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THE COMPERATIVE EFFICIENCY OF ACCOUNTING METHODS OF ARTHROPOD-PESTS OF GRAIN STOCKS

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The main objective this research was ascertainment of species composition of arthropod-pests of grain stocks, identifying most effective ways of accounting insects and mites. During 2012-2014 years, in course of field and laboratory experiments was established species composition of granary pests on territory granaries and elevators of Poltava region. As result of accounting were discovered 82 species of arthropod-pests of grain stocks, which belong to 30 families, 8 orders. The high indicators of capture using pheromone traps and food baits depending from species composition of granary pests were determined.

Introduction. A typical phenomenon is presence of large quantity of pests – insects and mites in granaries, on elevators and other agricultural enterprises for storage of grain and grain products. In Ukraine, thanks to warm climate created all necessary conditions for their reproduction and distribution.

The harmfulness of arthropods manifests in reducing quantity of grain, deteriorating its quality, contamination of feces, dead bodies, skins of molt, cobwebs. They lead to damage germ of grain, as result leads to decrease of sowing qualities, also observed release of heat and moisture in grain mass, which causes rapid caking and spontaneous heating of products.

Timely and qualitative inspection in order identify infestation of grain during storage, carrying out preventive measures can prevent to use of chemical treatments, that will allow to protect products of grain from further settlement and damage by pests.

During recent years, domestic and foreign sciences achieved significant success in improve of methods for detecting infestation of grain, determination of species composition of harmful arthropods and in development of effective measures of limit their quantity [1].

The review of silos on infestation includes detailed analysis of identify pests directly in warehouses and other premises, that associated with processing, transportation of grain and products.

For accounting of pests are sufficient quantity traditional and special methods in entomology. Primarily, to traditional methods of determining

explicit and latent forms of infestation of grain belong: visual method, analysis “average sample”, cracking caryopsides and coloration of “stoppers”.

The more progressive methods include: fototermoekleksiia (method of Berleze-Tullhrena), flotatsiinyi, renthenohrafichnyi, mikroliuministsentnyi [2, 3, 4].

For realization sanitary-hygienic control, laboratory specialists in granaries used method of "average sample" and cracking of grains. As alternative, more often proposed to use food baits and pheromone traps.

By using pheromone traps can timely identify, establish species composition and constantly supervise of quantity of dangerous species of pests. The synthesized analogs of insect pheromones are safe substances for humans and animals [5].

The limitation of space in granaries and constancy of species composition of pests in grain create favorable conditions for use of pheromone technology [6].

In our researches, we tried to analyze range of methods, which would be both effective and available for use within laboratories of cereal receiving of enterprises. The main purpose was to clarify species composition of arthropod-pests of grain stocks of spiked cultures. For achievement this purpose resolved following **objectives**: establish frequency of spread of pests of grain stocks, compare and identify advantages and disadvantages of traditional and modern methods of accounting, reveal most effective components of food baits for trapping insects and mites.

Materials and methods of researches. Scientific researches on refinement of species composition of pests of grain stocks of spiked cultures were carried out during spring-autumn period in granaries and elevators of Poltava region (2012-2014 years).

In order to identify degree of prevalence of granary pests in obvious form was conducted analysis “average sample” [2]. The experiments were carried out on winter wheat, spring barley, oats, that belong to different classes.

For detection of latent form of infestation were used method of cracking caryopsides [3] and more modern – flotation [4] using solution of saltpeter.

Traditional methods of inspection of grain stocks include periodic sampling collection and laboratory analysis on presence harmful insects and mites. This method is sufficiently laborious, expensive and insufficient accurate. Additionally, were laid food baits and pheromone traps for determination their efficiency during carrying out of accounting to detection of granary pests [7].

Two types of food baits were used: dry (mixture of groats, peanuts + yeasts, seeds of sunflower + yeasts) and oil (sunflower oil, peanuts + yeasts + oil).

