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ECOLOGICAL ASPECTS OF PHYTOSANITARY OPTIMIZATION OF ARID AGROBIOCENOSES OF THE SOUTH OF RUSSIA

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Abstract

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In the article features of phytosanitary situation in the agrarian sector of industry in the South of Russia are considered. The mechanisms and degree of influence of economic and environmental factors on the state of farmland, their infection with insect pests are revealed. The structure and dynamics of entomo-communities in arid agrocenoses of the region are analyzed. The effect of complex biopreparations in the system of agrotechnologies aimed at regulating the life activity of agrobiocenoses has been studied. New paths of optimization of scientifically based system of agrotechnical methods of management of agricultural ecosystems in arid conditions of the Lower Volga region are proposed.

Key words: aridization; insects' wreckers; protection of plants; entomopathogenic microorganisms; arrangement of a landscape

Introduction

The modern crop production in the south of Russia is characterized by exclusively low stability of a phytosanitary state (outbreaks of mass pest reproduction, epiphytotic diseases, widespread weed vegetation) and the progressing its deterioration (Belitskaya and Ivantsova, 2012; Kulik, 2003). Basic changes in perfecting of protection of plants against harmful organisms can be received only on the basis of in essence new strategy directed to the common phytosanitary optimization of crop production (Ivantsova, 2014).

The modern concept of plant protection provides for the rejection of total extermination of pests and a phased transition to the creation of phyto-sanitary stable agroecosystems in which the mechanism of self-regulation and control of the number of harmful organisms will operate (Zhu et al., 2014). The most important block in such systems is information on the ecological and biocenotic processes occurring in agrocenoses at a level that allows regulating the phytosanitary situation. The study of the composition and structure of insect communities of agrolandscapes is extremely important for the development of methods for preserving the biodiversity of entomofauna and activating the activity of entomophages, the inventory of phytopathogens on weeds and wild vegetation is the base stage for the search for agents of biological control (Pashalidou et al., 2014; Ivantsova, 2006, 2013).

The recent economic and environmental problems require significant changes in the technologies used in the direction of their biologization and resource saving while ensuring the profitability of agricultural production. This opens the way to the development of new directions in the cultivation of crops using microbiological fertilizers, bio-

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logical preparations of insecticidal and fungicidal action, growth stimulators and inducers of immunity (Cherezova, 1986; Ivantsova, 2013). These issues, considered in this work, should be considered among the most relevant and yet insufficiently developed for modern crop production.

The solution of the listed problems defines a possibility of realization of strategy of phytosanitary optimization of cereals and mustard agrocenoses in arid conditions of Lower Volga area that will promote preservation of a regional biodiversity, and also stable receiving high-quality ecologically safe production with minimum negative impact on a surrounding medium.

The Lower Volga region is the most "fragile" territory of the European part of the arid belt of Russia (Onistratenko et al., 2016). The Volgograd region is part of the Southern Federal District, its area is 11.3 million hectares, of which 8.8 million hectares are agricultural land, including 5.8 million hectares of arable land (67.3% of the farmland area), hayfields – 0.2 million hectares, pastures – 2.6 million hectares. According to the generally accepted classification, the territory of the region belongs to the continental East-European climatic province 14 (Kulik, 2003).

The main climatic features are formed under the influence of the Asian continent, supercooled in winter and overheated in summer, and also under the mitigating influence of the western air mass transfer. The right-bank part of the region is characterized by a continental inadequate wet and warm climate with steppe landscapes; the left-bank part is continental with a moderately dry and very warm climate of dry steppe and semi-desert. Characteristic features of the region's climate are small amounts of precipitation, recurring droughts, the presence of complex solonetsous soils and solonetzes (Aridisols in USDA soil taxonomy) in all natural zones, and the manifestation of water and wind erosion. A distinctive and most unfavorable for agricultural production feature of the climate is a sharp deficit of moisture in late spring and early summer. Agroclimatic conditions worsen the fissile wind mode, frequent sukhoveys (hot dry winds) that strengthens evaporation and sharply reduces reserves of productive moisture in the soil. Every third – the fourth year in the conditions of the Volgograd region happens droughty, and droughts can repeat several years in a row. Serious danger to crop production is constituted by frequent spring frosts. The complex of these factors makes most of the territory of the Volgograd Region a zone of risky farming. The variety of soil and climatic conditions in the Volgograd region allows the cultivation of most crops, but the production of crop production varies greatly from year to year (Ivantsova, 2014).

Materials and Methods

The experimental work was performed in various agroclimatic zones of the Volgograd region during 1997-2017 by carrying out environmental monitoring, field and production experiments, laboratory research.

