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Phytosanitary condition of grain storages of Kazakhstan

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Abstract

To store the prepared grain without loss and damage is an important state task related to the provision of the population with bread, animals – with feedstuff, and industry – with raw material. This article describes the main pests of grain reserves and grain products, the main contamination sources of grain storages, the results of harmfulness of the pest complex and measures of their control. The timely revealing of the ways of contamination of grain reserves and preventive and direct control measures decrease the degree of contamination and reduce the harmfulness in the storages. We also studied the role and value of the ozone and ion and ozone treatment of grain in the storage protection system against pests. The purpose of the work is to develop an improved protection system for grain storages and its derivative products from pests that allows reducing the losses and deterioration in quality by 1.5-2 times in the new conditions of economic management and peculiarities of storage. The observation of the sanitary conditions in the storages preventing the intervention of pests into food reserves were observed and examined. The efficiency of the preventive measures was estimated. Insectoacaricides were tested in unloaded grain storages. The experiments were executed in unloaded grain storages; the preventive works were performed in cleaned storages after treatment with insectoacaricides.

Keywords: grain, pests, storage, contamination sources, harmfulness, insecticides, efficiency

INTRODUCTION

Kazakhstan is a large grain producer; it takes the leading position in the world in grain production. In recent years, despite the significant optimization of the crop acreage structure, our country has produced 17-22 mln tons of grain annually.

Seasonal grain production and its consumption during the year, the formation of significant stocks for sale, seed material, forage fodder, and state reserves require the organization of long-term storage in elevators, grain reception centers and grain storages.

A good yield can be grown but then the yielded part of grain is lost in the storage, in the grain reception center, or in the elevator because of insects and mites. Besides, the grain is damaged by rodents and birds. During the storage period, grain and its derivative products are subjected to the attacks of pests. More than 100 species of insects and mites that damage the grain and grain products were revealed in the grain storages of Kazakhstan.

Nowadays, the new conditions of the economic management make farm enterprises, collective enterprises, joint stock companies and other goods producers store the collected yield in most cases in grain storages that are not suitable for long-term storage. The grain farming of Kazakhstan deteriorated during the market reforms. The system of reception, storage and processing of grain begins to develop. Being the leading country among the grain exporters, Kazakhstan shall develop the infrastructure providing the grain safety.

Living in grain and grain products, insects and mites use them as food and habitat. At the same time, they make direct harm as well as the indirect one. The direct harm includes a decrease in their mass, sowing qualities, pollution with excrements, skins during shed, dead bodies, and damage of mill equipment. Some species (granary and rice weevils, lesser grain borer) damage the grain endosperm, eating the significant part of the bruchid weevil mass, other (locust leaf rollers, larvae of dermestid beetles, tenebrionid beetles, cereal mites) gnaw out the corcule reducing the germinating ability of seeds. The indirect damage includes the self-heating of grain when its humidity is increased and this promotes the propagation of parasites and leads to the loss of germinating ability and edible qualities. Due to this, the stored grain or its derivative products become unsuitable for use, and heavily contaminated products can cause intoxication of a person or animal when eating.

According to our data, the Republic of Kazakhstan can lose annually 10-15% of reserves of grain and grain products because of pests if no protection measures are taken. This is the seeds' reserves, food grains and feeder grain or its derivative products. Thus, one beetle of grain weevil eats 225 mg of wheat during its life and its larva eats 45 mg. The progeny of one pair of beetles can reach hundreds thousands of insects and the part of grain eaten by them will be 150-200 kg. The beetle and larva of grain weevil, by damaging a grain and its corcule, reduce its seed properties. In the northern regions of Kazakhstan, mites also decrease the germinating ability of seeds. Thus, the decrease in this value reaches, according to our data, 16.3%.

