

Survey of Insects Pest Stored and Biological Control of *Trogoderma granarium* Everts in Setifian Region (North-East of Algeria)

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Abstract. Cereal grains are the major source of food for humans and most domesticated animals. In many developing countries like Algeria, overall post-harvest losses of cereals and legums of about 10–15% are fairly common. The study was conducted in Setif high plains in the north east of Algeria. The Setif region is one of the important areas for the production of cereal crops. The objective of this work was to survey the insects pests stored in different stored products in Setifian region. Using different methods: manual samples, traps, and probes have been used to determine the presence of insects and manual inspection, sieving, cracking-floatation and Berlese funnels are used at present to detect insects in grain. We recorded seven species (6 Coleoptera: *Trogoderma granarium*, *Tribolium castaneum*, *Rhyzopertha dominica*, *Tribolium confusum*, *Sitophilus granarius*, *Tenebrio molitor* and 1 Lepidoptera: *Ephestia kuehnielle*). The relative abundance of the different species was discussed. *Trogoderma granarium* was the dominant species (82,10%) of insect pests recorded from cereals grains. So, biological control on *Trogoderma granarium* is described. The stored conditions for these species are also discussed.

Keywords: botanical extract, cereal grains, Coleoptera, Lepidoptera, *Ocimum basilicum*, warehouses.

INTRODUCTION

Insects are a major cause of post-harvest losses of stored foods and food products the world over. Stored-product insect infestation can occur beginning at harvest and continuing through bulk storage (Mansoor-ul-Hasan et al., 2006). So a high risk for stored wheat and barley insect pests, which can cause significant damage and reduction in grain value. The protection of stored products is becoming increasingly important. To limit losses in stored grain, it is essential to find appropriate solutions.

Fauna survey and biological control of insects associated with stored products have been carried out of many authors. The aim of the present work was is first time to survey, identify and determine the rate of infestation with insects associated with grain cereals stored in three storage cooperatives in Setifian region and in the second time we try to apply a leaf powder of botanical *Ocimum basilicum* at different doses against one of the most important insect pest stored *Trogoderma granarium* as a biological control.

MATERIALS AND METHODS

SURVEY INSECTS ON CEREALS GRAINS STORED

Surveys were carried out in March to July, 2009 from 3 cooperatives cereals and dried vegetables stored cereals (CCLS) represented the commercial facilities of the region of Setif

to identify insect pests of stored grain cereals. The characteristics of each cooperative stored are showed in Table 1. Visual examinations were made, and samples taken. A conventional survey method was used, which consisted in taking sufficiently large samples of stored grain cereals (1 Kg.) before the commodities were treated. In metal bins and concrete silos, the samples were taken from several locations of the grain mass surface, whereas in flat warehouses the wheat was sampled from the bulk surface near the corners and walls. The samples were first analyzed in the laboratory by sieving the grain and examining the insects using a stereoscopic microscope. The samples of grains cereals stored were analyzed. Surveys were carried out in March to July, 2009 from 3 cooperatives cereals and dried vegetables stored cereals (CCLS) represented the commercial facilities of the region of Setif to identify insect pests of stored grain cereals. The characteristics of each cooperative stored are showed in Table 1. Visual examinations were made, and samples taken. A conventional survey method was used, which consisted in taking sufficiently large samples of stored grain cereals (1 Kg.) before the commodities were treated. The samples were first analyzed in the laboratory by sieving the grain and examining the insects using a stereoscopic microscope. The search for the free forms was performed as a result of sieving, while the hidden forms were detected by multiple methods: staining with Ninhydrine, and method of flotation (Scotti 1970). The identification of insects was made based on the work of Freeman (1980) and Weidner and Rack (1984). For each sample we noted the physiological characteristics of grain of different varieties of wheat and barley: the density, moisture of grain and impurities. Also the rate of damage was estimated. The number of species associated with stored products and the frequency of their occurrence were recorded.