Objects of research were entomofauna and mycobiota of grain and mustard agrocoenosis of the Lower Volga region. The researches established the effect of different methods and tools for the growth, development, yield and quality of cereals and mustard sareptana. The entomo- and disease resistance of the winter and spring wheat varieties cultivated in the Lower Volga region was assessed. Within the framework of the research, we determined the biological effectiveness of pesticides and biologics against a complex of harmful objects in agrocenoses of grain cereals and mustard mustards, as well as influential means for non-target objects (soil microflora and useful entomofauna).

Monitoring of the composition and density of entomocomplexes was carried out during all growing seasons through the years of research. We counted the numbers of openly living insects by counting individuals on stationary sites, the soil entomofauna was taken into account by the method of soil excavation, collection and recording of herpetobionts with the help of Barber's traps, chortobionts – by mowing with an entomological net.

The process of organizing and conducting field experiments used generally accepted installations as a basis. The variants of the experiments placement is systematic, in one or two stages, the repetition is fourfold. The area of experimental plots of 100-200 m^2, accounting area – 50 m^2. The area of production and experimental variants to evaluate various means and methods of controlling the population of harmful insects was 2-10 ha. All technological operations in the cultivation of crops carried out according to existing zonal recommendations.

The biological effectiveness of protective measures against phytophages was established according to the formula of Abbot (Abbot, 1925). The biological effectiveness of protective measures against a complex of pathogens was assessed, supplying of plants are affected by disease on the treated and control plots. Two factors: microbial activity and cellulose-destroying activity of the soil determined the soil biological activity in the use of pesticides. Determination of microbial activity was performed by placing soil samples in Petri dishes using artificial nutrient media MPA, KAA and Chapec medium. Definition cellulose-destroying activity of the soil was performed by the method of applications the percentage of dissolution of cellulose. Experimental materials were processed using methods of variation statistics of variance and regression analyses.

Results

The species composition of insects found in cereal agrocenoses is represented by 287 species. The leading place among the ecological groups belongs to entomophages – 191 species, or 61.72% of the total composition of the entomocomplex, and phytophages – 96 species, or 33.10%. The most represented groups among herbivorous are leaf-eating and sucking pests of generative organs – 26 species (27.08% of the total number of phytophages) each group. Intra stem and damaging root system treats wreckers about 14 types that make 14.58%. Slightly less types fall into gnawing wreckers of generative bodies – 10 types, or 10.41%. The mining flies (miners) make 6.25% of total of phytophages. The group of saprofag and necrophages has small representation; its participation in structure of entomocomplex does not exceed 1.72% of the common structure of a complex. The share of other species is also insignificant – 3.44%. Among the phytophagous species, the ratio of the number of species according to orders from the total number is as follows: Coleoptera – 29.16%, Orthoptera – 18.75%, Diptera – 14.58%, Hemiptera – 13.54%, Homoptera – 9.37%, Lepidoptera – 10.41%, Thysanoptera – 3.13%, Hymenoptera – 2.08% (Figure 1). The dominant position on the number of individuals in the cereal agrocenoses of the Volgograd region is held by *Haplothrips tritici* Klurd. High density of populations of *Phyllotreta vittula* Redt., *Oscinella sp*. The most common species are: *Eurygaster integriceps* Put., *Haplothrips tritici* Klurd., *Phyllotreta vittula* Redt., *Anisoplia austriaca* Hrbt., *Lema melanopus* L., *Chaetocnema hortensis* Geoffr., *Chaetocnema aridula* Gyll., *Oscinella pusilla* Mg., *Mayetiola destructor* Say., *Cephus pygmaeus* L., *Schizaphis graminum* Rond., *Sitobion avenae* F. *Phorbia fumigata* Meigen. for the Volgograd region is a relatively new phytophagus, the distribution and harmfulness area of which is rapidly growing.

A *Haplothrips tritici* Klurd has a dominant position by numbers of individuals in cereal agrocenoses of the Lower Volga region (relative abundance of species – 90.75%). The Figure 2 presents a population of wheat thrips in the conditions of the Volgograd region in the period 1987-2015.

