SURVEY OF MITES ON IMPORTED WHEAT, AND EFFECT OF CERTAIN GRAIN PROPERTIES ON MITES INFESTATION UNDER STORAG CONDITIONS

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Abstract

Two experiments were carried out to study mite infestation in stored grains. The first experiment was conducted to survey the mite species associated with imported wheat stored in metal silos at two cities (Tanta and Kafr El-Sheikh) in middle and north Delta of Egypt. The second experiment was conducted to study the relationship between mite infestations and chemical properties of six stored grains. Three mite groups were recorded on stored imported wheat , grain feeders, predacious and fungivorous. The recorded mites in Tanta silos were five species belonging to three families on American wheat and nine species representing six families on Russian wheat, while mites that recorded on American and Russian wheat in Kafr El-Sheikh silos were six species belonging to four families and eight species representing six families, respectively. The most dominant species recorded on American and Russian wheat were *Tyrophagus putrescentiae* Sch., *Cheyletus malaccensis* Oud. However, *Cheyletus eruditus* Sch. was the least one of the two tested imported wheat. Results of the proximate chemical composition obtained from tested legumes (crushed faba bean, cowpea and lentil), and cereal grains (wheat, maize and rough rice) showed that carbohydrates were the most dominant group of constituents, followed by protein. Moisture content came third in this category, while ash occupied the fourth rank and lipid was the minor group of constituents. A positive correlation was recorded between mite grain feeders and fungivorous and each of carbohydrates (r=0.279) and lipids (0.713). On the other hand, there were negatively correlations with total proteins (r=-0.543) and ash (r=-0.255). The effect of moisture of tested grains and total recorded mites was varied.

INTRODUCTION

Several pests are known to infest stored products allover the world. Mites associated with stored products are great economic importance, as they cause serious levels of damage, not only by consuming large amounts of stored products, but also by contaminating foods with their alive and dead bodies and faeces. In Egypt, due to insufficient production in the cultivated area, it has become necessary to import some grains, especially wheat and store them for periods short or long according to human being consumption, which leads to weight loss in the grains due to pest attacks. In

addition, problems appear in grain quality. So, it was important to study the mites associated with stored imported wheat. Studies on the incidence of storage Acari were reported by many authors in Egypt, and several regions around the globe (Cusack *et al*., 1975, Saleh, 1980, Taha, 1985, Hoda *et al*., 1990, Tadros and Gabrial, 1994, Athanassiou *et al*., 2001 and Essawy *et al*., 2013)

Therefore, the aims of the present study were:

1. Survey the mites infesting imported wheat from U.S.A. and Russian and stored in silos.
2. Investigate the relationship between some chemical constituents of six stored grains (wheat, maize, rough rice, crushed faba bean, cowpea and lentil) and population of mites.

MATERIALS AND METHODS

1. Imported wheat:

The present investigation was conducted to evaluate the population density of mites associated with imported wheat, two metal granaries were chosen at Tanta, El-Gharbia governorate and Kafr El-Sheikh city, Kafr El-Sheikh governorate. Wheat consignments stored in both granaries were imported from USA and Russia. American wheat was imported on 2nd of May, 2007 and stored in silos up to 17th December, 2007 at Kafr El-Sheikh and up to 23rd of November, 2007 at Tanta (about 7-8 months at both locations). Russian wheat was imported on 9th of November, 2007 and stored up to 25th of April, 2008 at Kafr El-Sheikh silo, and up to 3rd of April, 208 at Tanta silo.

Sampling technique:

Samples were taken at fortnightly intervals during the experimental period. At every sampling date, three replicates (each of 250 g) were taken from the lower level of silos in every consignment. Every replicate was separately in a polyethylene bags, closed and carried directly to laboratory for organism extraction.

