

ECOLOGICAL AND CONTROL STUDIES ON *SITOPHILUS ORYZAE* AND *ORYZAEPHILUS SURINAMENSIS* WITH REFERENCE TO INSECT STORE PESTS AT MENOUFIA GOVERNORATE

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ABSTRACT: A survey of insect species that infest eight grain crops at granary stores of Menoufia governorate along 2020-year months were conducted. Seasonal fluctuations of *Sitophilus oryzae*, and *Oryzaephilus surinamensis* infested peeled rice at three stores were determined. Furthermore, a control study was conducted to evaluate the effect of *Sonchus oleraceus*, and orange oil with Sodium chloride on the two insects. *Sitophilus oryzae*, *Sitotroga cerealella*, and *Callosobruchus maculatus*, were the most common primary insects, while *O. surinamensis*, and *Tribolium castaneum* was the most secondary insects, followed by *Ephestia elutella*, while *Lasioderma serricorne*, and *Liposcellis subfucicus* were found accidentally. The results show that no infection was observed by *S. oryzae* and *O. surinamensis* during January & February. August month recorded 140 insects/ 1kg rice as the highest population of *S. oryzae*. Moreover, *O. surinamensis*, recorded the highest population in December as 150 insects/ 1 kg. The application of weed powder, decreased *S. oryzae* to 90% at the 1st month decreased to 70% & 40% for the 2nd and 3rd months, however, orange oil and table salt decreased the population to 100% in the 1st month, 99, 91,76, 66, and 53% in the next five months, respectively. While the application of weed powder decreased 90% of *O. surinamensis* after one month, decreased to 76% and 45% for after two and three months, however, the orange oil and NaCl decreased 100% of the population after one month, while it decreased by 91, 66,64,55, and 49% in the next five months.

Key words: Rice weevil, Saw toothed grain beetle, store insects, control, and ecology.

INTRODUCTION

Stored product insects are considered one of sufficient important problems to warrant full time attention, because of the negative effects of synthetic pesticides, natural pesticides, which have a limited range, must be used as an alternative that has a lot of damage to the environment and public health, these alternatives are natural substances that kills or act as repellent to reduce pests destroy. Rice grain is vulnerable to be infected by various insects causing damage, where *Sitophilus oryzae* and *Oryzaephilus surinamensis*, commonly infested stored white milled rice USDA (1957); CABI (2021). *Sitophilus oryzae* infected the cereals firstly, then *O. surinamensis* can infect Ciesielska (1966). Loschiavo and Okumura (1979) reported the infection, fluctuations, and damage caused by store insects in Hawaii stores. Stored cereals have the spotlight of the research among the stored products because of their importance and the probability of the infection with insects and molds that reduces the cereals quality and quantity. Craker (2007) extracted some of

essential oil from different plants are toxic to some stored insects El-Nahal *et al.* (1989).

Monge and Huignard (1991) studied the biology of the Cowpea weevil infest cowpea seeds from November 1987 to September 1988 and found that the density of *Callosobruchus maculatus* adults was reduced at the beginning of storage and became predominant after 5-6 months. Ali *et al.* (2003) reported that insect population severely dropped by the end of September, the storage period with low population continued from December to April. As well as Buchelos and Katopodis (1995) conducted a survey for one and half year on stored barley and maize and identified more than twenty Coleopterans belonging to 12 families, and the most abundant species were *S. oryzae* and *S. granarius*.

From the previous view, this article was conducted to survey insect species that infest eight grain crops at stores at Menoufia governorate along 2020-year months; study the

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seasonal population dynamics of store insects, as well as to control these insects using safe agents.

MATERIALS AND METHODS

Grain Samples:

Wheat, peeled rice, maize, horse bean, cowpea, pea bean, peanut, and date samples were collected monthly from three private granary stores located at Menoufia Governorate, from January 2020 to December 2020.

Identification:

Collected insects were identified under a stereoscopic microscope with 10*6.4 x lens according to Arbogast *et al.* (1980); Thomas (1988); Colonnelli (2004); Rees (2007); Schawaller (2008); Akotsen and Philips (2009); Warchalowski (2013) and Richards & Davies (2015).