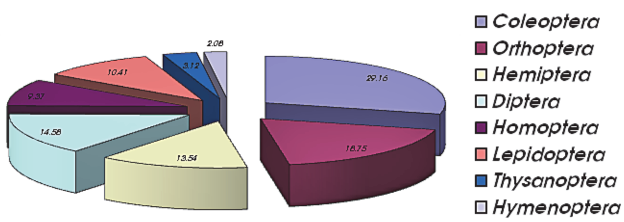

Fig. 1. The ratio of ordos of harmful insects in agrocenoses crops on number of species, %

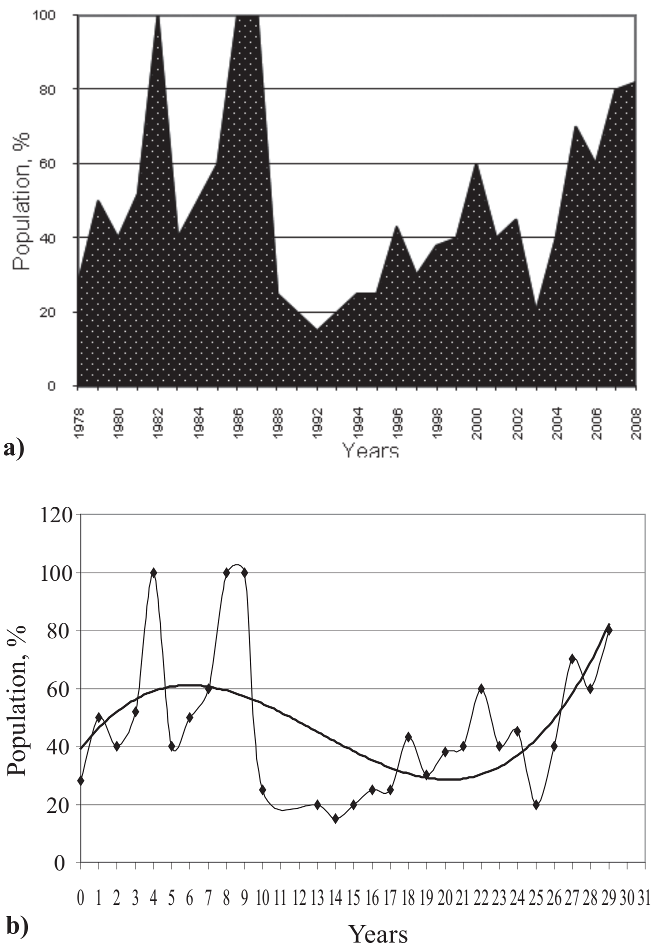

Fig. 2. Population of *Haplothrips tritici* Klurd. in the Volgograd region in the period 1987-2015: a – population by year, %; b – trend line

Statistical assessment of data: Average: 47.0000, Root mean square deviation: 24.5357, Reliability level (95%): 9.51395, The correlation coefficient of the damage by years of research: -0.086

The regression equation expressing the dependence of reducing the damage of plants *Haplothrips tritici* Klurd. studies has the form:

$$y = 0.02x3 - 0.89x2 + 8.19x + 39.02,$$

where y – estimate of damaged plants, x – years; $R^2 = 0.3289$.

The average of colonization of plants is 40-45%, only in separate years reaching 100%. Depending on the number of larvae feeding on the grain and wheat grade its weight may be reduced by 10-48%. In addition, larvae of *Haplothrips tritici* Klurd. reduces not only grain, but also its viability, reduce the number of embryonic roots. In this regard, the roots are in the surface soil layer and thereby consume less of the nutrients, die easier and faster from lack of moisture during dry periods, which, of course, affects the value of the crop. Data on changes in the baking qualities of grain to date remain controversial, among which most authors who have studied this question, believes that grain, damaged the escarpment, does not deteriorate these properties.

Table 1 shows a high density of populations of *Phyllotreta vittula* Redt., *Oscinella sp.* in cereal agrocenoses of the Lower Volga region. *Phorbia fumigata* Meigen. is relatively new phytophage for the Volgograd region, and has a rapidly increasing area of distribution and harmfulness.

The analysis of the quantitative structure of the faunal community shows that an increase in the number of insects in the stalks of agricultural lands is parallel with the growth and development of crops.

The density of the complex rises to its maximum value in the phase of milky-wax ripeness of grain. The seasonal course of population dynamics of insects from different ecological groups does not coincide (Figure 3).

