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LOSSES OF HAZELNUTS BY INFESTATION OF CERTAIN STORED PRODUCT INSECTS IN EGYPT.

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ABSTRACT

This study was carry out in the stored grain insects laboratory of Faculty of Agriculture, Cairo University throughout August 2008 to February 2009 to associate the insect populations with stored hazelnuts, determine the percentages of infestation on hazelnuts and percentages of weight losses in the infested nuts. Four species of stored-product pests were recorded, the sawtoothed grain beetle, *Oryzaephilus surinamensis*, the rust-red flour beetle, *Tribolium castaneum*, the Indianmeal moth, *Plodia interpunctella* and the cigarette beetle, *Lasioderma serricorne*. One predatory Hemiptera and another one Hymenoptera parasite were found during study to have potential for biological pest control. During storage period, the mean number of adults of four species were the highest in Sept. and Oct., after that the populations decreased gradually with increasing the storage period which reached the lowest number of adults in Feb. The percent of infestations were 50.03, 56.6, 60.63, 63.15, 57.75 and 54.35% during Sept., Oct., Nov., Dec., Jan., Feb., respectively. The corresponding values of losses in weight of nuts were 25.43, 27.2, 32.28, 21.53, 18.0 and 16.28%. Under artificial infestation levels, *P. interpunctella* was more effective for weight losses of nuts followed by *T. castaneum* then *O. surinamensis*. Weight losses ranged to 6.64 – 18.83, 1.6 – 6.55 and 0.87 – 3.42 % for *Plodia interpunctella, Tribolium castaneum* and *Oryzaephilus surinamensis*, respectively.

INTRODUCTION

Stored-product insects cause significant damage and loss to stored foods. Most of these storage pests are able to contaminate their feeding media through excretion, moulting, dead bodies and their own existence in the product, which is not commercially desirable. In addition, storage pests are able to increase in numbers drastically within a relatively short time.

Hazelnuts (*Carylus avellana*) are one of the most important inputs to the chocolate and confectionary industries. During the post-harvest storage of hazelnuts considerable qualitative and quantitative losses occur, especially under storage conditions with increasing moisture. (Isikber *et al*., 2006). Insect pests inflict their damage on stored products mainly by direct feeding, some species feed on the endosperm causing loss of weight and quality (Malek & Parveen, 1989; Santos *et al*., 1990). The monitoring for detecting stored-product insects can lead to early detection of low level infestations and pinpointing hidden infestations. The main aim of this work is to explore and list of the most common storage hazelnut pest species and show influence of differing population levels to provide quantitative data of losses.

MATERIALS AND METHODS

Hazelnuts were collected from the storage center of Sekam farm located in Belbis city, Egypt. Insects associated with hazelnuts were conducted during August 2008 to February 2009. All experiments were carried out in the stored grain insects laboratory of Faculty of Agriculture, Cairo University.

1- Samples preparation:

Before storage of the nuts, nuts were carefully examined and insect species associated with hazelnuts were recorded (Initial infestation). After that, nuts were divided into 20 samples, each sample was about 500 g.which kept in a glass jar of one pound capacity. Jars were covered with muslin fitted in place with rubber band and kept in the laboratory.

2- Stored-hazelnut pest monitoring

Carefully examinations for all samples were carried out. By the end of each month (6 months), samples were sieved through a 40- mesh and the numbers of adult of each insect species were recorded.

3- Infestation and weight loss under natural infestation:

Determination of loss during storage under natural infestation was conducted throughout August 2008 to February 2009. Nuts samples were carefully examined to record the following: number of undamaged nuts (Nu), weight of undamaged nuts (Wu), number of damaged nuts (Nd) and weight of damaged nuts (Wd). Infestation percentage for each sample was then calculated by applying the following equation:

$$\% \text{ Infestation } = \frac{Nd}{Nd + Nu} \times 100$$

The % weight loss in nuts was calculated by the "count-and-weight" method described by Harris and Lindblad (1978) applying the following equation:

$$\% \text{ Weight loss} = \frac{(Wu \times Nd) - (Wd \times Nu)}{Wu \times (Nd + Nu)} \times 100$$

4- Weight loss under artificial infestation levels

Sound sterilized nuts were used for the assessment of loss under artificial infestation. 150 grams of sterilized nuts of every artificial level were divided into 3 equal quantities (replicates) of ca. 50 grams each artificially infested with newly-adult emerged obtained from the stock culture at a rate 5, 10, 20, 40 adult of *Oryzaephilus surinamensis*, *Tribolium castaneum and Plodia interpunctella*. Jars were covered with muslin fitted in place with rubber band and incubated under the optimum conditions of 30 ± 2°C and 50 ± 5% RH. After six months of artificial infestation, the weight nuts of every level were recorded and the percentage of weight loss was calculated using formula of Harris and Lindblad (1978) which mentioned above.