In event, when were detected underdeveloped stages of pests should be applied biological method for rearing to adult for reliable definition of species composition by genitals [4].

The results of research and its discussion. As results of accounting in granaries and elevators of Poltava region were identified 82 species of arthropod-pests, that belong to 30 families, 8 orders, which with different frequency are presented in grain stocks of spiked cultures (Table 1) [8, 9, 10].

Table 1 *– The species composition of arthropod-pests of grain stocks of spiked cultures (Poltava region, 2012-2014)*

Order	Family	Species	Frequency
1	2	3	4
Acariformes	Acaridae	Flour mite (Acarus siro L.)	++
		Mould mite (Tyrophagus noxius A.Zach.)	+
		Caloglyphus Rodionova (Caloglyphus Rodionovi A. Zach.)	+
	Glycyphagidae	Fodder mite (Glycyphagus destructor Ouds.)	++
		Gohieria fusca (Gohieria fusca Ouds.)	+
		Chortoglyphus arcuatus (Chortoglyphus arcuatus Troup.)	++
	Cheyletidae	Cheyletus eruditus (Cheyletus eruditus Schrk.)	+++
		Cheletomorpha venustissima (Cheletomorpha venustissima Koch.)	+
	Parasitidae	Dung mite (Parasitus sp.)	++
	Lealaptidae	Dust mite (Zercoseius ometes Ouds.)	+++
	Tydeidae	Field mite (Pronematus bonatii Can.)	+
	Pediculoididae	Grass mite (Pediculoides graminum Reitt.)	+
Pseudoscorpionida	Cheliferidae	Book pseudoscorpion (Chelifer cancroides L.)	+
		Testaceous pseudoscorpion (Chelifer panzeri Koch.)	+
Thysanura	Lepismatidae	Silverfish (Lepisma saccharina L.)	+
Psocoptera	Psocidae	Pterodela pedicularia (Pterodela pedicularia L.)	+
	Atropidae	Trogium pulsatorium (Atropos pulsatoria L.)	+
		Liposcelis divinatorius (Troctes divinatorius Mull.)	+++
Coleoptera	Curculionidae	Grain weevil (Sitophilus granarius L.)	+++
		Rice weevil (Sitophilus oryzae L.)	+++
	Tenebrionidae	Confused flour beetle (Tribolium confusum Duv.)	+++
		Red flour beetle (Tribolium castaneum Hbst.)	+++
		Mealworm beetle (Tenebrio molitor L.)	+
		Dark mealworm beetle (Tenebrio obscurus F.)	+
		Destructive flour beetle (Tribolium destructor Uytt.)	++

		Litter beetle (Alphitobius diaperinus Panz.)	++
		Black flour beetle (Tribolium madens Charp.)	++
		Two-banded fungus beetle (Alphitophagus bifasciatus Say.)	+
		Sinister beetle (Blaps mortisaga L.)	+
		Gnathocerus cornutus (Gnathocerus cornutus F.)	+
	Ostomatidae	Cadelle beetle (Tenebrioides mauritanicus L.)	++
	Cucujidae	Cryptolestes pusillus (Cryptolestes pusillus Schonh.)	++
		Short-horned beetle (Cryptolestes ferrugineus Steph.)	+++
		Turkish beetle (Cryptolestes turcicus Gr.)	+
		Sawtoothed grain beetle (Oryzaephilus surinamensis L.)	+++
		Butyric cucujid beetle (Ahasverus advena Waltl.)	++
	Mycetophagidae	Hairy fungus beetle (Typhaea stercorea L.)	++
		Four-spotted fungus beetle (Mycetophagus quadriguttatus Mull.)	+
	Bruchidae	Euspermophagus sericeus (Euspermophagus sericeus Geoff.)	+
	Nitidulidae	Corn sap beetle (Carpophilus dimidiatus F.)	+++
		Dried-fruit beetle (Carpophilus hemipterus L.)	+
		Carpophilus marginellus (Carpophilus marginellus Motsch.)	++
	Dermestidae	Larder beetle (Dermestes lardarius L.)	+
		Attagenus schaefferi (Attagenus schaefferi Hb.)	+
		Varied carpet beetle (Anthrenus verbasci L.)	+
		Glabrous cabinet beetle (Trogoderma glabrum Hbst.)	++
		Black carpet beetle (Attagenus unicolor Brahm.)	+
		Megatoma tianschanica (Megatoma tianschanica Sok.)	+
		Dermestes laniarius (Dermestes laniarius Illiger)	+
		Polish dermestid beetle (Anthrenus polonicus Mr.)	+
		Museum beetle (Anthrenus museorum L.)	+
		Warehouse beetle (Trogoderma variabile Ball.)	++
		Buffalo carpet beetle (Anthrenus scrophulariae L.)	+
	Bostrychidae	Lesser grain borer (Rhizopertha dominica F.)	+++
	Anobiidae	Drugstore beetle (Stegobium paniceum L.)	+
		Cigarette beetle (Lasioderma serricorne F.)	+