TOXICITY TESTS

Fresh leaves of *Ocimum basilicum* L. (Lamiaceae) used in these studies were collected from different localities in the north region of Setif. Adults population of *Trogoderma granarium* Everts was collected from different storages of setifian region. The insects, thus collected were kept in wide mouth bottles covered with muslin cloth. The insects were placed in the laboratory conditions. Fresh leaves were cleared of foreign debris and shade dried for two days before even drying at 55°C for 48 h to stabilize their moisture contents. The oven-dried materials were pounded into powder in a wooden mortar with pestle and were sieved. The powder was stored in a refrigerator at 4°C prior for use. The powders obtained from the leaves of were mixed each at doses of 10, 15, 30 g per 100 g of meal of durum wheat (*Triticum durum*) in Petri dishes. The control contains only 100 g of meal of durum wheat. For each dose, three replications were performed. A batch of 20 adult insects was introduced separately in each Petri dish. Counts of dead insects are made after 24 hours of exposure and every day until complete death of all individuals.

STATISTICAL ANALYSIS

Mortality data were expressed as percentage of total number of insects introduced and it was corrected for using Abbott's formula (Abbott, 1925). It was subject to two way analyse of variance (ANOVA) and standard error means were calculated to show variations between replicates.

RESULTS AND DISCUSSION

SURVEY INSECTS ON CEREALS GRAINS STORED

Physical characteristics and variety of cereals grains stored in different warehouses study in the region Setif are showed in table 1. The conditions of storage conditions (temperature and humidity) contributed in the infestation of stored grain (Loschiavo, 1967). The state and nature of storage facilities can also contributed to increased damage by arthropods or fungi or vertebrates (Sinha, 1973). Physiological and the rate of damage on different varieties of cereals grains are showed in Table 2. We noted these characteristics varied between the variety of cereal and the warehouses.

In the present work 7 insect species belonging to 3 families of the Order Coleoptera and one species of the order Lepidoptera were recorded and are listed in table 3.

Tab.1

Physical characteristics and variety of cereals grains stored
in different warehouses study in the region Setif

Store cooperatives	C.C.L.S de Sétif Warehouses			C.C.L.S Ras elma	C.C.L.S El-eulma Warehouses	
	1	2	3		1	2
Nature of Warehouses	Cement Silos	Metal roof sheds	Steel silos	Steel silos	Cement silos	Metal roof sheds
Average storage temperature	11°C	10°C	12°C	14°C	12°C	13°C
Average Relative humidity %	75%	61%	70%	70%	71%	69%
Varieties of cereals stored	Local hard Wheat - M.B.B - WAHA - Bouteille	Local hard Wheat -Karim	Local Barley -Barbarouse - Jaidor	Hard wheat Imported Hard wheat M.B.B Tender wheat Imported Barley Imported	Local - Hd	Tender wheat - M.d

M.B.B: *Triticum durum* Var. Mohamed Ben Bachir

Hd: *Triticum aestivum vulgare* L var. Hd

M.d: *Triticum aestivum vulgare* L var. Mahon demias

Tab.2

Physiological characteristics and percentage of damage
on cereals grains stored during period from March to July 2009

Varieties of Cereal grains	Moisture (%)	Volumic mass (g/m)	Impurities (%)	Damage (%)
Hard Wheat				
M.B.B	12	1,28	1,95	9,81
M.B.B	11	1,26	3,63	5,42
Waha	10	1,25	0,45	6,57
Bouteille	08	1,19	0,68	2,08
Karim	05	1,25	1,50	1,00
Imported	08	1,34	4,10	2,18
Tender Wheat				
H.d	07	1,25	0,50	5,03
M.d	06	1,23	0,55	1,30
Imported	08	0,65	2,10	0,80
Barley				
Barberousse	06	1,16	0,87	0,80
Jaidor	10	1,13	1,18	2,15
Imported	03	2,00	2,00	0,50

Tab.3

Survey and relative abundance of insect pests on cereals grains
in Setif region during period from March to July 2009

