С. Сейфуллин атындағы Қазақ агротехникалық университетінің **Ғылым Жаршысы// Вестник Науки** Казахского агротехнического университета имени С. Сейфуллина. - 2016. – № 1(88). - P.91-98

PEST MONITORING OF DISTRIBUTION AND HARMFULNESS OF NON-GREGARIOUS LOCUSTS ON FARMLAND IN NORTHERN KAZAKHSTAN

Baibussenov K.S.

Annotation

Scientific paper presents the results of research by pest monitoring of distribution and harmfulness of harmful non-gregarious locusts complex in the northern regions of Kazakhstan for 2013-2015. Revealed the incidence and main ecological features of these pests. In the study of the distribution of this harmful insects on the main habitats of Northern Kazakhstan, found that on oil and bean cultures their number was very low or absent at all. Whereas, on perennial grass plant communities of cultural and cereal habitats revealed significant occupancy of the studied phytophagous. According to the results of researches, this insects harmfulness becomes economically significant when their number is > 10 ind./m^2, at which there is a need for protective measures.

Key words: pest monitoring, harmful non-gregarious locusts, distribution, harmfulness, agricultural lands, Northern Kazakhstan.

Introduction

In the economic development of any country is one of the most important areas is food safety. Today, locusts are still problem polyphagous pests of plants worldwide. The fight against them has been going on for few decades [1]. They are able to ruthlessly destroy all the crops and fields, while migrating over long distances. In Kazakhstan the area is home to over 270 species and subspecies of locusts and grasshoppers insects. Among them periodically, heavy damage to agricultural lands caused only 15-20 species [2].

From gregarious migratory locusts in the Northern regions of Kazakhstan is widely distributed *Calliptamus italicus* (L.). This poses a particular threat to agriculture during mass reproduction [3]. Along with gregarious species of locusts, in the territory of the Republic no small importance non-gregarious locusts. The most common types include: *Dociostaurus kraussi* (Ingen.), *Dociostaurus brevicollis* (Ev.), *Aeropus sibiricus* (L.), *Pararcyptera microptera* (F.d.W.), *Chorthippus albomarginatus* (Deg.) and *Stauroderus scalaris* (F.W.), *Stenobothrus fischeri* (Ev.) [4]. If gregarious locust substantial long-distance migrations and invasions from one territory to another, non-gregarious species are permanent inhabitants of the steppe and cultural

habitats. Depending on the cyclicality and weather conditions they are also characterized by massive outbreaks of the population [5].

Locusts, as a kind of phytophagous species, pose many problems. One of the most significant is related to the frequency of their mass reproduction in space and in time. In such circumstances, sometimes very difficult to maintain continuously functioning locusts control [6,7]. To avoid appreciable losses, polyphagous pests, including harmful locusts, always should be under special phytosanitary control [8]. Practice locust control in the countries of the CIS, and abroad shows that in the vast majority of cases, once the flash subsided, the interest in this problem is lost, as funding is reduced [9].

The purpose of the research is the phytosanitary monitoring of harmful non-gregarious locusts, aimed at the study of populations of harmful and economically important species of this phytophagous to identify prevalence, dominance and severity in natural and cultural phytocenoses of the Northern Kazakhstan.

Materials and methods of research

This work was done at the period of PhD study in 2013-2015 under the guidance of academic advisors D. B/S., Professor, academician V. K. Azhbenow, D. A/S., academician A. T. Sarbayev (Kazakhstan) and PhD, Professor V. B. Harizanova (Bulgaria).