Rodents and birds make a significant damage to grain reserves and grain derivative products. They eat seeds, food and feeder grain and its derivative products, and rodents eat also skin, rubber, spoil floors, walls, ceilings, furniture and clothes. Thus, a house mouse (Mus musculus) eats about 1.5 kg per year, and a sewer rat (Rattus norvegicus) eats 37 kg of grain. Rodents are also carriers and distributors of dangerous agents (plague, yellows, encephalitis, fever, brucellosis and typhoids) of diseases of human and animals. Among birds, sparrows and doves make damage to grain reserves.

According to the data of the UN Food Organization, the annual world losses of agricultural products on the fields because of pests, diseases and weeds are 15-20%, and during storage of grain reserves and grain products, they reach 10-15%, and in some tropical countries – up to 50% and more. Such amount of grain would be enough to feed several millions of people.

The milling, baking and food-processing characteristics of flour from the grain damaged by grain pests are deteriorated not only because they eat a part of grain but also because of the presence of these insects, mites and their dead bodies and their excretions in the flour. In the flour, they increase humidity, the amount of fatty acids, decrease the quality of fibrin; the flour becomes yellowish, gets an unpleasant odour and in some cases poisonous properties. The presence of excretions of insects and mites in the derivatives of grain affects the health of human and animals.

Due to the expansion of trade, exchange and by other ways, loosening of control, the intervention of pests into the republic increased. The high grain marketability produced by Kazakhstan requires that its export batches are pure from pests and correspond to the international standards.

Therefore, the problem of storage of grain reserves and grain derivatives shall be taken care of with responsibility. It requires the further development of the infrastructure of the grain market. Taking into account the above-mentioned, the protection measures were taken, are taken and will be taken to protect grain reserves and grain derivatives from pests. Great and ambiguous efforts are taken now to develop the perfect means and methods of protection of grain reserves and grain products from pests. Annually, its range is complemented with new and improved preparations and methods of protection. This work describes the means and methods that proved themselves and are necessary for protection of grain reserves from pests spread in the storages of Kazakhstan.

Analyzing the protection system of grain reserves during storage, we have to conclude that its main link is a chemical block. Use of insectoacaricides, fumigants is related to some negative consequences. They should be manufactured, stored, transported; they pollute the environment. The toxic residues of insectoacaricides and fumigants, their metabolites (breakdown products) in grain and grain products are undesirable for the health of human and animals. Therefore, the search of an alternative to insectoacaricides and fumigants is a critical task for protection of the stored grain.

Good yield can be grown but then its quality will be decreased by 10-15% or the yield part of grain will be lost in the storage or grain reception center because of insects and mites. Together with them, rodents

and birds make harm to grain. During the storage period, grain and its derivatives are subjected to the attacks of pests. More than 100 species of insects and mites damaging grain and grain products were found in the grain storages of Kazakhstan. During the storage period, grain and its derivatives are subjected to damage by the many types of insects and mites, more than 100 types of arthropods and mites, and in Northern Kazakhstan, there are 60 of them. The ability of reserve pests to year round reproduction leads to the huge losses that can reach 10-12.8% annually. The value of losses is not limited by the quantitative indexes; it also includes the qualitative features (contamination with spider web, excretions, microflora) as even at the slightly damage grain becomes non-commodity. Therefore to save the grain and its derivatives from hazardous pests the protection measures shall be taken.

METHODS

The objects of research are pests of grain and its derivatives.

The methods of research are generally accepted in the etymological research.

When observing, we paid attention to the type of storages (brick, slag-concrete, hangar, wooden), to the roofing (wood, steel, corrugated fiber cement sheet, straw), to the floor (ground, asphalt, concrete, cement) and to the intended use of seeds: food, feeder and seed. As a result of the observations, the determination of the species composition of granary pests and their number, the phytosanitary condition of grain storages in the region was revealed.