Table 1

The relative abundance and density of phytophages in the agrocenoses of grain crops of the Volgograd region, on average for 2001-2016

Phytophagous	The relative abundance, %	Density, individuals/ha	Root mean square deviation	Reliability level (95%)
Sitobion avenae F.	4.940	3171.2	24.28	15.05
Schizaphis graminum Rond.	3.155	2025.4	19.71	12.22
Haplothrips tritici Kurd.	90.753	58250.0	164.31	101.84
Eurygaster intergriceps Put.	0.047	30.3	2.7	1.67
Trigonotylus ruficornis Geoffr.	0.006	4.0	0.7	0.43
Anisoplia austriaca Hbst.	0.031	20.5	1.84	1.14
Lema melanopus L.	0.039	25.6	1.97	1.22
Phyllotreta vittula Redt.	0.471	302.9	29.55	18.31
Chaetocnema spp. (larva)	0.034	22.0	1.89	1.17
Cephus pigmaeus L. (larva)	0.028	18.2	1.44	0.89
Mayetiola destructor Say. (larva)	0.067	43.1	3.72	2.31
Meromysa nigriventris Mcq.	0.004	3.0	0.21	0.13
Chlorops pumilionis Bjerk.	0.009	6.1	0.59	0.37
Oscinella spp. (larva)	0.319	205.3	19.63	12.17
Phorbia genitalis Schnb. (larva)	0.088	57.0	5.1	3.16
Total	100.0	64184.60	234.54	145.37

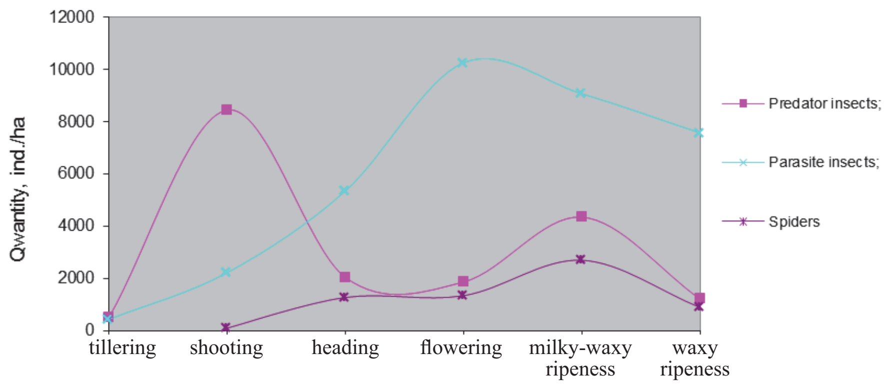

Fig. 3. Population dynamics of main pests on winter wheat

statistical estimation of the data (Figure 3)

	predator insects	parasite insects	spiders
root mean square deviation	2932.39	3886.17	942.40
reliability level (95%)	3077.35	4078.29	1170.14

So, the beginning of activity of wheaten trips is the share of a shooting phase, further there is a sharp rise in density of its population. This index reaches the highest values in a heading phase. The same trend is observed for other phytophagous arthropods with piercing-sucking mouthparts type. The exception is a *Trigonotylus ruficornis* and the sunn pest, maximum population density which coincides with the flowering stage and grain formation.

In predatory insects, a pronounced increase in the density of populations is fixed in the shooting phase, then there is a slight decrease in numbers, but at the end of the heading phase the number of them begins to increase and the abundance maximum falls on the period of grain filling. Rise in number of populations of parasitic insects begins with a shooting phase, and their absolute abundance is observed in a flowering phase. The peculiar way of population dynamics observed in spiders. Since the beginning of the vegetation period and up to the phase of heading (inclusive), there has been an increase in the number of these representatives of useful fauna. The culmination of this process coincided with a phase of milky-wax ripeness of grain, after which their share in the cenosis has sharply declined. When planning and conducting active defensive measures should take into account features of population dynamics of harmful and useful complex. Thus, exterminating measures against a sunn pest in order to preserve a useful entomofauna should be carried out during the phase of dairy ripeness of wheat, when the bulk of the egg consumers are not exposed to pesticides due to internal parasitism.

Species of insects identified in mustard agrocoenoses are presented by 381 species. The group of phytophages and entomophages is most represented – 314 species, or 82.4% of the total number of species. The proportion of herbivorous insects (103 species) is 27.03% of the total composition of entomocomplexes. Phytophages are subdivided into 6 ecological groups: leaf-eating (47 species), sucking (18 species), pests of generative organs (17 species), pests of the root system (15 species), minerals (5 species), intra-stems (1 species). The ratio of quantity of species of phytophages on groups from total looks as follows: *Coleoptera* – 47.57%, *Orthoptera* – 17.47%, *Hemiptera* – 14.56%, *Lepidoptera* – 10.67%, *Diptera* – 5.82%, *Homoptera* – 1.94%, *Thysanoptera* – 0.97%, *Hymenoptera* – 0.97%. The greatest number of species of entomophages (84) belongs to the order *Hymenoptera;* the order *Coleoptera* includes 78 species, *Diptera* – 21 species, *Hemiptera* – 11. Ordos *Neuroptera* (3), *Mantoptera* (2), *Orthoptera* (2) are represented by few species (3, 2 and 2 – relative). The dominant species in mustard crops is *Plutella maculipennis* Curt. Subdominant – *Phyllotreta sp*., *Euridema sp*.