Imaging:

Images taken under dissecting stereoscopic microscope with mobile camera, adjustments were prepared by Adobe Photoshop CS6, Alten (2014).

Preparing the powder of the annual sow thistle plants:

The annual sow thistle weed plants were collected from different places at Menoufia Governorate, washed under running water then let in the room temperature far from sun light to dry and grinded in an electric mixer, five kilograms of annual sow thistle weed plants gave 525 grams of powder, means that the humidity were 89.5%.

Orange oil:

Extracted from naval orange by mixing the peels in the mixer with water 50 °C and filtered in muslin gauze and sucked by syringe, 200 ml of orange oil extracts from five kilograms of Naval orange peels, means that the oil percentage is about 4%.

Sodium chloride:

Sodium chloride (fine table salt) was applied at the rate of 10 gram per one kilo of grains.

Statistical analysis of the data:

Collected data were subjected to statistical analysis of variance (ANOVA) at 5% probability, and the measurements were separated using Duncan's Multiple Range Test (DMRT) through CoStat software program (Version 6.400). CoStat version 6.400 Copyright © 1998-2008 Cohort Software. 798 Lighthouse Ave. PMB 320, Monterey, CA, 93940, USA.

Reduction percentages were counted according to Abbott's formula (1925).

Corrected mortality % =

$$\left(1 - \frac{\text{no in Treatment after treatment}}{\text{no in Control after treatment}}\right) \times 100$$

RESULTS AND DISCUSION

Ecological studies:

The present article revealed the presence of the following insects:

Order: Coleoptera:

- 1-Rice weevil, *Sitophilus oryzae*, Family: Curculionidae.
- 2-Saw-toothed beetle, *Oryzaephilus surinamensis* Fam.: Cucujidae.
- 3-Red flour beetle, *Tribolium castaneum* Fam.: Tenebrionidae.
- 4-Tobacco beetle, *Lasioderma serricorne*, Fam.: Ptinidae.
- 5-Cowpea weevil, *Callosobruchus maculatus*, Fam.: Chrysomelidae.
- 6-Pea weevil, *Bruchus rufimanus*, Fam.: Chrysomelidae.

Order: Lepidoptera:

- 1- Grain moth, *Sitotroga cerealella*, Fam.: Gelechiidae.
- 2- Chocolate moth, *Ephestia elutella*, Fam.: Pyralidae.

Order: Pscoptera:

- 1- Booklice, *Liposcellis subfuacus*, Fam.: Psocidae.

The obtained data in Table (1) revealed that the most common primary insects along one year of storage were: rice weevil, *Sitophilus oryzae*,

grain moth, *Sitotroga cerealella*, and cowpea weevil, *Callosobruchus maculatus*, while saw-toothed beetle, *Oryzaeophilus surinamensis*, and red flour beetle, *Tribolium castaneum* were the most common secondary insects in the three stores under study on the eight grains. Chocolate moth, *Ephestia elutella* levels of infestation came after this, while, *Lasioderma serricorne*, and *Liposcellis subfuacus* were found accidentally.

The results in Table (2) show that no infection was observed by *S. oryzae* and *O. surinamensis* during January and February. August month recorded 140 insects/ 1kg peeled rice as the highest population of *S. oryzae*, while *O. surinamensis*, recorded the highest population in December month with 150 insects/ 1 kg.

Control studies:

The obtained data in in Table (3) reported that the application of annual sow thistle weed powder to peeled rice grains at the rate of 10 g / 1 kg grain, decreased the population of *S. oryzae* to 90% after one month of application , decreased to 70% & 40% **after** two and three months, however, the application of orange oil combined with sodium chloride at the rate of 3 ml + 10 g / 1 kg decreased 100% of the population after one month, decreased to 99, 91,76, 66, and 53% in the next five months.

Regarding to the reduction effect of annual sow thistle weed powder on *O. surinamensis* results in Table (3) revealed 90% mortality of the insects, one month after application, decreased to 76% & 45% after two & three months. Orange oil combined with sodium chloride, reduced 100% of the *O. surinamensis* population, and

decreased to 91, 66, 64, 55, and 49% in the next five months, respectively.