The provision of the sanitary conditions preventing the intervention of pests to the food reserves (cleaning and disinfection of harvesting machines, whitewashing of grain storages, cleaning of territories, etc.) was observed and examined. Using the observations of contaminations with insects and mites of unloaded grain storages before and after disinfection, loaded storages and territories around them, elevators, storages, mills, flour mills, the efficiency estimation of prevention measures was given.

Tests of insectoacaricides were performed in unloaded grain storages. The efficient preparations with the corresponding consumption rates were used for the unloaded storage and the territory around. The control is water. 20 specimen of every type of insects were taken for test. The test was repeated three times. The control of death of insects was made on the 3rd and the 10th days.

The tests were performed in unloaded grain storages; after unloading the storages, preventive measures were taken (cracks filling, whitewashing of walls, cleaning inside the storages and territory around) and treatment with insectoacaricides was carried out. Control of the presence of pests was made 5 days after the work completion.

RESULTS AND DISCUSSION

To reveal the sources of grain contamination, we studied the contamination of grain storages, elevators, breweries and territories around storages with pests. For this, during the years of experiments, we sampled 108 samples from the silo of elevators, 225 – from loaded grain storages, 123 – from unloaded grain storages, 84 – from the territories around storages.

According to our data, the sources of contamination of the new yield grain are the territories around storages and unloaded grain storages.

According to our research, in the new conditions of grain storage, the species composition of insects and mites is represented by 39 species of insects from 14 families and 4 species of mites related to 3 families (Table 1).

The analysis of the collected samples allowed specifying the species composition of the insects and mites of Northern Kazakhstan that damaged grain (seed, food and feeder grain).

Tenebrionid beetles. 9 species of this family were found: big meal worm, small meal worm, fusty flour beetle, small black tenebrionid beetle, broad-horned flour beetle, dark big tenebrionid beetle, lesser mealworm beetle, smooth mealworm beetle, double strip fungus beetle. Fusty flour beetle and yellow mealworm beetle dominated among them. They were found in all the examined farms.

Weevils. They were represented by two species: grain weevil and rise weevil. They were wide spread pests of grain storages. They were found in all the examined farms.

Spider beetles. 5 species of this family were found – brown spider beetle, Ptinus testaceus, pilose spider beetle, hairy spider beetle, small spider beetle.

Cucuijid beetles. They were represented by 4 species: rusty grain beetle, saw-tooth grain beetle, flat grain beetle, Turkish cucuid beetle. They were wide spread. They were found in 6 farms.

Dermestid beetles. Among the species of this family, the following species were found – bacon beetles, carpet beetles, brown warehouse beetle, leather beetle, warehouse beetle, yellow carpet beetle, Attagenus schaefferi, warehouse megatoma. They were dangerous pests that damaged grain reserves and grain derivatives. They were found in the grain samples, flour sweepings, grain wastes, webs. This species was wide spread in the southern region and it was found in the north by us for the first time.

Wood-borers. One more species was found – corn borer. It was one of the dangerous pests of grain and its derivatives.

Cryptophagid beetles. They were represented by two species – warehouse mould beetles and cellar mould beetles. They were found in 9 farms.

Fungus beetles. Two species of this family were found – four-spotted fungus beetles and velvet fungus beetles. They were found in the storages of elevator and in the malt-house of breweries.

Plaster beetles. It was represented by one species – small plaster beetle. It was found in 7 farms.

Ant-like flower beetles. Only one species of this family was found – warehouse ant-like flower beetles. They were found in all examined farms.

Deathwatch beetles. Only one species of this family was found – drugstore beetle. It was found in the grain samples, sweepings and webs.

Pyralid moths. It was represented by one species only – meal moth. It was one of the wide-spread pests of grain storages. It was found in 20 farms.

Clothes moths. European grain moth of this family was found. It was spread everywhere and it was found in the sweepings and grain wastes.

Gelechiid moths. They were represented by one species – Angoumois grain moth. It was found in one farm – in the lower gallery of the elevator of Zhiger Limited Liability Partnership.