	Ptinidae	Golden spider beetle (Niptus hololeucus F.)	+
		Hairy spider beetle (Ptinus villiger Reitt.)	+
		Brown spider beetle (Ptinus latro F.)	+
	Cleridae	Necrobia ruficollis (Necrobia ruficollis F.)	+
	Cryptophagidae	Cryptophagus simple (Cryptophagus simplex Miller.)	+
		Cryptophagus dentatus (Cryptophagus dentatus Hbst.)	+
		Cryptophagus obsoletus (Cryptophagus obsoletus Reitt.)	+
		Cryptophagus nitidulus (Cryptophagus nitidulus Miller.)	+
		Cryptophagus hexagonalis (Cryptophagus hexagonalis Tournier.)	+
		Material cryptophagid beetle (Cryptophagus scanicus L.)	+
	Lathridiidae	Corticaria impressa (Corticaria impressa Oliv.)	+
		Little brown scavenger beetle/ Little plaster beetle (Enicmus minutus L.)	+
		Lathridius porcatus (Lathridius porcatus Hbst.)	+
Hemiptera	Pentatomidae	Eurygaster integniceps (Eurygaster integriceps Put.)	++
		Graphosoma lineatum (Graphosoma lineatum L.)	+
Lepidoptera	Pyralidae	Meal moth (Pyralis farinalis L.)	++
		Indian meal moth (Plodia interpunctella Hb.)	+++
		Mediterranean flour moth (Anagasta kuhniella Zell.)	++
		Cacao Moth (Ephestia elutella Hb.)	+++
	Gelechiidae	Angoumois grain moth (Sitotroga cerealella Oliv.)	+
	Tineidae	European grain moth (Nemapogon granellus L.)	++
		Common clothes moth (Tineola biselliella Humm.)	+
		Tinea translucens (Tinea translucens Meyr.)	+
		Haplotinea ditella (Haplotinea ditella P. et Diak.)	++
		Niditinea fuscipunctella (Niditinea fuscipunctella Hw.)	+
	Noctuidae	Xestia c-nigrum (Xestia c-nigrum L.)	+
Collembola	-	-	+++

Conditional denotations:
+++ - mass species;
++ - usual species;
+ - rare species.

During 2012-2014 years were used different methods of accounting of species composition of arthropod-pests of grain stocks. On basis of quantitative indicators was possible to determine most effective methods to

identify species composition of granary pests on territory of granaries of Poltava region (Table 2).

Table 2 *– The comparative efficiency of accounting methods of species composition of arthropod-pests of grain stocks*

Year	Average sample	%	Food baits	%	Pheromone traps	%	All
2012	982	43,8	1259	56,2	-	-	2241
2013	1091	50,3	1076	49,7	-	-	2167
2014	609	5,2	6271	53,2	4899	41,6	11779

The efficiency of different methods of accounting of species composition of pests of grain stocks significantly differed. In 2014 year were laid pheromone traps (Fig. 1), which showed high efficiency (41.6%), level of capture by selecting point samples (Fig. 2) significantly decreased, from 50.3% to 5.2%. In general, in the absence of pheromone traps, food baits are most effective and easy to use. The analysis of “average sample” showed high results during 2012-2013 years (40-50%), but it is quite laborious method, while food baits are not inferior by efficiency (<50%), their use are more optimal.