Methods of research and analysis are generally accepted in entomology, plant protection and pest monitoring [10-12]. Materials research - our results in the period of the survey agricultural land in the regions of Northern Kazakhstan. To determine the density of harmful non-gregarious locusts in different habitats, daily and seasonal dynamics of the populations and their damage to agricultural land were applied the following methods of accounting:

1 - Mowing 100 single (or dual 50) of sweeps of the entomological net in three or four replicates [10-11];

2 - Visual counting of the insects in sight - the absolute number of grasshoppers in mixed populations per unit area (1 m^2) is determined by the method of transects. Transects with a length of 10 meters to 20 fold repetition [11-12];

3 - The method of GPS-technologies for pest monitoring for accurate detection and identification coordinates (northern latitude; eastern longitude) foci of pests with high accuracy (deviation of 10-12 m) [13];

3 - The harmfulness of grasshoppers was determined according to the method, by comparing the yield on populated and unpopulated areas. The experiment was conducted in accordance with the methods of V. E. Kambulin and G. S. Bugaev [14-15]. Mathematical research processing was carried out according to methods in experimental and plant protection [16].

Results and discussion

In 2013-2015 route surveys conducted on the sample plots of agricultural land in Tselinograd, Burabay and Shortandy districts of Akmola region, Bayanaul, Kashyr of Pavlodar region, Altynsarin, Karabalyk districts of Kostanay

region, Kyzylzhar, Taiynsha districts of the North Kazakhstan region. The results of these surveys were refined and established harmful species of non-gregarious locusts, their frequency of occurrence and dominance in the areas of Northern Kazakhstan.

In this region among non-gregarious locusts, the most harmful and economically important for the agricultural sector we have 9 basic species. For these species developed all of our further research. All these species were found in the community or complex types.

As can be seen from table 1, in the areas of Northern Kazakhstan in 2013-2015. according to the results of pest monitoring met 9 species of harmful non-gregarious locusts. According to the literature and conducted investigations table 1 describes the main harmful species composition of grasshoppers and their habitat ecology.

Table 1 – Environmental features and the distribution of harmful non-gregarious locusts species in Northern Kazakhstan (average for 2013-2015)

Species of the harmful non-gregarious locusts	Confinement of the species to natural areas	Life forms of species	The distribution by regions			
			Pavlodar	Akmola	Kostanay	Noth Kazakhstan
Stenobothrus fischeri (Ev.)	Steppe	Cereal chortobionts	+++	++++	++++	+++
Aeropus sibiricus (L.)	Polyzonal, mountain-steppe	Optional chortobionts	+++	+	+	+
Dociostaurus kraussi (Ingen.)	Polyzonal, steppe	Cereal chortobionts	+++	+++	++	-
Dociostaurus brevicollis (Ev.)	Steppe	Cereal chortobionts	++++	++++	++++	+++
Oedaleus decorus (Germ.)	Mountain-steppe	Protective geophyles	++	++	+	+
Chorthippus albomarginatus (Deg.)	Forest-steppe and steppe	Cereal chortobionts	++++	++++	++++	++++
Podisma pedestris (L.)	Forest-steppe	Herbal chortobionts	+++	+++	++	+
Pararcyptera microptera (F.-W.)	Polyzonal, steppe	Cereal chortobionts	++++	++++	+++	++
Stauroderus scalaris (F.-W.)	Mountain-steppe	Protective geophyles	++	++	-	+
Note - + - a single encounter; ++ - do not see many; + + + moderately meet; ++++ - common view						

On life forms of these species the dominant position was occupied by cereal chortobiont: *Stenobothrus fischeri* (EV.), *Pararcyptera microptera* (F.-W.), *Dociostaurus kraussi* (Ingen.), *Dociostaurus brevicollis* (Ev.), Chorthippus albomarginatus (Deg.) There was also

an optional chortobiont - *Aeropus sibiricus sibiricus* (L.), herbal chortobiont - *Podisma pedestris* (L.) and the protective geophyles - *Stauroderus scalaris* (F.-W.), *Oedaleus decorus* (Germ.). All species are quite commonly distributed in areas of Northern Kazakhstan. Particularly common species include *Pararcyptera microptera* (F.-W.), *Dociostaurus brevicollis* (Ev.), *Podisma pedestris* (L.) – they met on all habitats, fallow lands, pastures and hayfields. The remaining species were found in lesser degree.

