval and adult counts increased gradually throughout January, February and March until a first peak of 2706 individuals / 40 plants took place by mid-March. Thrips counts were considerably high between mid-March and mid-April (1755-2332 individuals / 40 plants) then jumped to a second peak of 2598 individuals / 40 plants during the 3<sup>rd</sup> quarter of April. This peak was followed by a gradual decline in thrips population until all larvae and adults completely disappeared from onion fields by mid-May.

Fig. (1) indicates that at Assiut Governorate, infestation with onion thrips prevails in onion fields from early January until mid- or late May. Throughout that prevalence period, 2-3 overlapping population broods of thrips are of possible occurrence. By integrating the population lines in the same figure it appears that the 1<sup>st</sup> brood elapses about 3 months extending from early January to early April. The peak abundance of this particular brood mostly occurs by mid-March (67.7 – 70.8 individuals / plant). The 2<sup>nd</sup> brood covers a period of about 2 months from early March until mid- April with a relatively smaller peak of 58.3 individuals / plant. The 3<sup>rd</sup> brood lasts for about 2.5 months from mid-March until the end of May with a comparatively high peak of 62.1- 65.3 individuals / plant. Fig. (1) further indicates that both 1<sup>st</sup> and 3<sup>rd</sup> broods are of

definite annual occurrence while the 2<sup>nd</sup> brood may or may not occur in certain years. As for the relative sizes of the different broods it seems that the 1<sup>st</sup> and 3<sup>rd</sup> broods are of nearly equal size while the 2<sup>nd</sup> brood – whenever happens – is slightly smaller.

At Assiut Governorate, thrips counts in onion fields tended to increase from an onion growing season to the next. The total counts of thrips individuals for the whole season were 20548 in 2002/2003, 22411 in 2003/2004 and 23608 in 2004/ 2005. Similarly, the respective mean numbers of thrips individuals / inspection were 1284.3, 1400.7 and 1475.5 for 2002/2003, 2003/2004 and 2004/2005 seasons, respectively. Such counts emphasize the tendency towards population increase one season after another.

The above results more or less agree with the findings of a group of investigations conducted in Egypt. Karaman (1970) and Khalil *et al.* (1971) coincided that the various stages of *T. tabaci* are found in onion fields in relatively low numbers during December, then increase rapidly to reach maximum abundance through April. Haydar and Sherif (1987) mentioned that the population of *T. tabaci* begins to build up by early February and reaches its maximum during April. El-Gendi (1998) stated that *T. tabaci* is active in onion fields from mid-December to mid-May. Furthermore, El-Serwiy *et al.* (1985) observed that in Iraq the population density of *T. tabaci* varies from one year to another and reaches a peak by early April. In Texas, USA, Edelson *et al.* (1986) found that *T. tabaci* individuals occur in onion fields from February till harvest-time in April or May with a peak of abundance in early April. Lu and Lee (1987) contributed that the population density of *T. tabaci* in Taiwan increases from November to April. Kalafchi *et al.* (2006) added that in Iran the population density of *T. tabaci* is the highest 130-158 days after planting.

### 3.2. The onion bulb fly, *E. amoenus*

The quarter-monthly rate of infestation with *E. amoenus* (represented as the number of infested bulbs per 100 bulbs *i.e.*, percentage of infested bulbs) and its population fluctuations (represented as total larval and pupal counts per 40 bulbs) at Assiut Governorate during the three successive storage seasons of 2003-2005 are graphically illustrated in Fig. (2) and Fig. (3), respectively.