2. Chemical composition of tested grains:

Three cereals (wheat, maize and rough rice) and three legumes (crushed faba bean, cowpea and lentil) were obtained from the local Kafr El-Sheikh markets, and kept in glass jars for two years (May, 2007 – April, 2009). Each of cereals or legumes was represented by 10 kg. The grains were cleared from mud and any other undesirable materials, and then kept in an electrical oven at 60^{o}C for about six hours to kill any organisms (immature and mature stages). The procedure was followed according to Baker (2000). Every sample was divided into three equal ports and kept in glass jars without cover for a period of six months until natural infestation occurred under laboratory conditions. From each jar 250 g were taken at fortnightly intervals. Three replicates were taken to represent each sampling date of the six tested materials. At the same time, samples of the six tested materials were added once

more to their original jars after examination to be used again with the bulk. Extraction of living organisms took place by using Batteries of Modified Tullegran Funnels and the obtained mites were mounted on glass slides using Hoyer's medium and identified using keys of Hughes (1976) and Zaher (1986). Dominancy of mite species was determined according to Athanassious *et al*., (2002) a given species can be classified as dominance (<5%), influence (2-5%) or recedent (>2%).

The seeds of the six investigated grains (cereal and legumes) were analyzed to determine moisture, protein, carbohydrates, lipids and ash according to A.O.A.C. method (A.O.A.C., 1990).

Simple correlation coefficient values were calculated between chemical composition of tested materials and mites infestation.

RESULTS AND DISCUSSION

I- Survey of mites infesting American and Russian wheat in silos:

The present experiment was conducted to survey the mite species associated with the imported American and Russian wheat in Tanta and Kafr El-Sheikh silos.

1. Tanta Silo:

1.1. American wheat:

Data in Table (1) revealed that the occurrence of five mite species, belonging to three families and three mite groups, grain feeders, predacious and fungivorous. It was clear that the grain feeder group was represented by only one species *Tyrophaus putrescentiae* Sch. belonging to family Acaridae and constituted 34.19% out of the whole recorded mites. Predacious mites group was represented by three species and two families, the species were: *Cheyletus malaccensis* Oud. (45.64%) and *Cheyletus eruditus* Sch. (2.09%) from family Cheyleidae and *Bdella lignicola* Cans. (3.70%) from family Bdellidae. This group constituted 51.43% out of the whole recorded mites. Fungivorous mites group was represented by only one species *Caloglyhus rhizoglyphoides* Zach. (14.38%) belonging to family Acaridae and constituted 14.38% of the whole mites. It was found that *C. malaccensis, T. putrescentiae* and *C. rhizoglyphoides* were dominant species followed by *B. lignicola* as influent species, while *C. eruditus* was considered as a recedent one.

1.2. Russian wheat:

Data in Table (1) indicated that nine species were extracted from Russian wheat stored in Tanta silos. The obtained mite species were belonging to six families, and three mite groups as previously mentioned with American wheat. It was found that grain feeders group was represented by three species, *T. putrescentiae* (41.12%) and *Tyrophagus lini* Oud. (9.03%) from family Acaridae and *Lepidoglyphus destructor* Sch. (5.92%) from family Glycyphaeidae. Predaceious mite group contained four species and three families, the species were *C. malaccensis* (14.14%) and *C. eruditus*

(1.60%) from family Cheyletidae, *B. lignicola* (3.51%) from family Bdellidae and *Blattisocius tarsalis* Ber. (8.52%) from family Ascidae. Fungivorous mite group was represented by two species and two families: *C. rhizoglyphoides* (10.55%) from family Acaridae and *Tarsonemus* sp. (5.61) from family Tarsonemidae. Grain feeders, predacious and fungivorous mites were represented by 56.07, 27.77 and 16.16%, respectively, from the whole recorded mites.

From the same Table, it could be stated that *T. putrescentiae*, *C. malaccensis*, *C. rhizoglyphides*, *T. lini*, *B. tarsalis*, *L. destructor* and *Tarsonemus* sp. were dominant species, while *B. lignicola* was considered influent species, on the other hand *C. eruditus* was found as recedent species.

Table 1. Mite species associated with imported American and Russian wheat in Tanta silo.