Due to the fact that cultural fields are not target habitats of locusts, as fixed plots were selected natural habitats (pasture phytocenoses) of this phytophages. In the survey of selected parcels used GPS navigation brand GARMIN series eTrex 30. It enables to keep a strict account and control of all surveys, set foci of pests with high accuracy, to determine the effectiveness of protective measures because it is based on accurate knowledge [13, p. 14].

In the areas of research carried out observations on species composition and their dominance index. The dominant forms are the species that made up more than 16%, and subdominant - from 4 to 16% of the total number of collected species [17]. According to the results presented in figure -1, the dominant species were classified as *Dociostaurus brevicollis* (Ev.), *Pararcyptera microptera* (F. d.W.), *Podisma pedestris* (L.), and subdominant species are *Stenobothrus fischeri* (Ev.), *Aeropus sibiricus* (L.), *Dociostaurus kraussi* (Ingen.), *Oedaleus decorus* (Germ.) and *Chorthippus albomarginatus* (Deg.).

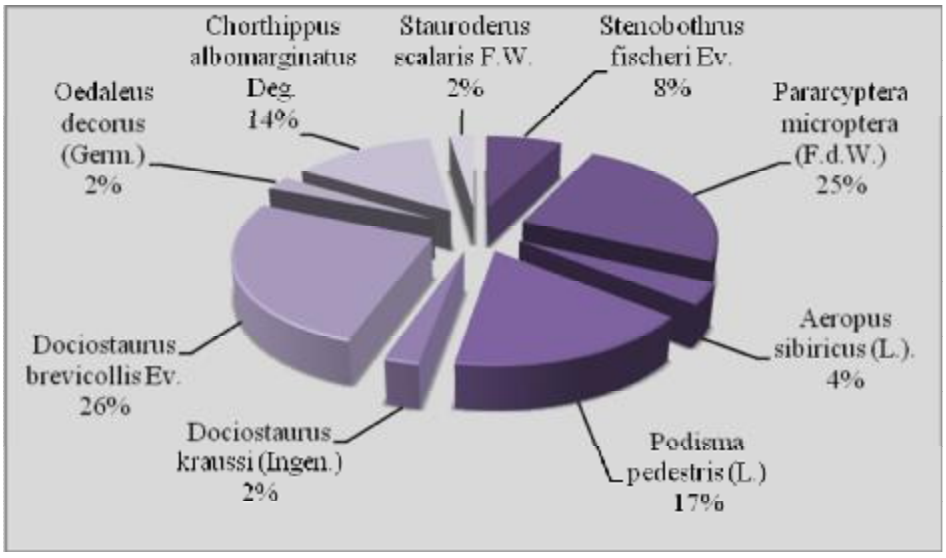

Figure 1 - Ratio between harmful non-gregarious locusts species in Northern Kazakhstan, (average for 2013-2015)

Route surveys of various habitats were carried out by the bands with the distance between 100-300 m, mowing entomological net. Were identified some characteristics of their spatial distribution. The population density of non-

gregarious locusts per 1 m^2 in different habitats of Northern areas of Kazakhstan is subject to variation. Thus, in the study years was an increase in their numbers. They were distributed mainly on cereal plots (to 22.5 ind./m^2). Whereas, oil and bean cultures, their number was very low (0-3 ind./m^2) or even absent (table 2).

Table 2 - Habitat areas prevalence of harmful non-gregarious locusts complex in Northern Kazakhstan (average for 2013-2015)