#### 3.2.1. The percentage of bulb infestation

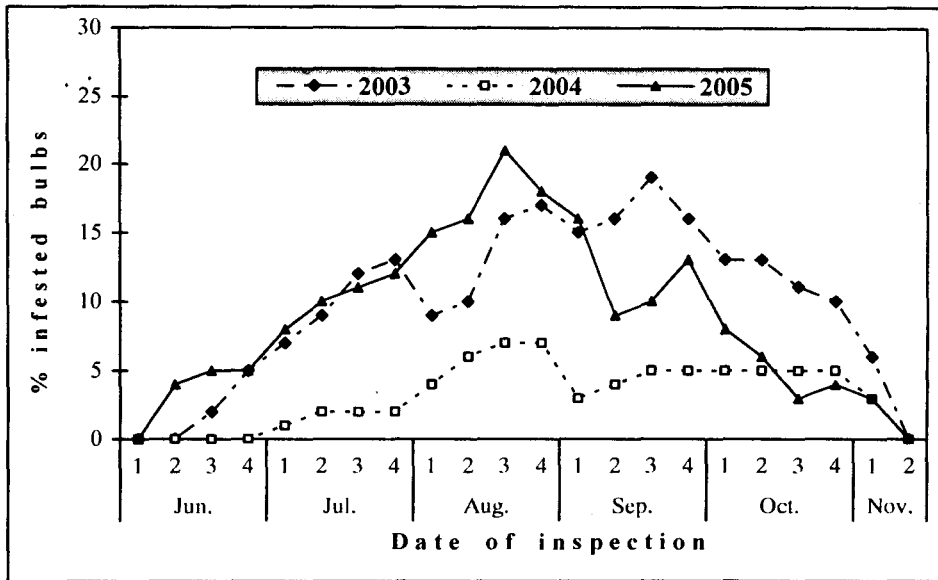


Fig. (2): Percentage of bulb infestation with *E. amoenus* on stored onion bulbs at Assiut Governorate during the storage seasons 2003 – 2005.

Fig. (2) shows that the highest percentage of infested bulbs occurred in 2003 (2-19 %, with a mean of 11.5%) and the lowest percentage took place in 2004 (1 – 7 %, with a mean of 3.6%) while in 2005 this percentage was slightly less than in 2003 (3-21%, with a mean of 9.9 %). For the three storage seasons collectively, the percentage of infested bulbs was generally low in

June (0 – 5 %, with a mean of 2.6%), moderate in July (1-13%, with a mean of 7.3%), relatively high in August and September (4-21%, with a mean of 12.2% and 3-19%, with a mean of 10.9%, respectively) then moderate again in October (3-13% , with a mean of 7.3%) and low in November (3-6%, with a mean of 4.0%). The same figure further indicates that, based on the quarter-

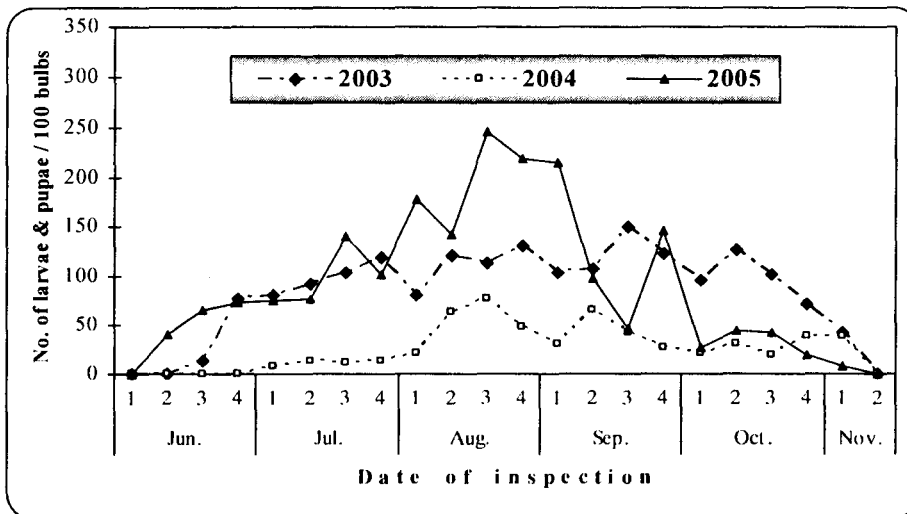


Fig. (3): Total number of *E. amoenus* larvae and pupae recorded on stored onion bulbs at Assiut Governorate during the storage seasons 2003 – 2005.