Mite groups	Families	Species	American		Russian	
			Average No.	%	Average No.	%
Grain feeders	Acaridae	*Tyrophagus putrescentiae*	21.2	34.19	41.0	41.12
	Acaridae	*Tyrophagus lini*	-	-	9.0	9.03
	Glycyphagidae	*Lepidoglyphus destructor*	-	-	5.9	5.92
Total grain feeders			21.2	34.19	55.9	56.07
Predacious	Cheyletidae	*Cheyletus malaccensis*	28.3	45.64	14.1	14.14
	Cheyletidae	*Cheyletus eruditus*	1.3	2.09	1.6	1.60
	Bdellidae	*Bdella lignicola*	2.3	3.70	3.5	3.51
	Ascidae	*Blattisocius tarsalis*	-	-	8.5	8.52
Total predacious			31.9	51.43	27.7	27.77
Fungivorous	Acaridae	*Caloglyphus rhizoglyphoides*	8.9	14.38	10.5	10.55
	Tarsonemidae	*Tarsonemus* sp.	-	-	5.6	5.61
Total fungivorous			8.9	14.38	16.1	16.16
Total mites			62.0		99.7	

2. Kafr El-Sheikh silo:

2.1. American wheat:

Data in Table (2) revealed the occurrence of six species belonging to four families and three mite groups, grain feeders, predacious and fungivorous. The grain feeder group was represented by 31.13% of whole mite and one only species, *T. purtescentiae* from family Acaridae, predacious mites group was represented by 47.67% of whole recorded mites and three species belonging to two families, *C. malaccensis* (42.86%) and *C. eruditus* (3.01%) from family Chelytidae and *B. lignicola* (1.80%) from family Bdellidae. Fungivorous mites group constituted 21.20% of the whole recorded mites and was represented by two species and two families, *C. rhizoglyphoides* (15.34%) from family Acaridae and *Tarsonemus* sp. (5.86%) from family Tarsonemidae.

The species *C. malaccensis*, *T. putrescentiae, C. rhizoglyphoides* and *Tarsonemus* sp. were dominant ones, while *C. eruditus* was considered influent. On the other hand, *B. lignicola* was considered recedent one.

Table 2. Mite species associated with imported American and Russian wheat in Kafr El-Sheikh silo.

Mite groups	Families	Species	American		Russian	
			Average No.	%	Average No.	%
Grain feeders	Acaridae	*Tyrophagus putrescentiae*	20.7	31.13	35.9	35.09
	Glycyphagidae	*Lepidoglyphus destructor*	-	-	4.4	4.30
Total grain feeders			20.7	31.13	40.3	39.39
Predacious	Cheyletidae	*Cheyletus malaccensis*	28.5	42.86	22.1	21.61
	Cheyletidae	*Cheyletus eruditus*	2.0	3.01	1.0	0.97
	Bdellidae	*Bdella lignicola*	1.2	1.80	4.2	4.11
	Ascidae	*Blattisocius tarsalis*	-	-	15.4	15.05
Total predacious			31.7	47.67	42.7	41.74
Fungivorous	Acaridae	*Caloglyphus rhizoglyphoides*	10.2	15.34	10.7	10.46
	Tarsonemidae	*Tarsonemus* sp.	3.9	5.86	8.6	8.41
Total fungivorous			14.1	21.20	19.3	18.87
Total mites			66.5		102.3	