Agrocenosis, habitat areas	Population density per m^2 (range variations) by regions							
	Akmola region		Pavlodar region		Kostanay region		Petropavl region	
Perennial grasses association	10-22	16.0	15-30	22.5	12-20	16.0	8-15	11.5
Perennial grasses–sagebrush association	10-20	15.0	15-25	20.0	12-18	15.0	8-12	9.0
Triticum aestivum (L.)	8-10	9.0	12-15	13.5	10-15	12.5	6-10	8.0
Triticum durum (L.)	5-7	6.0	10-12	11.0	8-10	9.0	4-8	6.0
Hordeum sativum (L.)	8-12	10.0	12-15	13.5	9-15	12.0	6-10	8.0
Avena sativa (L.)	6-15	10.5	10-20	15.0	8-16	12.0	5-10	7.5
Onobryhis viciafolia (Z.)	2-4	3.0	2-5	3.5	2-5	3.5	0-1	0.5
Medicago sativa (L.)	0-2	1.0	0.5-2	1.2	0.0	0.0	0.0	0.0
Galega orientalis (L.)	0.0	0.0	0-2	1.0	0.0	0.0	0.0	0.0
Brassica napus (L.)	0-2	1.0	0-3	1.5	0.0	0.0	0.0	0.0
Linum usitatissimum (L.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lens culinaris (L.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pisum sativum (L.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Helianthus annus (L.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phleum (L.)	5-7	6.0	10-12	11.0	8-10	9.0	4-8	6.0
Sorghum drummondii (L.)	6-15	10.5	10-20	15.0	8-16	12.0	5-10	7.5

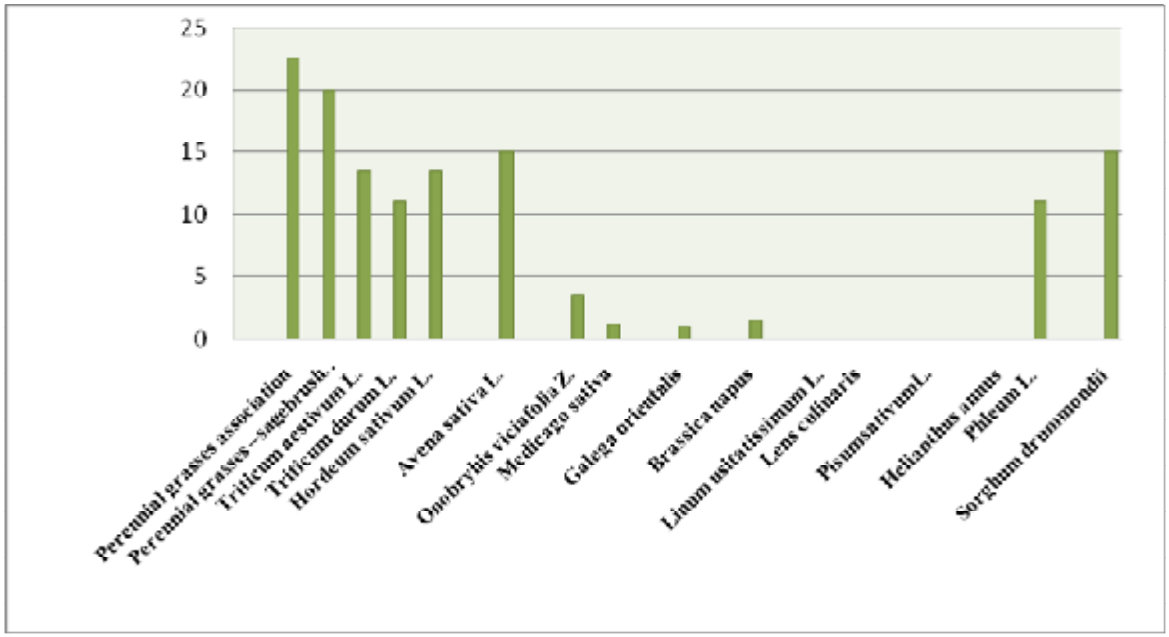

Figure 2 - Average density of the complex of harmful grasshoppers locust (vertical) in different habitats (horizontal) on average in Northern Kazakhstan (average for 2013-2015)

Basically, they occupied the station of perennial grasses, less frequently - cereals crops (figure 2). Only when the shortage or deterioration of the sward in grass habitats can migrate to crops other agricultural crops.

Meanwhile, in the vegetation period of 2013 in Northern Kazakhstan, the amount of precipitation by 15-20% above the norm, a growing season of 2014 and 2015 rather dropped out of the drier. In this regard, the state of pastures, hayfields and sales improved, which created favorable conditions for phytophagous species feeding on plants grass habitats.