monthly changes of the percentages of infested bulbs, *E. amoenus* had four population peaks throughout each storage season. These peaks could be roughly approximated as shown in Table (1) which refers that in 2003 - the season with the highest infestation - the four peaks were quite distinct whereas in both 2004 and 2005 the seasons with relatively less infestation, only three peaks could be recognized while the fourth one was too small. Such approximation for the peaks of infestation percentage on the stored onion bulbs leads to the general conclusion that, at Assuit Governorate, infestation with *E. amoenus* reaches peaks during the 4<sup>th</sup> quarter of July, the 3<sup>rd</sup> - 4<sup>th</sup> quarters of August, the 3<sup>rd</sup> - 4<sup>th</sup> quarters of September and throughout October.

**3.2.2. Total larval and pupal populations**

Fig. (3). shows that in 2003, onion bulbs began to show infestation with *E. amoenus* larvae during the 2<sup>nd</sup> half of June. Pupae were noticed in July and the total number of larvae and pupae reached a high 1<sup>st</sup> peak of 120 / 100 bulbs during the 4<sup>th</sup> quarter of the same month. This peak was followed by a small decline in the total larval and pupal count then a 2<sup>nd</sup> high peak of 122 larvae and pupae/100 bulbs occurred by mid-August. Total larval and pupal count remained noticeably high in August and September until a 3<sup>rd</sup> relatively higher peak of 150 /100 bulbs took place during the 3<sup>rd</sup> quarter of September. Larval and pupal count tended to decline between late September and early October but it regained increase towards a 4<sup>th</sup> high peak of 128 / 100

100 bulbs was observed by mid August. The 2<sup>nd</sup> peak was followed by a gradual decline in larval and pupal count between late August and early September, then this count increased to a moderate 3<sup>rd</sup> peak of 66/ 100 bulbs reached during the 2<sup>nd</sup> quarter of September. Although larval and pupal count tended to oscillate thereafter, a 4<sup>th</sup> relatively small peak of 31-39/ 100 bulbs took place during the 2<sup>nd</sup> half of October and by early November. In 2005, the larvae and pupae of *E. amoenus* were found on the stored onion bulbs starting from the 2<sup>nd</sup> quarter of June and their total count increased rapidly towards a 1<sup>st</sup> high peak of 142/100 bulbs recorded during the 3<sup>rd</sup> quarter of July. Larval and pupal count was noticeably high between mid-July and mid-August and reached a markedly high 2<sup>nd</sup> peak of 245 / 100 bulbs during the 3<sup>rd</sup> quarter of August. The latter peak was followed by a continuous decrease of total larval and pupal count until the 3<sup>rd</sup> quarter of September when it increased again towards a 3<sup>rd</sup> high peak of 147 / 100 bulbs reached during the 4<sup>th</sup> quarter of the same month. A 4<sup>th</sup> relatively smaller peak of 44 larvae and pupae/ 100 bulbs took place about two weeks later during the 2<sup>nd</sup> week of October. Larvae and pupae tended to decrease in number gradually thereafter until they completely disappeared by the end of the storage season about mid-November.

Data in Figs. (2&3) seem to more or less agree with the findings of the previous investigators. El-Sherif (1971) who observed that stored onion bulbs are liable to infestation with *E. amoenus*

**Table (1): Approximate periods of peak occurrence of *E. amoenus* on stored onion bulbs throughout the storage period for 2003 – 2005 seasons.**

Peak	STORAGE SEASON		
	2003	2004	2005
First	4 <sup>th</sup> quarter of July	*	4 <sup>th</sup> quarter of July
Second	4 <sup>th</sup> quarter of August	3 <sup>rd</sup> & 4 <sup>th</sup> quarters of August	3 <sup>rd</sup> quarter of August
Third	3 <sup>rd</sup> quarter of September	3 <sup>rd</sup> & 4 <sup>th</sup> quarters of September	4 <sup>th</sup> quarter of September
Fourth	1 <sup>st</sup> & 2 <sup>nd</sup> quarters of October	1 <sup>st</sup> – 4 <sup>th</sup> quarters of October	*