2.2. Russian wheat:

Survey of mite species associated with Russian wheat in Kafr El-Sheikh silo is shown in Table (2) and indicated that eight mite species were belonging to six families and three groups, grain feeders, predacious and fungivorous. Data indicated also that grain feeders had two species and two families, *T. putrescentiae* (35.09%) from family Acaridae, *L. destructor* (4.30%) from Glycyphagidae. The grain feeders group represented by 39.39% of whole recorded mites. The predacious group was represented by 41.74% of whole recorded mites and four species belonging to three families, the species were: *C. malaccensis* (21.61%) and *C. eruditus* (0.97%), from family Cheyletidae, *B. lignicola* (4.11%) from family Bdellidae, *B. tarsalis* (15..05%) from family Ascidae. Fungivorous mites group was represented by 18.87% of the whole recorded mites and two species belonging to two families, *C. rhizoglyphoides* (10.46%) from family Acaridae and *Tarsonemus* sp. (8.41%) from family Tarsonemidae. Also, Table (2) showed that *T. putrescentiae, C. malaccensis, B. tarsalis, C. rhizoglyphoides* and *Tarsonemus* sp. were dominant species, while *L. destructor* and *B. lignicola* were influent ones. On the other hand, *C. eruditus* was recorded as a recedent species.

Results indicated that Russian wheat had higher number of mite species than American wheat in the two tested locations. These results may be attributed to some factors, but according to our circumstances, it may be due to the time that cargo takes from the exported port to the imported one, and for how long the carrying

vessel takes before discharging at destination port, and also to the time for transporting those consignments from import ports to the silos.

Similar results were obtained by Helal *et al*., (1997) who indicated that susceptibility of imported wheat to pest infestation differed according to its sources, since the Australian wheat showed the highest pest infestation, while the Canadian wheat showed the least one.

II- Chemical composition of the six investigated materials and its correlation with mites infestation :

The results of the chemical composition obtained from the six tested grains are presented in Table (3) and showed that carbohydrates was the most dominant group of constituents and it represented 68.69, 62.44 and 59.23% for rice, maize and wheat, respectively. In legume grains, carbohydrate was less than in cereal grains and gave 56.72, 55.09 and 52.15% in faba bean, lentil and cowpea, respectively. The highest protein contents were recorded in legume grains and averaged 28.00, 25.80 and 21.86% in cowpea, faba bean and lentil, respectively, while recorded 14.78, 11.55 and 9.18% in wheat, maize and rice, respectively. From the same Table, the moisture contents were 10.61% in wheat, 8.93% in maize, 10.21% in rice, 9.18% in cowpea, 9.63% in faba bean, while 8.88% in lentil. Lipids contents were higher in cereals and recorded 2.31, 3.27 and 2.54% in wheat, maize and rice, respectively, but lower in legumes and gave 1.96, 1.66 and 1.34% for cowpea, faba bean and lentil, respectively. Ash contents were 4.74, 4.15, 3.92, 5.33, 4.95 and 4.57% in wheat, maize, rice, cowpea, faba bean and lentil, respectively. Results obtained from the same Table revealed an insignificant negative correlation (-0.017) between moisture content and mite populations during the first season, while the correlation was insignificantly positive during the second season, r = 0.387. Protein contents showed insignificant negative correlations with the mite populations during the first and second seasons, where r = -0.657 and -0.522, respectively. On the other hand, carbohydrates gave an insignificant positive correlation with mite populations during both seasons (r = 0.556 and 0.256 for the first and second season, consecutively). From the same Table, it was clear that lipids contents recorded a highly significant positive correlation (0.950) with mite populations during the first season, for the second season, insignificant positive correlation was detected since r = 0.641. Ash contents showed insignificant negative correlations with mite populations during the two seasons, since r = -0.559 and -0.204 for the first and second seasons, respectively.

Table 3. Chemical composition of tested cereals and legumes and its correlation with mites infestation at Kafr El-Sheikh during 2007/2008 and 208/2009 seasons.