Discussions

We have established that the number of insects varies markedly in the phases of development of sarepta mustard. In the seasonal dynamics of the most important pests of mustard, two can be identified, in some years three periods with the maximum number of harmful insects – the seedling, flowering and seeding phases. Hence it can be concluded that measures to control pests must be timed to the critical moment of plant development, ie, to the first days of their growth and to the budding phase, in order to prevent damage to mustard during flowering. In this regard, the practical value of insecticides should be determined by the combination of their high toxic properties with a long-lasting effect on pests.

Data of our researches show that *Eurygaster integriceps* Put. and *Anisoplia austriaca* Hbst. can promote distribution of *Puccinia recondita* Rob. et Desm. and *Blumeria graminis* Speer., *Haplothrips tritici* Klurd. postpones on itself disputes of *Ustilago tritici* Jens. and *Puccinia triticina* Iens. Oscinella *sp.* contribute to the spread of *Ustilago tritici* Iens., *Phyllotreta vittula* Redt.– *Blumeria graminis* Speer., *Acridoidea –Helminthosporium sativum* Pam., *Fuzarium sp.* According to the degree of insect infestation it's found that the greatest number of conidia of *Erysiphe draminis* Ds. can carry on itself *Eurygaster integriceps* Put. and *Phyllotreta vittula* Redt.. The role of insects as carriers of fungal diseases is well known, and the harm caused in this way is often more significant than from the pest itself. This circumstance should be taken into account in the development of protective measures, especially in areas of distribution and high severity of insects, to which primarily the arid regions of Russia, including the Volgograd Region, are. It should be noted that distributors of many fungal diseases can also be useful insects. For example, it was revealed that potential carriers of uredospores *Puccinia recondita* Rob. et Desm., *Puccinia triticina* Iens., *Ustilago tritici* Jens. and *Blumeria graminis* Speer. are *Coccinella septempunctata* L. and *Adolia variegata* Gz. Thus, insects, moving from a sick plant to healthy, can promote infection of the last and growth of a focus of the disease, i.e. insects, participating in distribution of spores of fungi, carry out interrelation between the higher plants and a microflora, and through plants – wildlife reserves there is an exchange of a microflora of natural and artificial phytocenoses.

Damage to plants by insects often increases the intensity of the development of various diseases, which is explained both by a violation of the integrity of the tissues, and by their general weakening. Data on the relationship between the prevalence and intensity of root rot development on barley varieties

Table 2
Correlations of lesion of barley plants root rot and Swedish fly (Kalachevskiy district, 2013-2015, %)

Preplant pesticide treatment	Root rots				The population the Swedish fly, %	Root mean square deviation
	The spread of the disease, %	Root mean square deviation	The development of the disease %	Root mean square deviation		
Control (without treatment)	94.5	8.95	69.0	7.21	24.1	1.59
Vial	80.5	7.64	56.5	4.69	20.9	1.63
Vial + Biosil	69.8	6.31	45.2	3.94	19.5	1.87
Binoram	58.8	5.21	42.7	3.67	13.8	0.76
Binoram + Biosil	75.3	6.88	50.7	4.93	14.6	0.82
Biosil	89.8	8.12	60.5	6.77	20.2	1.54

Zernogradets-770 with damage to stems by cereal flies were obtained by us in the fields of Kalachevsky district of the Volgograd region using various means of protecting the culture from the complex of disease-causing diseases (Table 2).

It was found that on variants using biological fungicide binoram as a disinfectant, where the prevalence and intensity of development of helminthosporium-fusarium rot was lower than in untreated control, stalk damage by the larvae of *Oscinella sp*. decreased by 10.3% compared to the control. The damage of plants with variants using the chemical disinfectant vial was 20.9%, which is 3.2% lower than in the control. The greatest infection of stems with flies was observed on the variant with biosil. We also established a fairly close correlation (0.8) between the development of root rot and damage to the stems of the larvae of *Oscinella sp*. The enzymes that secrete the larvae of cereal flies lyse the young tissues of cereal plants and cause a change in their structure. In this case, the injured tissue sites remain alive for several weeks. This creates a very long-acting “gate”, facilitating the introduction of the causative agent of the disease in the plant. The development of diseases is affected not only by a violation of the integrity of tissues, but also, as indicated above, the general weakening of plants caused by damage by insects.