5- Statistical analyses

F. and Duncan tests using SPSS computing program were adopted for calculating the infestation rates, weight losses using ANOVA according to described by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

1- Initial infestation:

The population density of the different insect species associated with stored hazelnuts were recorded. The occurrence of the different insects to

their populations were as follows: the sawtoothed grain beetle, *Oryzaephilus surinamensis* was 573 adults which consisted 32.2% of the fauna, the rust-red flour beetle, *Tribolium castaneum* was 252 adults which consisted 23.8% of the fauna, the Indianmeal moth, *Plodia interpunctella* was 211 adults which consisted 21.0% of the fauna and the cigarette beetle, *Lasioderma serricorne* was 143 adults which consisted 16.4% of the fauna. The total percentage of infestation was 41.8% and the percent of weight loss was 12.0%. One predatory Hemiptera and another one Hymenoptera parasite were found during study. The same observations were recorded by Eliopoulos *et al.* (2002) and considered to have potential for biological pest control. This result agreement with Gahukar (1975) which recorded the occurrence *L. serricorne* on nuts and coconut meal. Johanson *et al.* (1995) mentioned that the Indianmeal moth, *Plodia interpunctella* infests nuts during storage. Begum *et al*. (2007) mentioned that the ability of stored-product pests including the cigarette beetle, *Lasioderma serricorne*, the sawtoothed grain beetle, *Oryzaephilus surinamensis*, the rust-red flour beetle, *Tribolium castaneum*, and the almond moth, *Ephestia cautella* to infest chocolates under packaged and unpackaged conditions.

2- Natural infestation during 6 months of storage

Population, The % infestation and % weight losses of *T. castaneum*, *O. surinamensis*, *L. serricorne* and *P. interpunctella* were recorded in Table (1). The mean number of adults of four species were the highest in Sept. and Oct., after that the populations decreased gradually with increasing the storage period which reached the lowest number of adults in Feb.

Statistical analysis indicated that, in both Sept. and Oct. *P. interpunctella* received significantly less population than each of other species which were insignificantly different from each other. During Nov. and Dec. populations of *T. castaneum* was significantly higher than population of other species. Also population of *O. surinamensis* was higher than population of both *L. serricorne* and *P. interpunctella* which were insignificantly different from each other. During Jan. and Feb. *T. castaneum* received significantly higher population than other species which were insignificantly different between each other.

The percent of infestations were 50.03, 56.6, 60.63, 63.15, 57.75 and 54.35% during Sept., Oct., Nov., Dec., Jan., Feb., respectively. The corresponding values of losses in weight of nuts were 25.43, 27.2, 32.28, 21.53, 18.0 and 16.28%.

The statistical analysis indicated that the percent of infestation during storage months were insignificant between each other. On the other hand, the percent of weight losses during Sep., Oct. and Nov. were significantly higher than during Dec., Jan. and Feb.

Several studies were conducted on the infestation of different stored product with some insect species. As a matter of fact, the knowledge on the effect of insect species on the weight losses of hazelnuts is very scanty. The investigations on the damage and weight losses on some stored grains could be summarized in the following: Cotton (2007) estimates and reflects differences in populations pressure, with insect pests being more important than diseases.

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Mallya (1992) recorded that maize losses of up to 35% may occur in 5-6 months after storage. Keil (1988) mentioned that maize losses reached up to 60% after nine months of storage. Delaplane (2004) determine the percentage of infestation of cowpeas which attacked by a complex of insect pests. infestations of stored cowpeas can be as high as 90%in stores after few months of storage. Abukar *et al.* (1986) evaluated post-harvest losses caused by storage insects to maize grains in samples obtained from 43 villages of south Somalia. The average % weight loss caused by insects ranged 24.35% - 31.85%. In Tanzania, Nyambo (1993) found that the percentage of weight loss in sorghum grains four months after harvest averaged 8.1% - 14 % in traditional granaries.