Mites. Flour mite was found in 4 farms. The contamination degree was III. They were found in the wheat samples and in sweepings taken from the lower gallery and mill, in the loaded storage of brewery.

The obtained data show that the main pests of the grain storages of Northern Kazakhstan are weevils, meal worms, grain beetles, spider beetles.

The preventive measures taken in the unloaded storages and the territory around them in Zarechye Experimental Production Farm and Ivolga Limited Liability Partnership in the Kostanay region allowed excluding the contamination of the incoming grain by the pests.

The preparations fastac 10% emulsion concentrate, sumi alfa 5% emulsion concentrate in the unloaded grain storages and in the territory around showed high efficiency against small meal worm – 78-100%, big meal worm – 60-86%, against meal worm first two preparations showed low efficiency 30-49% [1].

A study of the duration of the protection action of the preparations of sumi alfa 5% emulsion concentrate and fastac 10% emulsion concentrate showed the reliable protection of grain from insects during 3 months. However, the first two preparations suppressed weakly the development of the flour mite. The results of the performed research allowed improving the protection system of grain from pests during storage in Northern Kazakhstan.

To determine the phytosanitary condition of grain storages and processing enterprises, we examined the grains storages, warehouses, elevators, breweries, grain reception center, territories around storages and farm grain storages in the west and southeast of Kazakhstan.

The Aktyubinsk and West-Kazakhstan regions are grain producing regions in the west of Kazakhstan. Aktau grain terminal Ak biday is situated in the Mangystau region from where the grain is exported into foreign countries.

The grain storages, warehouses in Eskeldin, Karasai and Talgar districts of the Almaty region were examined in the southeast of Kazakhstan.

249 samples were collected and analyzed.

The contamination degree of objects of grain storage was II-III.

The main sources of contamination are the territories around storage, loaded and unloaded grain storages. Despite the protective measures, a part of pest populations survives. The low disinfection activity of grain storages is explained by the weak tightness of grain storages and

poor cleaning before treatment. Besides, during several years the same preparations are used and the pests become resistant.

According to the results of many scientists' research and also according to our data, the main pest reservations of grain reserves are the storages, territory around them, livestock facilities, hay, straw, rodents and birds [2; 3; 4].

Thus, the constant source of grain contamination of the new yield and its derivatives are the grain storage contaminated by pests (loaded and unloaded), silos of elevators and territories around storages. The grain reserves stored in the storages of all examined regions are subjected to pest contamination. This confirms the absence or weak efficiency of extermination and preventive measures.

Table 1 – Species composition of insects and mites damaging grain and its derivatives in Akmolinsk, Kostanay and North Kazakhstan regions.