Tested grains	Total no. of mites		Grain feeders and fungivorous mites	Moisture %	Protein %	Carbo-hydrates %	Lipids %	Ash %
	1st season	2nd season						
Wheat	103.1	281.9	122.7	10.61	14.78	59.23	2.31	4.74
Maize	212.7	231.9	120.2	8.93	11.55	62.44	3.27	4.15
Rice	98.3	84.9	23.75	10.21	9.18	68.69	2.54	3.92
Faba bean	63.3	83.0	23.65	9.63	25.80	56.72	1.66	4.95
Cowpea	52.3	72.7	17.80	9.18	28.00	52.15	1.96	5.33
Lentil	28.4	60.0	10.85	8.88	21.26	55.09	1.34	4.57
Total mites	Correlation coefficient 1st season			-0.017	-0.675	0.556	0.950**	-0.559
	Correlation coefficient 2nd season			0.387	-0.522	0.256	0.641	-0.204
Grain feeders and fungivorous mites	Correlation coefficient			0.274	-0.543	0.279	0.713	-0.255

** Correlation is significant at the 0.01 level

In accordance with grain feeders and fungivorous populations as mean of the two tested seasons, results in the same Table indicated that moisture contents recorded insignificant positive correlation with grain feeders and fungivorous population, r=0.274. Protein contents showed insignificant negative correlation with grain feeders and fungivorous population, r=-0.543, while carbohydrate contents recorded insignificant positive correlation with grain feeders and fungivorous population, r=0.279. Lipids contents gave insignificant positive correlation with grain feeders and fungivorous population, r=0.713. On the other hand, ash contents recorded insignificant negative correlation with grain feeders and fungivorous populations, since r=-0.255.

As the authors aware, no literature was found concerning the relationship between mite infestation and chemical contents of seeds. So, our results agree with the recorded results on other pests and chemical contents of some seeds. Chunni and Singh (1996) recorded negative correlation between crude fiber and protein contents of 64 wheat varieties and infestation of *Sitophilus oryzae* L. Zein and Abo-Arab (2000) inferred a highly significant negative correlation between crude protein, crude fiber and infestation of *S. oryzae* and *Rhizopertha dominica* F. on two wheat varieties.

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حصر الأكاروسات على القمح المستورد وتأثير بعض صفات الحبوب على الإصابة الأكاروسية تحت ظروف التخزين

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أجريت تجربتان لدراسة الاصابة الاكاروسية على الحبوب المخزونة الأولى لحصر أنواع الأكاروسات المرتبطة بالقمح المستورد والمخزن فى صوامع معدنية فى مدينتين (طنطا وكفرالشيخ) فى وسط وشمال الدلتا ــ مصر. وأجريت الثانية لدراسة العلاقة بين الإصابة الأكاروسية والخواص الكيماوية لستة حبوب مخزونة وقد سجلت ثلاث مجاميع على القمح المستورد وهى الأكاروسات المتغذية على الحبوب والأكاروسات المفترسة والأكاروسات المتغذية على الفطر. سجلت خمسة أنواع من الأكاروسات فى صومعة طنطا تتبع ثلاث عائلات على القمح الأمريكى وتسعة أنواع تتبع ستة عائلات على القمح الروسى ، بينما وجد أن عدد الأكاروسات المسجلة على القمح الأمريكى والروسى والمخزن فى صومعة كفرالشيخ هى ستة أنواع تابعة لأربع عائلات وثمانية أنواع تتبع ستة عائلات على التوالى. وكانت أكثر الأنواع تواجدا على القمح الأمريكى والقمح الروسى *Cheyletus malaccensis* Oud. ،*Tyrophagus putrescentiae* Sch. وكان النوع *Cheyletus eruditus* Sch. هو الأقل تواجدا على نوعى القمح المستورد.

دلت نتائج التحليل الكيماوى للحبوب المختبرة أن نسبة الكربوهيدرات هى الأعلى تلاها البروتين ثم الرطوبة ثم الرماد وجاءت الدهون فى المرتبة الأخيرة. وقد سجلت النتائج إرتباطا موجبا بين العدد الكلى للاكاروسات التى تتغذى على الحبوب وعلى الفطر وبين كل من الكربوهيدرات (0.279) والدهون (0.713) داخل الحبوب ، وعلى العكس من ذلك كان هناك ارتباط سالب بين المجاميع الأكاروسية التى تتغذى على الحبوب والفطر وبين كل من البروتين (-0.543) والرماد (-0.255) بينما الارتباط مع الرطوبة كان متغيرا.