3- Losses under artificial infestation

The losses of nuts under different levels of artificial infestation of *T. castaneum*, *O. surinamensis* and *P. interpunctella* were recorded in Table (2). In general, the results indicated that weight losses of nuts were increased gradually with the increase of level of artificial infestation. Statistical analysis indicated that, the differences between weight losses in all cases were significant except the differences between levels of 5 and 10 adults and levels of 20 and 40 adults. In each of infestation level, *P. interpunctella* was more effective for weight losses of nuts followed by *T. castaneum* then *O. surinamensis*. Weight losses ranged to 6.64 – 18.83, 1.6 – 6.55 and 0.87 – 3.42 % for *Plodia interpunctella, Tribolium castaneum* and *Oryzaephilus surinamensis*, respectively. Differences between weight loss due to *P. interpunctella* and two another tested insects were significant in levels of 5 and 20 adults. At the same levels insignificant different were found between *T. castaneum* and *O. surinamensis*. In level of 10 adults, differences between weight losses to the three tested insects were insignificant but were significant at level of 40 adults.

Few studies were conducted on the weight losses of nuts under artificial infestation of stored product insect. In that respect, reference is made to the works of Mbata and Osuji (1983) which recorded that, losses in weight of nuts were 8.6% when 13 larvae of *P. interpunctella* completed development in 30 g. of whole nuts. These findings seem to agree with the findings of the current study. Begum *et al*. (2007) using different artificial infestation with 20Adults or 30eggs per replicate of *L. serricorne*, *O. surinamensis*, *T. castaneum*, and *E. cautella* to infest four types of chocolates, milk, nut, dried fruit and nut, and wafer chocolates under the laboratory conditions at 25±1 °C and 65±5% r.h. they mentioned that, when adult beetles were released on chocolates, the degree of infestation varied depending on the species and the type of chocolate. The highest infestation observed in chocolate was that of *O. surinamensis* (mean 138.4) in nut chocolate.

Table (2): Weight losses % in nuts caused by *T. castaneum*, *O. surinamensis* and *P. interpunctella* under different levels of artificial infestations.

Level of infestation (Adults / 50g)	Weight loss (%)			F value	P value
	T. castaneum	*O. surinamensis*	*P. interpunctella*		
5	1.60 ± 0.23 $^{b\ B}$	0.87 ± 0.41 $^{b\ B}$	6.64 ± 1.27 $^{b\ A}$	16.145	0.004
10	3.28 ± 0.68 ^{b}	0.80 ± 0.50 ^{b}	9.66 ± 3.84 ^{b}	4.055	INS
20	5.28 ± 0.58 $^{a\ B}$	2.42 ± 0.30 $^{a\ B}$	13.67 ± 2.44 $^{ab\ A}$	16.056	0.004
40	6.55 ± 0.49 $^{a\ B}$	3.42 ± 0.20 $^{a\ C}$	18.83 ± 1.44 $^{a\ A}$	84.602	0.000
F value	17.560	11.807	4.562	-	-
P value	0.001	0.003	0.038	-	-

a, b, c; small letters means different levels means within the same column are significant while capital letters means different insects means within the same raw are significant according to Duncan test P<0.05.
INS, Insignificant

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الفاقد فى البندق نتيجة الاصابة ببعض حشرات الحبوب المواد المخزونة فى مصر