The harmfulness of non-gregarious locusts was determined according to the method, by comparing the yield on populated and unpopulated areas. Bookmark field experiments and mathematical processing of experimental work was made according to the standard technique in a pilot case. As model objects were collected two types: *Pararcyptera microptera* (F.-W.) and *Dociostaurus brevicollis* (Ev.). In Northern Kazakhstan these species are ubiquitous and have economic value when mass reproduction.

On pastures and grasslands in Shortandy district of Akmola region were set cages the size of 100x100x70 sm. The vegetation of the area is represented mainly by grass-feather-grass association. Thus, in cages hooked locust's larvae in the data 0,5,8,10,15 number of instances starting from the first age.

The number of insects in nurseries was maintained by the release of the missing individuals every 5 days. At the onset of the ripening phase of the background plants produced account of the yield of herbage. At the end of the experience the plants in cages had a sidelong look, dried and weighed. The amount of feed consumed was determined by weight difference between control and experimental samples with the translation on the indices of dry matter (table 4).

Table 3 – Harmfulness of *Dociostaurus brevicollis* (Ev.) and *Pararcyptera microptera* (F.-W.) depending on crop yield for pasture biotopes (Akmola region, Shortandy district, on average for 2013-2015)

The density of larvae, ind./m^2	The yield of pasture biotope		Decrease in the yield of the pasture habitat in comparison with the Control	
	g/m^2	c/ha	c/ha	%
5	433,5	43,3	- 2,3	5,0
8	391,5	39,1	- 6,5	14,3
10	383,0	38,3	- 7,6	16,1
15	326,0	32,6	- 13,0	28,6
Control (without locusts)	456,7	45,6	-	-

$LSD_{0,5}$	1,3 c/ha
M%	1,1 %

In the years of the research, the density of non-gregarious locusts larvae largely exceeded the economic threshold. According to our revised data at 5, 8, 10, 15 ind./m^2 they can cause damage to yields from 5.0 to 41.1% (table 3). Minor loss of productivity occurs only when the number of locusts are $\leq$ 5 ind./m^2. In other cases, the loss of yield is quite high. So, at < 10 ind./m^2 yield reduction is 14.3-16.1 %. When number of individuals > 10 ind./m^2, the yield loss reaches up to 28.6-41.1 %. Thus, it is established that the number of non-gregarious locusts > 10 ind./m^2, their harmfulness increases and becomes economically significant. All yields of the experiences statistically processed and the results of analysis of variance.

The use of plant protection products can be recommended only in those situations when there is a phytosanitary risk and the threat of tangible economic loss of the crop and there is no danger of environmental pollution by pesticides. The important point is the development of economic thresholds of harmfulness and the appropriateness of the use of pesticides, i.e. phytosanitary standards.

The results of studies on the harmfulness serve as the basis to determine the economic importance of the harmful species, establishing the risk level that affects food security. According to phytosanitary regulations, the established economic threshold (ET) for harmful grasshoppers in the Republic of Kazakhstan is 8-10 ind./m^2. But in our opinion, this approach relies on very exact data, what in the biology of insects to provide, or not always possible to identify. According to the results of our research, we propose to introduce the model phytosanitary standard as follows:

1) > 10 ind./m^2 – the number of pests exceed economic threshold and chemical treatment appropriate;

2) < 10 ind./m^2 – the number of pests does not exceed the economic threshold and chemical treatment is not feasible.

Acceptance of this offer phytosanitary standard gives the opportunity to reduce the planned volumes of chemical treatments by 15-20%, which allows improving the overall ecological situation of the environment and the status of non-target objects.