As a result of research developed and proved system of optimization of phytosanitary state of agrocenosis to ensure activation, the induction of mechanisms of self-regulation, increase the adaptive properties of crops by modifying the structure of the agricultural landscape and through the use of technical measures, biological means of plant protection, rational use of pesticides.

Introduction of forest belts in the agro landscape is one of the most important factors of environmentally safe plant protection. The silvicultural amelioration arrangement of agrocenoses of winter wheat and sarepta mustard contributed to a decrease in the number of harmful complex on average by 18.4% and an increase in the density of entomophages in 1,5-3,9 times compared with non-forested fields (Table 3).

For the forest-protected fields the pronounced aggregation of harmful insects in the zones adjacent to forest belts (Figure 4) is characteristic that testifies to a possibility of restriction of chemical fight against them with boundary treatments of crops.

Table 3
The number of arthropods in forest protected and open cereals and mustard agrocenoses, on average for 2011-2013

Pests	Qwantity, thous. ex./ha	
	forest-protected	opened
The winter wheat agrocenosis		
Phytophagous		
Eurygaster integriceps	17.6±1.36	22.4±1.87
Anisoplia austriaca	15.3±1.21	26.7±2.47
Jassus sexnotatus	6.8±0.49	15.1±1.18
Oulema melanopus.	18.9±1.64	51.3±4.89
Haplothrips tritici	48731. ±3901.98	61351.2±5984.15
Cephus pygmeus	0.8±0.07	1.1±0.64
Chloropidae	12.7±1.14	17.8±1.32
Entomophagous		
Parasites	29.8±2.63	8.0±0.74
Predators	23.3±1.89	15.1±1.32
incl. Spiders	11.5±0.94	9.3±0.67
The sarepta mustard (*Brassica juncea*) agrocenosis		
Phytophagous		
Phyllotreta cruciferae	41.2±3.87	45.1±3.67
Eurydema	49.4±4.06	56.4±5.17
Colaphus hoefti	52.6±4.88	67.9±7.01
Plutella xylostella	86.2±9.15	101.3±9.67
Athalia rosae	23.1±1.75	30.5±2.99
Entomophagous		
Parasites	41.4±3.89	10.6±0.93
Predators	25.3±2.26	16.3±.23
incl. Spiders	12.3±0.81	10.2±0.88

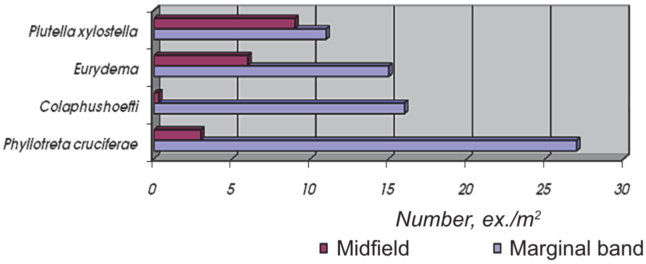

Fig. 4. The number of major pests of sarepta mustard in various zones of the field in the the phase of leaf rosette, ind. /m²

Due to the less negative effect of boundary treatments on the useful entomofauna than solid, we are to consider this method of local application of insecticides on the environment as the most acceptable.

Agrotechnical measures (use of resistant varieties, application of fertilizers) are among the most important factors in controlling the phytosanitary condition of agrocenoses. Among the varieties of the grain crops zoned and which are widely used in production in the Volgograd region on resistance to damages of Eurygaster integriceps Put. varieties of winter wheat the Zarnitsa, Yermak, spring-sown wheat – Prokhorovka and Saratov 70 are allocated, to Anisoplia austriaca Hrbt. – Saratov 70, Prokhorovka, Albidum 188, Cephus pygmaeus L. – winter wheat Prikumskaya 140, summer – Albidum 28, Saratov 70, Oscinella sp. – Saratov 60. These varieties cultivating will contribute to the production of high quality products while reducing the pesticide pressure, energy consumption, and ultimately stabilize the phytosanitary situation in the agrocenoses of cereal crops.

The sowing of double superphosphate (20 kg ai/ha) and spring fertilizing of winter wheat in the tillering phase with a 10% solution of urea led to a decrease in the population of ears by the larvae of Haplothrips tritici Klurd. with an average of 26.9% compared with the control, the number of *Eurygaster integriceps* Put. – 19.1%. In fertilizer applications, the sterilization of stems of Cephus pygmaeus L. was found to be 1.2 times lower than in the control, which significantly reduced the harmful effect on the mass by 1.6 times.