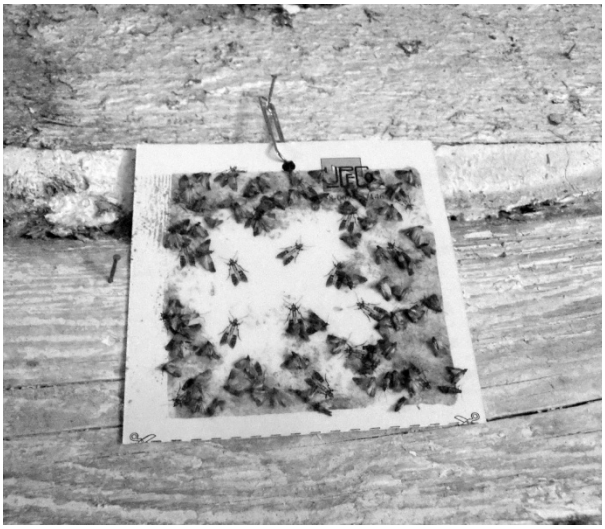

Fig. 1 *– The capture of adults of Indian Meal Moth using pheromone traps*

Fig. 2 *– The taking of spot samples of grain for analysis of average sample*

The food baits differed in composition, which allowed to talk about their comparative efficiency when analyzing of insects and mites. During 2013 year, highest results were obtained when using baits with sunflower oil (34.4%). It is particularly effective in detection of Liposcelis divinatorius and Collembola, which are present in large quantities in all warehouses. The food baits with mixture of groats (28.4%) and peanuts, yeasts, oil (25.3%) ensured average efficiency. Peanuts (5.02%) and seeds of sunflower (6.9%) in mixture with dry yeasts showed low results (Fig. 3).

The repeated determination of efficiency of different composition of food baits confirmed unconditional productivity of sunflower oil, 50.4%.

Comparatively effective is mixture of peanuts with dry yeasts and sunflower oil (27.6%). Effective baits, which included mixture of groats for Coleoptera (13.01%). Indicators of capture were characterized by low level when using all other dry baits (Fig. 4). This indicates that efficiency of food baits depends from submitted species composition, condition of warehouse and other.

Oil baits are effective at spreading by Lepidoptera, Psocoptera and Collembola. Dry baits expedient to use for determining of species composition of Acariformes and larvae, imago Coleoptera.