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أجريت هذه الدراسة بمعمل حشرات الحبوب المخزونة بكلية الزراعة جامعة القاهرة خلال الفترة من أغسطس ٢٠٠٨ حتى فبراير ٢٠٠٩. أستهدفت الدراسة حصر الأنواع الحشرية المصاحبة للبندق خلال فترة التخزين وتقدير النسبة المئوية للاصابة والفقد فى الوزن تحت ظروف الاصابة الطبيعية والعدوى الصناعية. أوضحت النتائج وجود أربعة أفات حشرية مصاحبة للبندق أثناء التخزين وهى خنفساء السورينام و خنفساء الدقيق الصدأية وخنفساء السجاير ودودة جريش الذرة بالاضافة الى وجود نوع من الطفيليات الحشرية من رتبة غشائية الاجنحة وأخر من المفترسات التابع لرتبة نصفية الأجنحة والتي يمكن استخدامها فى مجال المكافحة البيولوجية. كما أوضحت النتائج ايضاً أنه خلال فترة التخزين سجل أعلى متوسط من تعداد الحشرات الكاملة للحشرات الأربعة السابقة الذكر خلال شهرى سبتمبر وأكتوبر وتلى ذلك انخفاض تدريجى فى التعداد حيث وصل الى أقل تعداد خلال شهر فبراير. وكانت النسبة المئوية للاصابة تحت ظروف الإصابة الطبيعية ٥٠,٣ و ٦٠,٦٣ و ٦٣,١٥ و ٥٧,٧٥ و ٥٤,٣٥ % خلال أشهر سبتمبر وأكتوبر ونوفمبر وديسمبر ويناير و فبراير، على الترتيب.وكانت النسب المئوية للفقد في الوزن المقابلة هي ٢٥,٤٣ و ٢٧,٢ و ٣٢,٢٨ و ٢١,٥٣ و ١٨,٠ و ١٦,٢%. وتحت ظروف مستويات العدوى الصناعية وجد أن دودة جريش الذرة كانت أكثر تأثيراً على الفقد فى وزن البندق يليها خنفساء الدقيق المتشابهه يليها خنفساء السورينام حيث تراوحت النسبة المئوية للفقد خلال مستويات الاصابة المختلفة ٦,٦٤- ١٨,٨٣ و ١,٦- ٥٥.٦ و ٠,٨٧ – ٣,٤٢ %، على التوالي.

Table 1. Population, infestation (%) and weight losses (%) of *Tribolium castaneum*, *Oryzaephilus surinamensis*, *Plodia interpunctella* and *Laisoderma serricorne* in nuts under natural infestation during Sept. 2008 to Feb. 2009.

Month	Mean no. of insects/ 500g.						Infestation (%)	Weight losses (%)
	T. castaneum	*O. surinamensis*	*P. interpunctella*	*L. serricorne*	F value	P value		
September	14.80 ± 1.34 $^{c\,A}$	17.85 ± 1.90 $^{b\,A}$	2.85 ± 0.42 $^{b\,B}$	13.80 ± 2.27 $^{b\,A}$	15.870	0.000	50.03 ± 2.51	25.43 ± 1.82 ^{abc}
October	31.00 ± 2.54 $^{a\,A}$	24.95 ± 2.58 $^{a\,A}$	3.70 ± 0.40 $^{a\,B}$	29.40 ± 3.38 $^{a\,A}$	25.850	0.000	56.60 ± 10.20	27.20 ± 3.93 ^{ab}
November	25.55 ± 1.57 $^{b\,A}$	15.55 ± 1.12 $^{bc\,B}$	1.65 ± 0.17 $^{c\,C}$	0.80 ± 0.19 $^{c\,C}$	149.157	0.000	60.63 ± 6.06	32.28 ± 4.61 ^{a}
December	22.60 ± 1.92 $^{b\,A}$	11.85 ± 1.67 $^{c\,B}$	1.50 ± 0.17 $^{c\,C}$	0.95 ± 0.20 $^{c\,C}$	64.103	0.000	63.15 ± 1.68	21.53 ± 1.56 ^{bcd}
January	13.00 ± 1.21 $^{c\,A}$	3.20 ± 0.93 $^{d\,B}$	1.05 ± 0.14 $^{c\,B}$	0.95 ± 0.28 $^{c\,B}$	53.795	0.000	57.75 ± 2.23	18.00 ± 0.81 ^{cd}
February	7.30 ± 1.06 $^{d\,A}$	1.15 ± 0.23 $^{d\,B}$	0.85 ± 0.26 $^{c\,B}$	0.30 ± 0.13 $^{c\,B}$	34.078	0.000	54.35 ± 3. 74	16.28 ± 0.75 ^{d}
F value	27.54	32.123	15.341	50.293	-	-	0.762	4.969
P value	0.000	0.000	0.000	0.000	-	-	INS	0.005

a, b, c, d; small letters means different months means within the same column are significant while capital letters means different insects means within the same raw are significant according to Duncan test P<0.01.
INS, Insignificant