The positive influence of Flavobacterin microbiological fertilizer on the growth, development, and productivity of the sarepta mustard was established. Due to the more intensive development of plants and increase their compensatory abilities the presowing seed treatment with the soil fertilizer increased plant resistance to damage by Phyllotreta sp. The harvest increase on options with Flavobakterin made up to 0.23 t/ha in comparison with the control, improvement of quality of seeds also was noted.

Microbiological fertilizers together with pesticides were performed in a buffer, neutralizing functions under a negative impact on soil of chemical synthesis preparations. Due to this, in the soil profile of the agrocenosis there was an increase in biomass across all functionally important groups of microorganisms (except microscopic fungi) and, on the whole, the biogenicity of the pedocoenoses increased.

Use of natural entomopathogenic microorganisms is among the important directions of management of a phytosanitary condition of agrotsenosis. A bacikol (based on BtH10) application led to decrease in number of coleopterous and lepidopterous wreckers of sarepta mustard at the level which is not conceding to chemical insecticides. The resulting studies positive evidence of the effectiveness bacikol against a complex of pests indicate the prospects of application of this biopesticide along with other the currently used microbial insecticides.

Biofungicides, immuno- and growth-stimulators of natural origin, used both for presowing seed treatment and for vegetative spraying of plants can be used under certain conditions as an alternative to chemical preparations. Positive influence Biosil (bioforce) and a Binoram as growth stimulators on energy of germination, viability, stalk density, productive bushiness, weight of 1000 grains was noted. There was a positive trend to reduce the development of root rot and leaf-stems' infections (Septoria and powdery mildew) under the influence of the tested substances.

The increase in yield of spring and winter wheat in average years of research on the Binoram options compared with the control were respectively of 0.2 t/ha and 0.3 t/ha for spring barley yield increase of 0.2 t/ha. In the variants using Biosil, the yield increment was: 0.1 t / ha on winter wheat, 0.2 t / ha on spring wheat and spring barley. The yield on variants with the use of chemical means of protection (Vitasil, Vitavax 200, Sumi-8) was at or slightly lower than when using biopreparations.

The long-term dynamics of the number of pests in cereals and mustard agrocenoses has a wave-like character, where the number increases are alternating with depressions. To build the forecast taking into account a minimum or a maximum of solar activity it is very risky as the coefficient of correlation between indexes of Wolf numbers and dynamics of population of the studied species of insects was not essential.

Information about the ecology, harmfulness and population dynamics of major pests of crops and sarepta mustard in the region, revealed in full for the first time, are the basis for the development of methods of personnel management these types. The conservation and activation of natural entomophagous populations are extremely important in regulated ecosystems. They need to pay more attention, determine their significance on specific crops, control their numbers along with the dynamics of the number of harmful insects, in limiting their distribution, they can in some cases be crucial. So, for example, annually, in connection with the vigorous activity of afidofags pest extermination actions in the Volgograd region on the area from 4 to 125 thousand hectares are cancelled.

The specific structure of a pathogenic microflora on cereal crops and *Brassica juncea* (sarepta mustard) in the conditions of the Volgograd region is specified, the ecological role of activators is revealed, the most harmful species are defined as long-term dynamics of a course of pathological processes in the agrocenoses of grain crops is analyzed. It is established that the role of the main micromycetes in cereal agrocenoses is performed by leaf phytopathogens and pathogens of root rot. Quite a serious threat to cereal crops can create other illnesses, among which the progressive importance of the smut diseases. There is an increased frequency of occurrence in cereal agrocenoses Septoria – a previously rare pathogen among the weak endemics. There is also a sharp increase in the prevalence of leaf helminthosporiosis on barley.

Economic value of diseases of mustard Sarepta in the conditions of the Volgograd region is small; holding protective measures concerning them is inexpedient.

All insecticides of chemical synthesis in a varying degree exerted toxic impact on the useful biota. The quantitative accounting of entomophages in a mustard agrocenoses with preseeding processing of seeds showed that the greatest decrease in number of predatory insects and spiders in comparison with control option happened on option with furadany incrustation of seeds. A softer impact on entomocomplexes characterized the variants with application of Cruiser and also mixture compositions Cruiser + Flavobacterium. Vegetative spraying of mustard crops with the microbiological insecticide bacikol did not affect the abundance of useful entomofauna, while in chemical treatments the number of entomophages and pollinators decreased by more than 1.5-2 times compared to the untreated control. Of the preparations of chemical synthesis, the Actara insecticide possessed the least negative impact on entomophages, the Mauric – on pollinators.