\* Peaks are too small to be precisely approximated.

bulbs during the 2<sup>nd</sup> quarter of the latter month. In 2004, no larval or pupal infestations were recorded during June. Larvae began to occur on stored bulbs throughout July with a 1<sup>st</sup> small peak of 13 larvae / 100 bulbs by the end of the month. A 2<sup>nd</sup> moderate peak of 77 larvae and pupae /

maggots from mid-June until early November. Mikhael (1978) mentioned that the percentage of *E. amoenus* infestation to stored onion bulbs reaches a peak by the beginning of the 2<sup>nd</sup> week of July. Abd-El-Fattah (1980) added that the highest mean percentage of infestation with *E. amoenus*

on onion bulbs (12.5%) occurs in July and the highest level of larval and pupal populations on them (a mean of 40.5 /bulb) takes place in August. Ismail *et al.* (1990) reported that the larvae of *E. amoenus* are first seen on stored onion bulbs during the 1<sup>st</sup> week of June then they increase in number towards two peaks; one during the 1<sup>st</sup> week of July and the other by mid-August. Massry (2002) contributed that the infestation of stored onion bulbs with *E. amoenus* reaches a maximum by late July or early August.

September and mid-November. As for the relative sizes of the above-mentioned four generations, a glance to Figs. (2&3) reveals that the 2<sup>nd</sup> and 3<sup>rd</sup> generations are relatively stronger than the 1<sup>st</sup> and 4<sup>th</sup> generations. Based on the quarter-monthly percentages of bulb infestation during the two storage seasons with the comparatively high infestation with *E. amoenus* (2003 and 2005, Fig.2) as well as the quarter-monthly total larval and pupal counts during the same two storage seasons (Fig.3), it seems that the 1<sup>st</sup> generation is

**Table (2): Approximate occurrence periods of the four successive overlapping generations of *E. amoenus* on stored onion bulbs throughout the storage period for 2003-2005 seasons.**

GENERATION	STORAGE SEASON		
	2003	2004	2005
<b>FIRST :</b>			
From	2 <sup>nd</sup> quarter of June	4 <sup>th</sup> quarter of June	1 <sup>st</sup> quarter of June
To	2 <sup>nd</sup> quarter of August *(9)	2 <sup>nd</sup> quarter of August *(7)	1 <sup>st</sup> quarter of August *(9)
<b>SECOND :</b>			
From	3 <sup>rd</sup> quarter of July	4 <sup>th</sup> quarter of July	2 <sup>nd</sup> quarter of July
To	3 <sup>rd</sup> quarter of September *(9)	2 <sup>nd</sup> quarter of September *(7)	1 <sup>st</sup> quarter of September *(8)
<b>THIRD :</b>			
From	4 <sup>th</sup> quarter of August	3 <sup>rd</sup> quarter of August	1 <sup>st</sup> quarter of August
To	3 <sup>rd</sup> quarter of October *(8)	2 <sup>nd</sup> quarter of October *(8)	4 <sup>th</sup> quarter of September *(9)
<b>FOURTH :</b>			
From	2 <sup>nd</sup> quarter of September	3 <sup>rd</sup> quarter of September	2 <sup>nd</sup> quarter of September
To	2 <sup>nd</sup> quarter of November *(9)	2 <sup>nd</sup> quarter of November *(8)	2 <sup>nd</sup> quarter of November *(9)

\* Figures between brackets represent the approximate generation durations in weeks