The obtained results are in harmony with those of Lale and Mustapha (2000) measured the efficacy of neem seeds oil on four cowpea varieties with the susceptibilities to *Callosobruchus maculatus*. Larson *et al.*, (2008) tested commercial (food & pheromone) baited pitfall traps and pheromone-baited sticky traps to survey stored-product insect adults in eight participating feed mills in the midwestern United States and found twenty-seven species of Coleopterans and three species of Lepidopterans in commercial traps, where red flour beetle, *Tribolium castaneum* was the most abundant insect species captured inside the studied mills. Mahdi and Behnam (2018) evaluated the toxicity of orange leaves as fumigant on the adults of *Rhyzopertha dominica*, and *Lasioderma serricorne*, and found that *R. dominica* adults were more sensitive than *L. serricorne* to orange oil. In addition, Gueribis et al. 2019 who determined the toxicity of inuloxins (A, B, and C) in addition to the acid (α -costic), extracted from *Dittrichia viscosa* on *Callosobruchus maculatus*, and found that the 100% decrease was achieved only after one day after application of the applied agents but inuloxins A. Moreover, Mfarrej and Rara (2019) studied the effectiveness of eleven ingredients of natural materials with different concentrations to indicate which the most effective components and mix them in one treatment and revealed that the results were very positive for some of them and showed how these organic pesticides are effective in term of killing and repelling insect pests.

Table (1): Identified insects in the stored grains at Menoufia along 2020 year.

Order	Family	Scientific and English name
Wheat		
Coleoptera	Curculionidae	<i>Sitophilus oryzae</i> , Rice weevil
Coleoptera	Tenebrionidae	<i>Tribolium castaneum</i> , Red flour beetle
Lepidoptera	Gelechiidae	<i>Sitotroga cerealella</i> , Grain moth
Peeled rice		

Coleoptera	Curculionidae	<i>Sitophilus oryzae</i> , Rice weevil
Coleoptera	Cucujidae	<i>Oryzaephilus surinamensis</i> , Saw-toothed beetle
Coleoptera	Tenebrionidae	<i>Tribolium castaneum</i> , Red flour beetle
Lepidoptera	Gelechiidae	<i>Sitotroga cerealella</i> , Grain moth
Maize		
Coleoptera	Curculionidae	<i>Sitophilus oryzae</i> , Rice weevil
Coleoptera	Tenebrionidae	<i>Tribolium castaneum</i> , Red flour beetle
Pscoptera	Psocidae	<i>Liposcellis subfuacus</i> , Booklice
Lepidoptera	Gelechiidae	<i>Sitotroga cerealella</i> , Grain moth
Horse bean		
Coleoptera	Chrysomelidae	<i>Callosobruchus maculatus</i> , Cowpea weevil
Coleoptera	Chrysomelidae	<i>Bruchus rufimanus</i> , Pea weevil
Cowpea		
Coleoptera	Chrysomelidae	<i>Callosobruchus maculatus</i> , Cowpea weevil
Pea bean		
Coleoptera	Chrysomelidae	<i>Callosobruchus maculatus</i> , Cowpea weevil
Peanut		
Coleoptera	Cucujidae	<i>Oryzaephilus surinamensis</i> , Saw-toothed beetle
Coleoptera	Tenebrionidae	<i>Tribolium castaneum</i> , Red flour beetle
Coleoptera	Ptinidae	<i>Lasioderma serricorne</i> , Tobacco beetle
Lepidoptera	Pyralidae	<i>Ephestia elutella</i> , Chocolate moth
Dates		
Pscoptera	Psocidae	<i>Liposcellis subfuacus</i> , Booklice
Lepidoptera	Pyralidae	<i>Ephestia elutella</i> , Chocolate moth
Coleoptera	Cucujidae	<i>Oryzaephilus surinamensis</i> , Saw-toothed beetle

Table (2): Average numbers of rice weevil, *S. oryzae* and saw-toothed grain beetle, *O. surinamensis* infesting peeled rice along the 2020-year months