Sharing of biopreparations with chemical plant protection products (insecticides, fungicides, herbicides) reduced stressful effect of chemical preparations on plants, stimulated their body height, provided protection of culture against a complex of harmful objects and adverse conditions of the environment, increased productivity and quality of production, led to increase in economic efficiency of means of protection due to decrease in consumption rates and costs of their exploitation.

An assessment of the ecological and economic efficiency of the means and methods of protection of agrocenoses showed high payback of padding expenses. It has been established that in years that are relatively favorable in phytosanitary terms, the use of mustard saffer flavobacterin in agrocenoses mustard, and in years with massive development of pests – the Actara, Fastak and tank mix of Bacikol with a Fastak. The use of a cruiser for the incrustation of mustard seeds under the current conditions of the years under study is economically less profitable than the use of vegetative treatments with the aforementioned insecticides.

Carrying out preseeding processing of seeds of grain crops against a complex of diseases the highest profitability it is noted on options with use of biological preparations as binoram and biosil. It is quite possible to use only biological ways of plant protection in the absence of smut infection in the seed material, decreased level of infection of seeds and soil with causative agents of root rot.

Conclusion

Agroforestry arrangement of the landscape, cultivation of resistant varieties, use of microbial fertilizers, natural inducers of immune system, biological insecticides and fungicides both in pure forms and in mixture compositions of chemical plant protection products, rational use of pesticides, the replacement of solid processing of local crops provides the preservation and restoration of biological diversity, enhancing the role of natural regulatory mechanisms, the decrease of pesticide pressing, contributes to the stabilization of phytosanitary situation in agrocenoses.

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References

Abbott, W. S., 1925 A method for computing the effectiveness of an insecticide. *J. Econ. Entomol.,* **18:** 265-267.

Belitskaya, M. N. and E. A. Ivantsova, 2012. The fauna in the forest agricultural landscapes entomophags of arid zone. *Herald of Volgograd State University*. *Series 11: Natural Sciences*, **2:** 50-55 (Ru).

Cherezova, L. B., 1986. Soil mesofauna and features of its distribution in the forest agricultural landscape. Main Directions of Plant Protection in the Conditions of the Lower Volga Region:

Mes. Rep. Region. Scient.-Pract. Conference, pp. 71-72 (Ru).

Ivantsova, E. A., 2006. Influence of forest strips on number and distribution of an entomofauna. Proceedings of the Lower Volga Agrouniversity Complex: Science and Higher Professional Education, Vol. 4, pp. 46-50 (Ru).

Ivantsova, E. A., 2013. Zoogeographical structure and the formation of entomofaunistic communities of the agroforestry landscapes in the steppe zone of the Lower Volga region. Proceedings of the Lower Volga Agrouniversity Complex: Science and Higher Professional Education, **1** (1): 85-90 (Ru).

Ivantsova, E. A., 2014. Agroecological value of protective forest plantings in Lower Volga area. *Herald of Volgograd State University. Series 11: Natural sciences,* **4:** 40-47 (Ru).

Kulik, K. N., 2003. The role of protective forest plantations in the formation of Russian arid zone. The age old experience of formation of forest ecosystems in agricultural landscapes of the arid zone Russia: Proceedings of the International. Scientific-Practical. Conference Dedicated to the 100th Anniversary of the Lower Volga Plant Breeding Trees, pp. 9-15 (Ru).

Onistratenko, N. V., E. A. Ivantsova, A. A. Denysov and D. A. Solodovnikov, 2016. Heavy metals in suburban ecosystems of industrial centres and ways of their reduction. *Ekológia (Bratislava),* 35 (3): 205-212. DOI:10.1515/eko-2016-0016.

Pashalidou, F. G., R. Gols, B.W. Berkhout, B.T. Weldegergis, J. J. van Loon, M. Dicke and N.E. Fatouros, 2015. To be in time: egg deposition enhances plant-mediated detection of young caterpillars by parasitoids. *Oecologia*, **177** (2): 477-486. doi: 10.1007/s00442-014-3098-0. Epub 2014 Oct 2.

Zhu, P., Z. Lu, K. Heong, G. Chen, X. Zheng, H. Xu, Y. Yang, H. I. Nicol and G. M. Gurr, 2014. Selection of nectar plants for use in ecological engineering to promote biological control of rice pests by the predatory bug, *Cyrtorhinus lividipennis*, (Heteroptera: Miridae). *PLoS One.,* **9** (9):e108669. doi: 10.1371/journal.pone.0108669. eCollection 2014.

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