### 3.2.3. Number of generations throughout storage period

By integrating the lines representing the quarter-monthly fluctuations of larval and pupal counts of *E. amoenus* in onion stores for the three successive storage seasons (Fig. 3), it appears that the pest undergoes four overlapping generations throughout the storage period which extends from early June until early November. An approximation of the occurrence periods of these generations and the duration of each generation is presented in Table (2). This table indicates that the 1<sup>st</sup> generation takes place from early June to mid-August and lasts for about 7-9 weeks. The 2<sup>nd</sup> generation elapses the period between mid-July and mid-September and lasts for about 7-9 weeks also. The 3<sup>rd</sup> generation covers a period of about 8-9 weeks between early August and mid-October. The duration of the 4<sup>th</sup> generation ranges about 8-9 weeks extending between mid-

relatively weak while the 2<sup>nd</sup> and 3<sup>rd</sup> generations are quite strong and the 4<sup>th</sup> generation is the weakest.

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كثافات التعداد لأفتين حشريتين هامتين على البصل:  
تربس البصل ( *Thrips tabaci* Lindeman ) في الحقل  
وذبابة البصل الكبيرة ( *Eumerus amoenus* Loew .) في المخزن

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ملخص

تعرض زراعات البصل وكذلك الأبخال المخزنة للإصابة بعدد من الأفات الحشرية التي تؤثر بشكل كبير على نوعية وكمية المحصول. ويسود بين تلك الأفات كل من تربس البصل *Thrips tabaci* من عائلة Thripidae ورتبة هديبة الأجنحة Thysanoptera على النباتات في الحقل وذبابة البصل الكبيرة *Eumerus amoenus* من عائلة Syrphidae ورتبة ذات الجناحين Diptera على الأبخال المخزنة. درست الكثافة العددية لتربس البصل في الحقل خلال ثلاثة مواسم زراعية متتالية من ٢٠٠٢/٢٠٠٣ إلى ٢٠٠٤/٢٠٠٥ بمحافظة أسيوط باستخدام الصنف "جيزة ٦ محسن". ووجدت اليرقات والحشرات الكاملة للأفة من أوائل يناير حتى أواخر مايو، وكان لها في كل موسم من ٢ إلى ٣ حضنات متداخلة. واستغرقت الحضنة الأولى نحو ثلاثة أشهر من أوائل يناير حتى أوائل أبريل والحضنة الثانية حوالي شهرين من أوائل مارس حتى منتصف أبريل، والحضنة الثالثة نحو شهرين ونصف بين أوائل مارس وأواخر مايو، وكانت الحضنتان الأولى والثالثة متكررتي الحدوث كل موسم أما الحضنة الثانية فحدثت في موسم واحد فقط (٢٠٠٣/٢٠٠٤). كذلك درست الكثافة العددية ليرقات وعدادى ذبابة البصل الكبيرة خلال ثلاثة مواسم تخزينية متتالية (٢٠٠٣ - ٢٠٠٥) بمحافظة أسيوط باستخدام الصنف "جيزة ٦ محسن" ووجدت الأفة خلال فترة التخزين التي تمتد من يونيو حتى نوفمبر حيث كان متوسط النسبة المئوية للأبخال المصابة منخفضة في يونيو (٢,٦%)، ومتوسطا في يولية (٧,٣%)، وعالية خلال كل من أغسطس وسبتمبر (١٢,٢% و ١٠,٩%، على التوالي)، ثم متوسطا خلال أكتوبر (٧,٣%) ومنخفضا في نوفمبر (٤,٠%). وأتمت ذبابة البصل الكبيرة أربعة أجيال متداخلة على الأبخال المخزنة استغرق كل منها ٧ إلى ٩ أسابيع، وسجلت قمم الأجيال الأربعة المتعاقبة في أواخر يولية، ومنتصف أغسطس، والنصف الثاني من سبتمبر وخلال أكتوبر، على التوالي، وكان الجيل الأول ضعيفا نسبيا أما الجيلان الثاني والثالث فكانا قويان في حين كان الجيل الرابع أضعف الأجيال.

المجلة العلمية لكلية الزراعة - جامعة القاهرة - المجلد (٥٩) العدد الرابع (أكتوبر ٢٠٠٨) : ٣٢٦-٣٣٢.