Conclusion

According results of pest monitoring in Northern Kazakhstan areas for 2013-2015 met 9 dominant species of harmful non-gregarious locusts. All species are quite commonly distributed in areas of Northern Kazakhstan. Particularly common species include *Pararcyptera microptera* (F.-W.), *Dociostaurus brevicollis* (EV.), *Podisma pedestris* (L.) – they met on all cereal plots, fallow lands and pastures. The remaining species were found in lesser degree. In studying the dissemination of phytophages on

various natural and cultural habitats, revealed that the population density of this harmful grasshoppers per 1 m^2 in different habitats of Northern areas of Kazakhstan is subject to variation. In oilseeds and legumes, their number was very low or absent. Basically, they inhabited habitats of perennial grasses, less frequently - cereals crops. Severity data phytophagous becomes economically significant when number > 10 ind./m^2. The target is invited to take over the permissible threshold of number of harmful non-gregarious locusts, causing loss of productivity culture in which it is necessary to conduct phytosanitary measures of protection agricultural lands.

References

1. Abduvaliev R. A., Baibolov E. A. Development of the system of training farmers in Thailand // Materials of the seminar "Testing and implementation international experience: possibilities and prospects". – Astana, 2009. - P. 5-7.

2. Нурмуратов Т.Н., Ажбенов В.К., Камбулин В.Е., Чильдебаев М., Комиссарова И.А., Жумагалиева Г. Саранчовые вредители сельскохозяйственных растений Казахстана и рекомендации по ограничению их численности. - Алматы: «Asia Publishing», 2000. -56 с.

3. Azhbenov V.K. Analysis and Forecast of Kazakhstan farmland phytosanitary on locust pests // Materials of the International Round Table "Problems of management with locusts in Central Asia" - Almaty, 2001. - P. 25-26.

4. Акмолаева А.С. Нестадные саранчовые Северного Казахстана (фауна, экология, вредоносность) и совершенствование мер борьбы с ними: автореф. ... канд. с./х. наук: 06.01.11. – Алматы, 2005. – 23 с.

5. Baibussenov K.S. Long-term analysis of harmful grasshoppers population dynamics – shaping factor of forecasting their abundance // News of the National Academy of Science of the Republic of Kazakhstan. Series of agricultural science. – Flmaty, 2015. – Vol. 5. Iss. 29. – P. 5-10.

6. Azhbenov V.K., Kostyuchenkov etc. Technological innovation and novercraft for phitosanitary monitoring of dangerous pests in remote areas // Science Review of Kazakh Agro Technical University named after S.Seifullin. - 2012. - P. 3-11.

7. Azhbenov V.K., Baybussenov K.S., Sarbaev A.T., Harizanova V.B. Preventive approach of phytosanitary control of locust pests in Kazakhstan and adjacent areas. IICBE Int'l Conference Proceedings of International Conference on Agricultural, Ecological and Medical Sciences (AEMS-2015), Penang (Malaysia), pp. 33-37.

8. Baibussenov K.S., Sarbaev A.T., Azhbenov V.K., Harizanova V.B. Environmental features of population dynamics of hazard nongregarious locusts in northern Kazakhstan. Life Science Journal, New York, 2014; 11 (10s), pp. 277-281.

9. Baibussenov K.S., Sarbaev A.T., Azhbenov V.K., Harizanova V.B. Predicting the phase state of the abundance dynamics of harmful non-gregarious locusts in Northern Kazakhstan and substantiation of protective measures // Biosciences Biotechnology Research Asia - 2015. - Vol. 12. - Iss 2. - P. 1535-1543.

10. Дубровин В.В., Теняева О.Л., Крицкая В.П. Методы фитосанитарного мониторинга в защите растений от вредных организмов. – Саратов, 2011. – 230 с.

11. Сагитов А.О., Ажбенов В.К. (под ред.). Методические указания по учету и выявлению особо опасных вредителей и болезней сельскохозяйственных угодий. - Алматы: Бастау, 2003. - 3 с.

12. Сулейменов С.И., Абдрахманов М.А., Сулейменова З.Ш., Камбулин В.Е. и др. Методические указания по учету и выявлению вредных и особо опасных вредных организмов сельскохозяйственных угодий. – Астана, 2009. – 312 с.