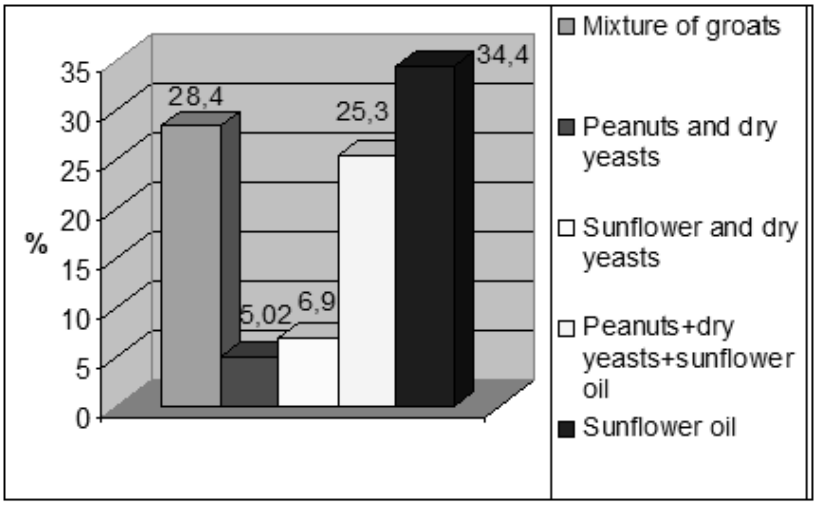

Fig. 3 *– The comparative efficiency of food baits (Poltava region, 2013)*

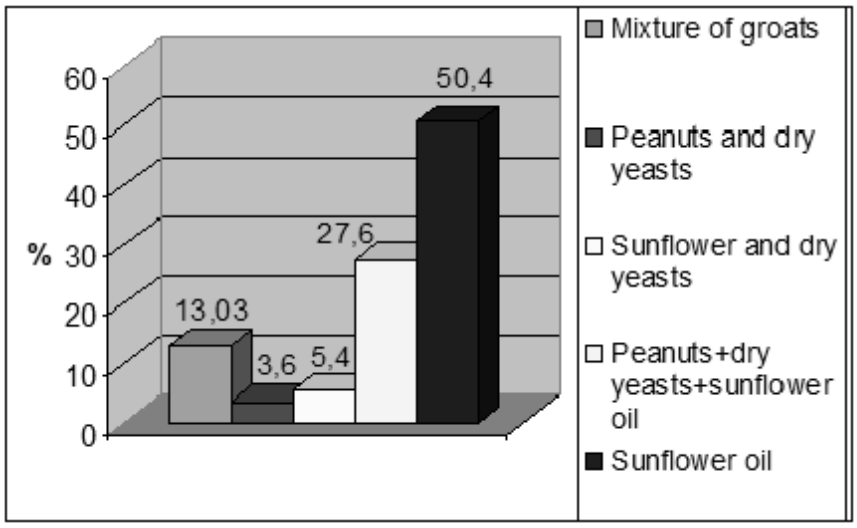

Fig. 4 *– The comparative efficiency of food baits (Poltava region, 2014)*

Conclusions.

1. The most common arthropod-pests of grain stocks of spiked cultures on territory of Poltava region are: Fodder mite (*Glycyphagus destructor Ouds*.), Cheyletus eruditus (*Cheyletus eruditus Schrk*.), Dust mite (*Zercoseius ometes Ouds*.), Liposcelis divinatorius (*Troctes divinatorius Mull.*), Grain weevil (*Sitophilus granarius L*.), Rice weevil (*Sitophilus oryzae L.*), Red flour beetle (*Tribolium castaneum Hbst*.), Short-horned beetle

(*Cryptolestes ferrugineus Steph*.), Sawtoothed grain beetle (*Oryzaephilus surinamensis L.*), Corn sap beetle (*Carpophilus dimidiatus F.*), Lesser grain borer (*Rhizopertha dominica F*.), Indian meal moth (*Plodia interpunctella Hb*.), Cacao Moth (*Ephestia elutella Hb.*) and representatives of order *Collembola*.

2. The results of using different methods of accounting of species composition of arthropod-pests of grain stocks indicate on their different efficiency. During researches, by analysis of average samples were identified 2682 pests (33.1%), when using of food baits - 8606 individuals (53.03%). In this case, pheromone traps were most productive, found 4899 (41.6%) insects and mites during spring-autumn period 2014 year.

3. Different efficiency of food baits was noted depending from their type and composition. The most effective food baits with sunflower oil - 42.4%, high indices were obtained when using of peanuts with dry yeasts and oil (26.5%), mixture of groats (20.7%). All other food baits are not effective, their efficiency did not exceed 10.0%.

4. In order to establish species composition of pests of grain stocks of spiked cultures recommend to use dry food baits with mixture of groats for accounting of larvae and adults of Coleoptera, larvae of Lepidoptera and mites. For adults of Lepidoptera are highly effective pheromone traps. Baits with sunflower oil should be used for accounting of representatives of Psocoptera and Collembola. For establish of species composition of adults Lepidoptera in absence of pheromone traps can be used oil baits, but their efficiency will be relatively lower.

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