Species	Region		
	Akmolinsk	Kostanay	North Kazakhstan
1	2	3	4
Family of tenebrionid beetles – *Tenebrionidae*			
1. Big meal worm – *Tenebrio molitor L.*	+	+	+
2. Small meal worm – *Tribolium confusum Duv.*	+	+	-
3. Fusty flour beetle – *Tribolium castaneum Herbst.*	-	+	+
4. Small black tenebrionid beetle – *Tribolium destructor Uytt.*	-	+	-
5. Broad-horned flour beetle – *Gnathocerus cornutus F.*	-	-	+
6. Dark big tenebrionid beetle – *Tenebrio obscurus F.*	-	+	+
7. Lesser mealworm beetle – *Alphitobius diaperinus Panz.*	-	-	+
8. Smooth mealworm beetle – *Palorus subdepressus Woll.*	+	+	-
9. Double strip fungus beetle – *Alphitophagus bifasciatus Say.*	+	+	+
Family of weevils – *Curculionidae*			
10. Grain weevil – *Sitophilus granaries L.*	+	+	+
11. Rice weevil – *Sitophilus (Calandra) oryzae L.*	+	+	-
Family of wood-borer – *Bostrychidae*			
12. Corn borer – *Rhizopertha dominica F.*	+	+	-
Family of cucujid beetles – *Cucujidae*			
13. Rusty grain beetle – *Cryptolestes ferrugineus Steph.*	+	-	-
14. Saw-tooth grain beetle – *Oryzaephilus surinamensis L.*	+	-	-
15. Flat grain beetle – *Cryptolestes pusillus Schonk.*	+	-	-
16. Turkish cucuid beetle – *Cryptolestes turcicus Grouw.*	+	-	-
Family of cryptophagid beetles – *Cryptophagidae*			
17. Warehouse mould beetles– *Cryptophagus scanicus L.*	+	-	+
18. Cellar mould beetles – *Cryptophagus cellaris Scop.*	+	-	+
Family of plaster beetles – *Lathrididae*			
19. Small plaster beetle – *Lathridius bergrothi Reit.*	+	+	-
Family of spider beetle – *Ptinidae*			
20. Brown spider beetle – *Ptinus fur L.*	+	+	+
21. Ptinus testaceus – *Ptinus testaceus Ol.*	-	+	-
22. Pilose spider beetle – *Ptinus subpilosus St.*	-	+	-
23. Hairy spider beetle – *Ptinus villiger Rt.*	+	+	-
24. Small spider beetle – *Ptinus pusillus St.*	+	-	-
Family of dermestid beetles – *Dermestidae*			
25. Bacon beetles – *Dermestes lardarius L.*	+	+	+
26. Carpet beetles – *Attagenus piceus Oliv.*	-	+	+
27.Brown wharehouse beetle – *Attagenus simulans Sols.*	-	+	-
28. Leather beetle – *Dermestes frischi Kugel.*	+	+	-
29. Warehouse beetle – *Trogoderma variabile*	+	-	-
30. Yellow carpet beetle – *Anthrenus flavidus Sols.*	-	-	+
31. Dermestid beetle schaefferi – *Attagenus schaefferi Hb.*	-	+	-
32. Warehouse megatoma – *Megatoma tianschanica Sok.*	-	+	-
Family of fungus beetles – *Mycetophagidae*			
33. Four-spotted fungus beetles – *Mycetophagus quadriguttatus Mull.*			
34. Velvet fungus beetle – *Typhaea stercorea L.*	+	+	-
	-	-	+
Family of ant-like flower beetles – *Notoxidae (Anthicidae)*			
35. Warehouse ant-like flower beetles – *Anthicus floralis L.*	-	+	-
Family of deathwatch beetles – *Anobiidae*			
36. Drugstore beetle – *Stegobium paniceum L.*	+	-	-
Family of pyralid moths – *Pyralidae*			
37. Meal moth – *Pyralis farinalis L.*	-	-	+
Family of gelechiid moths – *Gelecheidae*			
38. Angoumois grain moth – *Sitotroga cerealella Oliv.*	+	+	+
Family of clothes moths – *Tineidae*			
39. European grain moth – *Nemapogon granellus L.*	+	-	-
Family of cereal mites –*Acaridae*			
1. Flour mite – *Acarus siro L.*	+	+	+
2. Mould mite – *Tyrophagus putrescentiae Schrank.*	+	+	+
Family of pilose mites – *Glycyphagidae*			
3. Ordinary pilose mite – *Glycyphagus destructor Ouds.*	+	+	+
Family of dust lice – *Atropidae*			
4. Dust mite – *Atropus pulsatoria L.*	+	+	+

Note: + species is revealed; - species is not revealed

The obtained data show that the main pests of grain storages of the Western Kazakhstan are mites, weevils, dermestid beetles, ant-like flower beetles, and the pests of the southeast are curculios, weevils, dermestid beetles [5].

The contamination degree of grain storages was II-III. The main sources of contamination were the same: the territory around storages, loaded and unloaded grain storages. The low efficiency of disinfection of grain storages was explained by the low tightness of grain storages, poor cleaning before treatment.