13. Камбулин В.Е., Бугаев К.С. Методы оценки численности вредоносности саранчовых на сенокосах и пастбищах // Защита зерновых культур от вредителей и сорняков в Северном Казахстане. – Алма-Ата, 1982. - С. 90-96.

14. Камбулин В.Е. К методике определения вредоносности саранчовых на сенокосах и пастбищах // Вестник сельскохозяйственной науки. - 1975. - №2. - С.40-41.

15. Пересыпкин В. Ф., Коваленко С. Н., Шелестова В. С., Асатур М. К. Практикум по методике опытного дела в защите растений. – М.: Агропромиздат, 1989. – 175 с.

16. Ажбенов. В.К. Руководство для выполнения мониторинговых работ по итальянской саранче с использованием GPS-технологий. - Астана, 2013.– 41с.

17. Правдин Ф.Н. Экологическая география насекомых Средней Азии. – М: Наука, 1978. – 271 с.

Түйін

Мақалада Солтүстік Қазақстанның ауыл шаруашылық алқаптарында зиянды саяқ шегірткелер бойынша 2013-2015 жж. өткізілген фитосанитарлық мониторингі жайында талдау жүргізіледі. Бұл фитофагтардың анықталған барлық 9 түрі де Солтүстік Қазақстанның облыстарында кең таралған. Аса жиі кездесетін зиянды түрлеріне ***Pararcyptera microptera*** (F.-W.), ***Dociostaurus brevicollis*** (Ev.), ***Podisma pedestris*** (L.) жатады және олар барлық астық тұқымдас стацияларда, себу айналымынан шыққан бос алқаптарда және жайылымдарда кездескен. Мәліметтер көрсеткендей, майлы және бұршақ тұқымдас дақылдар егістіктерінде қарастырылған жәндіктердің саны өте төмен болған немесе мүлдем кездеспеген. Олар негізінен көп жылдық астық тұқымдас стацияларды мекендеп, астық тұқымдас масақты дақылдар егістіктерінде салыстырмалы түрде аздау кездесті. Зерттеулердің мәліметі

бойынша, бұл фитофагтардың зияндылығы олардың сандылығы > 10 экз/м^2 болғанда ғана экономикалық тұрғыдан маңызды болады. Бұл жағдайда зиянды саяқ шегірткелердің кешеніне қарсы фитосанитарлық шараларды қолдануға ұсынылады.

Резюме

В статье обсуждаются результаты исследований по фитосанитарному мониторингу комплекса вредных нестадных саранчовых на сельскохозяйственных угодьях Северного Казахстана за 2013-2015 гг. Все выявленных 9 видов данных фитофагов довольно часто распространены в областях Северного Казахстана. К особо часто встречаемым видам относятся *Pararcyptera microptera* (F.-W.), *Dociostaurus brevicollis* (Ev.), *Podisma pedestris* (L.) – они встречались на всех злаковых стациях, залежах и пастбищах. Установлено, что на масличных и бобовых культурах численность рассматриваемых насекомых была очень низка или отсутствовала. В основном, они заселяли стации многолетних злаковых, реже - посевы зерновых колосовых культур. Исследования показали, что вредоносность данных вредителей становится экономически значимой при их численности > 10 экз/м^2. В данном случае рекомендуется применять фитосанитарные меры по борьбе с комплексом вредных нестадных саранчовых.

Summary

Scientific paper discusses the results of research on pest monitoring of harmful non-gregarious locusts complex on agricultural lands of Northen Kazakhstan for 2013-2015. All identified 9 species of phytophagous often common in areas of Northern Kazakhstan. Particularly common species include *Pararcyptera microptera* (F.-W.), *Dociostaurus brevicollis* (EV.), *Podisma pedestris* (L.) – they met on all cereal plots, fallow lands and pastures. It is established that on oil and bean cultures the number of insects was very low or absent. Basically, they inhabited habitats of perennial grasses, less frequently - cereals crops. Studies have shown that the harmfulness of this rests becomes economically significant when their numbers are > 10 ind./m^2. In this case it is recommended to apply phytosanitary measures against harmful non-gregarious locusts complex.