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
average numbers of insects/ 1 kg peeled rice											
<i>S. oryzae</i> LSD 5% = 16.5											
0.0 g	0.0 g	12.0 fg	13.0 fg	25.0 f	45.0 e	83.0bc	140.0 a	90.0 b	70.0cd	68.0 cd	60.0de
<i>O. surinamensis</i> LSD 5% = 15.2											
0.0 f	0.0 f	0.0 f	1.0 f	3.0 f	22.0 e	53.0 d	67.0 d	83.0 c	97.0 c	120.0 b	150.0 a

mean values followed by the same letter(s) are not significantly different by (P=0.05) according to Duncan's multiple range test.

Table (3): Mortality % of the rice weevil and saw-toothed beetle, infested peeled rice as affected by weed powder, orange oil combined with sodium chloride

Period after application	decrease % of <i>S. oryzae</i>				decrease % of <i>O. surinamensis</i>			
	weed powder		orange oil + NaCl		weed powder		orange oil + NaCl	
	Mean	± S. E	Mean	± S. E	Mean	± S. E	Mean	± S. E
1 Month	90.0	3.0	100.0	0.0	90.0	2.2	100.0	0.0
2 Months	70.0	5.2	99.0	1.0	76.0	4.2	91.0	0.8

3 Months	40.0	5.0	91.0	1.0	45.0	4.6	66.0	6.4
4 Months	10.0	11.5	76.0	2.6	37.0	7.2	64.0	8.0
5 Months	13.0	14.4	66.0	11.4	40.0	6.2	55.0	8.6
6 Months	10.0	6.3	53.0	14.6	20.0	7.0	49.0	11.5

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دراسات بينية ومكافحة على سوسة الأرز وخنفساء السورينام مع الإشارة الى الآفات الحشرية في المخازن بمحافظة المنوفية

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الملخص العربي

تم إجراء هذا البحث بهدف حصر وتصنيف أنواع الحشرات التي تصيب حبوب المحاصيل والتمر في المخازن في محافظة المنوفية خلال عام 2020، كما تم دراسة تعداد حشرتي سوسة الأرز وخنفساء السورينام بثلاثة مخازن مختلفة في محافظة المنوفية خلال عام كامل، وأجريت دراسة مكافحة للحشرتين بخلط حبوب الأرز الأبيض المخزن بمسحوق حشيشة الجعضيض وزيت البرتقال وملح الطعام.

أظهرت النتائج أن سوسة الأرز وفراشة الحبوب وخنفساء اللوبيا كانت أكثر الحشرات الأولية انتشاراً داخل المخازن، تلاها خنفساء السورينام المنشارية ودودة التمر أما خنفساء السجانر وقمل الكتب تم تسجيلهما بشكل عرضي داخل المخزن. أوضحت الدراسة أيضاً خلو المخازن من الإصابة بالحشرات طوال شهري يناير وفبراير، وسجل أعلى تعداد بحشرة سوسة الأرز في أغسطس على العكس من خنفساء السورينام التي سجلت أعلى تعداد في ديسمبر. وجد أن تطبيق زيت البرتقال مع ملح المائدة أعطى تأثير مميت وقلل أعداد حشرات سوسة الأرز إلى 100% خفض بالشهر الأول و99، 91، 76، 66، 53 % للأشهر الثاني والثالث والرابع والخامس والسادس بعد المعاملة على التوالي ، كما أدى الى خفض أعداد خنفساء السورينام بنسبة 100% بعد شهر من المعاملة وكانت 91، 66، 64، 55، 49 % في الخمس أشهر التالية على التوالي . وجد أن إضافة مسحوق حشيشة الجعضيض أقل تأثيراً حيث أدى لخفض أعداد حشرة سوسة الأرز بمعدل 90% بعد شهر من المعاملة و70، 40% للشهر الثاني والثالث، كما أدى لخفض أعداد حشرة خنفساء السورينام بمعدل 90 % بعد شهر من المعاملة و76، 45% بعد شهرين وثلاثة أشهر من المعاملة على التوالي.

أسماء السادة المحكمين

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