The species composition and pest accumulation are influenced significantly by the type of storages. The storage shall be integral, without cracks, breaks and other hidden places of reproduction and accumulation of pests. In the grain storage, the ventilation of the room shall be possible in any season, isolation of grain from the flows of the external air, or vice versa, fast ventilation in dry weather. For example, in the grain storages of Sheminovka Limited Liability Partnership, Sulu Limited Liability Partnership, Razumovich Limited Liability Partnership and Viktorovka Limited Liability Partnership there are no windows for ventilation and due to this it is very warm inside and correspondingly there is a large accumulation of pests (dermestid beetles, weevils, spider beetles, curculios, mites).

The species composition of pests in the Western and South-East Kazakhstan is very diverse. The obtained materials show that grain and its derivatives are damaged during storage by many pests. As a result of the processing of the collected material, mites and other pests of grain reserves were found everywhere except Aktau grain terminal. Flour mite and Atrops pulsatoria were found. In the grain storages of South-East Kazakhstan, grain and its derivatives were damaged during storage by 11 types of pests and 10 of them were insects that referred to 7 families and 1 species of mite.

Mites, dermestid beetles, weevils, meal beetles dominated in the grain storages of the Western Kazakhstan, and mites, dermestid beetles, furniture beetles, curculios dominated in the storages of South-East Kazakhstan. The population density degree of these pests was I and II.

Knowing the main ways of pest contamination, we can plan the particular measures. The protection of grain storages and processing plants from pests is achieved by preventive and extermination measures.

The most important is timely and qualitative treatment of storage before the loading of grain and preparation of grain for storage. The preparation of storages includes the repair of the structures and equipment, their thorough cleaning and disinfection. The preparation of territory of the enterprise is also included.

The complex protection includes the consequent preventive and extermination measures that are composed of the physical and mechanical and chemical methods.

The pest control of grain reserves starts from the preparation of the storages for reception of grain of the new yield.

In this regard, we determined the efficiency of the preventive works that influence the development of the storage pests in the grain storages. The sanitary conditions in storages were examined and observed that prevent the intervention of pests into the food reserves (cleaning, disinfection of harvesting machines, whitewashing, cleaning of the territory).

The preventive works were performed such as washing of walls, floor with water; 2 days later, the humid disinfection was performed by the mixture of preparations aktellik 50% emulsion concentrate and karate 5% emulsion concentrate with consumption rates of 0.4 ml/m^2, and also fufanon, emulsion concentrate – 0.15 ml/m^2. These preparations were also used for treatment of the external walls of the storage and the territory around it. Before loading of the storage of the new yield, the constant examinations were made by sampling to determine the presence of pests. Before the loading, the workers whitewashed the walls by the mixture of lime and kerosene. The biological efficiency of the work performed was from 94 to 100%. The found pests were dead and paralyzed; in the territory around the storage, the pests were not found. In the spring, before the shipment of the seed material, the samples for analysis were collected. The results showed that pests were not found and in the control samples the weevils, meal beetles and mites were available. During the autumn examination, the samples for analysis were collected, pests were not found.

The complex of preventive measures in the unloaded storages and the territory around storage allowed excluding the pest contamination of the grain received for storage.

We also studied the role and impact of the ozone and ion and ozone grain treatment in the protection system of grain reserves. The increase in the concentration of the main reserve pests decreased their fertility and lifetime and increased the terms of development of the preimaginal stages. For the complex of reserve pests, the optimal modes of grain disinfection with ozone are the concentrations of 4.9 and 6.3 g/m^3 at 60 minutes exposition, ion zone is 1.4 g/m^3 3000 units. Ozone application is possible for disinfection of grain of food and fodder use. The results of work require a wide test in the industrial conditions; this will allow decreasing the consumption of insectoacaricides, and the system of reserves protection will be considered more environment friendly.