Insects species recorded	Family	Relative Abundance (%)	C.C.L.S Sétif	C.C.L.S Ras elma	C.C.L.S El- eulma
Coleoptera					
<i>Trogoderma granarium</i> Everst	Dermestidae	82,10	+	+	+
<i>Sitophilus granarius</i> L.	Curculionidae	05,68	+	-	+
<i>Rhizopertha dominica</i> Fabr.	Bostrychidae	03,96	+	+	+
<i>Tribolium castaneum</i> Herbst	Tenebrionidae	01,42	+	-	-
<i>Tenebrio molitor</i> L.	Tenebrionidae	00,85	+	-	+
<i>Tribolium confusum</i> L.	Tenebrionidae	00,56	+	-	-
Lepidoptera					
<i>Ephestia kuehniella</i> Zeller	Pyralidae	05,68	+	-	-
Specific Richness		100	7	2	4

+ Present

- Absent

Tab.4

Degree of infestation of different insect species on cereals stored
during period from March to July 2009

Insects species recorded	Family	Hard wheat (%)	Tender wheat (%)	Barley (%)
Coleoptera				
<i>Trogoderma granarium</i> Everst	Dermestidae	77,95	86,97	64,02
<i>Sitophilus granarius</i> L.	Curculionidae	5,58	6,72	19,63
<i>Rhizopertha dominica</i> Fabr.	Bostrychidae	-	2,44	10,57
<i>Tribolium castaneum</i> Herbst	Tenebrionidae	3,84	4,87	0,96
<i>Tenebrio molitor</i> L.	Tenebrionidae	-	-	2,90
<i>Tribolium confusum</i> L.	Tenebrionidae	1,12	-	1,92
Lepidoptera				
<i>Ephestia kuehniella</i> Zeller	Pyralidae	11,51	-	-

TOXICITY TESTS

The effectiveness of *O. basilicum* powder leaves to depend primarily on the treatment dose, time of treatment and although other variables, such as the active compounds of this plant may be potentially important (Tab.5). Results showed that treatments, time, and interaction between treatments and time have highly significant effect on adults mortality of *Trogoderma granarium* (Everts) compared to the control. The interaction between treatments time and concentrations has also significant effect. (Tab.6)

Tab.5

Overall mean cumulative percent mortality of adults *T. granarium*
against *Ocimum basilicum* at various concentrations

Time	24 h	48h	72h	96h	120h	144h
T	0	0	0	1,66	3,33	4,99
C1	0	0	1,69	15,25	18,29	20,68

C2	0	0	8,48	15,25	24,13	34,47	
C3	0	0	15,25	28,81	48,27	55,16	
	168h	192h	216h	240h	264h	288h	312h
T	4,99	6,65	8,31	8,31	8,31	8,31	8,31
C1	40,34	55,35	68,42	73,68	83,63	96,35	100
C2	43,85	57,14	75,43	89,47	92,72	100	100
C3	78,94	89,28	96,48	100	100	100	100

(T: Control, C1: 10 %, C2: 15 % et C3: 30 %). (Each value is a mean of three replications)

Tab.6

Variance analysis of the insecticidal effect of leaves powder
of *O. basilicum* against *Trogoderma granarium*

	Sum of square	d.d.l	Mean square	F	P
Concentrations	326.1285	1	326.1285	35.4584	4.1678e-008 (***)
Time of treatment.	601.743	10	60.1743	6.5425	1.1622e-007 (***)
Interaction Time of treatment X Concentrations	541.8179	35	15.4805	1.6831	0.024284 (*)

- : Significantly and ***: very highly significant ($P > 0.05$) and $P > F$

CONCLUSIONS

The storage conditions, the physiological characteristics of the grain, type of cereal and grain cereals varieties and their origins, contributed significantly in the degree of infestation, species richness and the level of presence of insects. Survey of insect species showed *T. granarium* as the major pest in all warehouses of storage.

The leaves powder of *O. basilicum* was found to be toxic to adult stages of *Trogoderma granarium*. These results indicate that insecticide from the botanical *O. basilicum* might be effective controls for this pest species.

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