In this regard, in the farms the work of determination of the efficiency of preventive measures was performed that influenced the development of granary pests in grain storages. The examination of the storages and observations of the sanitary conditions were performed that prevented the intervention of pests to the food reserves (cleaning, disinfection of harvesting machines, whitewashing, cleaning of the territory).

Thus, the measures are directed to the prevention of the possible contamination of grain products. The complex of measures of pest control of grain reserves has a great significance because their application excludes the contamination of the stored grain reserves by pests and that allows avoiding the losses and quality deterioration.

During the years of grain pest control in 2001-2014, we have tested some insectoacaricides and fumigants to protect grain from pests.

In last years, the pirethroid preparations – aktellik, decis, karate; fumigants – magtoxine, phostoxine of foreign manufacture were used for disinfection of grain storages. They restrain the displacement of populations of harmful anthropods and reduce the possible damage. However, the fact that the number of pests and the amount of the contaminated products is almost at the same level, the resistance of the first is becoming higher from year to year and causes the necessity of an increase in the consumption rate of pesticides or requires its complete replacement. In this regard, one of the main purposes of the work is to extend the range of preparations.

In 2002, two preparations – decis 2.5% emulsion concentrate and karate 5% emulsion concentrate - were tested in the laboratory conditions against the pest complex (flour mite, saw-tooth grain beetle, granary weevil, tenebrionid beetle) of grain storages.

The test of decis and karate at the consumption rate of 0.4 g/m^2 showed rather high efficiency. On the concrete and wooden surfaces treated with decis and karate against the insects, the efficiency was from 92 to 100%, on the soil surface it was from 60 to 89%; treatment of all three types of surfaces against mites was 100% (Table 26).

Thus, decis 2.5% emulsion concentrate and karate 5% emulsion concentrate are efficient preparations against granary pests.

In 2003, the test of pesticides was performed by the wet method in the unloaded storage and in the territory around it. The preparations of sumi alfa 5% emulsion concentrate with the consumption rate for unloaded storage 0.3-0.4 ml/m, 0.6-0.8 for the territory around the storage, fastak 10% emulsion concentrate – 0.2-0.3 ml/m^2, 0.4-0.6 ml/m^2, correspondingly, were taken to test against the pest complex (mites, dermestid beetles, granary weevil, red grain beetle, large and small flour weevil). The reference of karate 5% emulsion concentrate with the consumption rate 0.4-0.8 ml/m^2. The control is water.

The obtained data showed that when the unloaded storages were treated with fastak 10% emulsion concentrate and sumi alfa 5% emulsion concentrate in the specified rates, these preparations were efficient against beetles of granary weevil, small flour weevil, red grain beetle. The biological efficiency of sumi alfa 5% emulsion concentrate was from 76 to 100%, and the efficiency of fastak 10% emulsion concentrate – from 85.2 to 100%.

When treating the territory around storage against the beetles, the insecticides showed 60-100% efficiency. These preparations showed the biological efficiency of 10-75% when treating the unloaded storage and the territory around it at the specified rate against mite, larva of dermestid beetles, large flour weevil.

Now we study the aerosol nanotechnologies of storages' protection from grain reserve pests by the controlled atmosphere. They are based upon the multifunctional generator of controlled atmosphere developed by the participants in the program. This approach found use for the firefighting method and it was used for treatment on the close rooms [6; 7].

The tests of development of various compositions of controlled atmosphere were performed against the main storage pests. Also, the tests were carried out to estimate the efficiency of impact of the controlled atmosphere (CA) on the base of potassium iodide on grain reserve pests [8]. As a result, we found out that the application of the controlled atmosphere at high concentrations led to the death during the short period of time after treatment, and also at low concentration it promoted the changes in the organisms of insects that led to the suspension of their development and death during the longer period.

The research of the development of various compositions of the controlled atmosphere against pests is in progress. The compositions of the controlled atmosphere established by us against grain reserve pests require wide examination [9; 10].

CONCLUSION

Thus, the strategy of grain reserve protection from pests is based upon their distribution, development, reproduction and injuriousness, depends upon the conditions, ways and modes of grain storage, and combines the complex of preventive and extermination measures at all the stages of procurement, transportation and long-term storage inside and outside the storages. The analysis of the collected samples allowed specifying the species compositions of insects and mites of Northern Kazakhstan damaging grain (seed, food and fodder grain). The main pests of the grain storages of Western Kazakhstan were mites, tenebrionid beetles, dermestid beetles, ant-like flower beetles, and in the grain storages of the south-east – weevils, tenebrionid beetles, dermestid beetles. As a result of the performed modern preventive works, the contamination degree was decreased and injuriousness was reduced.

REFERENCES

[1] Ismukhambetov, Zh.D., Kozhakhmetova, F.K., & Sarsenbaeva, G.B. (2004). Fitosanitarnoe sostoyanie zernoskladov, elevatorov v Severnom Kazakhstane [Phytosanitary Condition of Grain Storages, Elevators in Northern Kazakhstan]. *Zerno i zernoprodukty*, *2*, 19-21.

[2] Sagitov, A.O., & Sarsenbaeva, G.B. (2015). Vrediteli zapasov zerna i produktov ego pererabotki v Kazakhstane [Pests of Grain Reserves and Its Derivatives in Kazakhstan]. In *Materialy V mezhdunarodnoi nauchno-prakticheskoi konferentsii "Aktualnye problemy nauki XXI veka"* [Proceedings of the Vth International Scientific and Practical Conference "Urgent Problems of Science of the 21st Century"] (Part 1, pp. 125-129). Moscow.

[3] Sagitov, A.O., Ismukhambetov, Zh.D., Kozhakhmetova, F.K., & Sarsenbaeva, G.B. (2007). *Rekomendatsii po zashchite zapasov zerna i zernoproduktov ot vreditelei pri khranenii v Severnom Kazakhstane* [Recommendations on Protection of Grain Reserves and Grain Products from Pests during Storage in Northern Kazakhstan]. Almaty. (p. 24).

[4] Zakladnoi, G.A. (2006). Vrediteli khlebnykh zapasov [Pests of Bread Reserves]. *Zashchita i karantin rastenii*, *6*, 79-84.

[5] Ismukhambetov, Zh.D., Sarsenbaeva, G.B., Kozhakhmetova, F.K., & Salpiev, R.K. (2015). Vrediteli zapasov zerna i produktov ego pererabotki na zapade Kazakhstana [Pests of Grain Reserves and Their Derivatives in the West of Kazakhstan]. *Vestnik selskokhozyaistvennoi nauki*, *5-6*, 38-43.

[6] Vakhrouchev, A.V., & Golubchikov, V.B. (2007). Numerical Investigation of the Dynamics of Nanoparticle Systems in Biological Processes of plant Nutrition. *Journal of Physics: Conference Series, 61*, 31-35.

[7] Vakhrouchev, A.V., & Lipanov, A.M. (2007). Numerical Analysis of the Atomic Structure and Shape of Metal Nanoparticles. *Computational Mathematics and Mathematical Physics*, *47*(10), 1702-1711.

[8] Sarsenbaeva, G.B. (2016). O primenenii reguliruemykh gazovykh sred protiv vreditelei zerna i produktov ego pererabotki [Application of Regulated Gas Media against the Pests of Grain and Its Derivatives]. *Agroalem*, *07*(84), 46-47.

[9] Lindahl, E., Hess, B., & van der Spoel, D. (2001). Gromacs 3.0: A Package for Molecular Simulation and Trajectory Analysis. *Journal of Molecular Modeling*, *7*(8), 306-317.

[10] Vakhrouchev, A.V. (2007). Computer Simulation of Nanoparticles Formation, Moving, Interaction and Self-Organization. *Journal of Physics: Conference Series*, *61*, 26-30.