

RISK ASSESSMENT OF OUTBREAK OF RODENTS AS MAIN PESTS OF AGRICULTURAL CROPS IN BULGARIA IN 2009

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Abstract: The need of chemical pest control is discussed based on assessment of the common vole numbers carried out in rapeseed and autumn cereals fields in the regions of Razgrad, Plevan and Bourgas. Common vole was chosen as a model species to assess the risk of agricultural pests' outbreak in Bulgaria in 2009 and the need of chemical control. In autumn, under climatic conditions typical for the studied regions, voles' reproductive period comes to an end and their numbers reaches maximum value. The analysis of the autumn numbers of the common vole showed possible voles' outbreak in 2009 in the Central part of Danube plain, in Loudogorie, Dobroudzha, the South-Eastern parts of the country and the fields of Western Bulgaria. It is pointed that: (i) the real assessment of the risk of development of voles' populations under particular ecological conditions and agrotechnologies applied in different agricultural regions enables the balanced approach of chemical control using rodenticides without excessive environmental changes; (ii) in all cases of chemical pest control, relevant chemicals should be applied only in amounts corresponding to the degree of anthropogenic transformation of the treated lands.

ОЦЕНКА НА РИСКА ОТ МАСОВО НАМНОЖАВАНЕ НА ГРИЗАЧИ - ОСНОВНИ ВРЕДИТЕЛИ ПО СЕЛСКОСТОПАНСКИТЕ КУЛТУРИ В БЪЛГАРИЯ ПРЕЗ 2009 г.

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Резюме: На основата на анализ на данните от проведеното обследване на агроecosистеми и оценка размера на популационното развитие на обикновената полевка в посеви от рапица и есенни житни в районите на Разград, Плевен и Бургас се дискутира необходимостта от провеждане на химическа борба с тях. С оглед оценка на риска от масово размножаване през 2009 г. на гризачи - вредители по селскостопанските култури в България и необходимостта от провеждане на химическа борба с тях, като моделен обект е избрана обикновената полевка. Подложените на анализ есенни отчитания на числеността на полевката, тогава когато при характерните за изследваните региони климатични условия, полевките завършват своя размножителен период и тяхната численост достига своята максимална стойност за годишния цикъл на своето развитие показват че за 2009 г. се очертава развитие на масово размножаване на полевката в Централната част на Дунавската равнина, Лудогорието, Добруджа, Югоизточните части на страната и Полетата в Западна България. Постулира се, че: (i) реално оцененият риск от развитието на нейните популации при конкретните екологични условия и прилагани селскостопански техники, в различните агрорегиони създава възможност за балансиран подход при провеждането на химическата борба с родентициди, който да съхрани реколтата, но и да не предизвиква прекомерни промени в природната среда; (ii) във всички случаи при провеждането на химическата борба с «вредителите», химичните вещества следва да се използват само в размери съответстващи на това в каква степен е преобразувана от човека, обработваната с тях територия.

Introduction

Nowadays it is beyond doubt that the only way to reduce damages caused by small mammals to the crops and to save a significant part of these crops is numbers control of particular rodent populations. Harmful impact of some rodent species on people's life have been confirmed by the investigations of the World Health Organization pointing that the damages caused by these pests reached up 33 million tones annually, an amount of food enough for 130 million of people [1].

Damages caused by pest rodents have necessitated the development of a system for control of particular species. Special government programs for control of pest rodents have been put in action in many countries; at the same time the methods for pest control become more and more refined all over the world. Chemical industry provides practically unlimited amounts of synthetic substances at relatively low pieces; thereby, it is possible to limit the pest numbers in agricultural ecosystems to admissible margins. Dozens of modern highly toxic rodenticides have been allowed and put into practice for this purpose all over the world; the modern equipment used for application of rodenticides' allows treating billions of hectares of agricultural lands.

Chemical pest control is based on the misconception that this is the only way to save the crops and although applied in high dosages, the used substances are harmless; thus, a real opportunity of misuse is revealed. This negative trend is particularly strong when people are determined to provide their subsistence by all means, and excessive use of rodenticides inevitably breaks the balance in nature.

About 30-40 years ago the widespread use of chemical substances in agricultural ecosystems caused unintentional extermination of harmless and even useful animals and strongly distorted the ecological balance in natural and transformed landscapes. Unreasonable use of strong poisons over large areas, both cultivated and untouched with reserved natural balance, endangers seriously not only the nature, but the man too. Therefore, taking the point of view of nature protection, a reasonable question could be brought up: if the applied methods of control of particular groups of organisms inevitably cause damages on the biological diversity, should the modern society use them at all? Although artificially created, the agricultural ecosystems provide favorable conditions for massive reproduction of "pest" animals; and the other point of view, supported widely by farmers, asserts that pest control could be successful only if carried out by artificial means as well. So, we would hardly leave chemical pest control in the nearest future.

Thus, it becomes indispensable to work out a compromise between the control of numbers of particular "pest" species in agricultural ecosystems, preservation of biggest part of the food resources of mankind and conservation of biological diversity of nature. The system for extermination of particular pest species should be improved in a way diminishing the contradiction between extermination and decrease of biological diversity. Therefore, reliable data about actual and/or expected outbreak of rodents as main agricultural pests are needed to carry out chemical pest control in agricultural ecosystems with aims and scale commensurate to the expected results.

The main agricultural areas in Bulgaria are periodically invaded by pest rodents in high numbers. These are the grey voles *Microtus arvalis* and *Microtus levis*. Because of their high reproductive potential, voles become agricultural pests in huge numbers. During the short periods of depression of vole's numbers these areas are dominated by the wood mice *Apodemus flavicollis* and *Apodemus sylvaticus* together with the wild species of the house mouse: steppe mouse *Mus spicilegus* Petenyi in North Bulgaria and Balkan short-tailed mouse *Mus macedonicus* Petrov & Ruzic in South Bulgaria. The two voles' species are morphologically sibling species and it is impossible to differentiate between them under field conditions; moreover, in many regions of the country they occur sympatrically in agricultural areas. Because of relatively equalized harmful impact of the two voles' species the numbers of these pests should be assessed as a generalized total of the numbers of the two species in studied areas. Differentiation between the two wood mice species in the regions of their sympatric occurrence is also difficult because their exterior characteristics vary widely and even overlap. At the same time, their harmful impact is also relatively equalized and allows again expressing their numbers as a generalized total of the numbers of wood mice. Therefore, the grey voles, the wood mice and wild species of the house mouse represent the main pests when numbers control should be carried out, risk of outbreak in numbers of pest rodents should be assessed and the course of their propagation should be traced.

As a model species in assessment of the risk of pest rodents' outbreak in 2009 in Bulgaria and estimation of necessity of chemical control, the common vole was chosen. The common vole is the most abundant agricultural pest species among the small rodents inhabiting Bulgaria. It is a typical steppe inhabitant, bound up with open plains and especially with agricultural areas. The common vole had permanently changed its original habitats – natural riverside meadows surrounded in the past with vast woodlands and steppes – for anthropogenically created ecosystems providing much more food. Being polygamous, with post-natal estrus and well-expressed capability of females to feed numerous

offspring, this species is adapted to intensive reproduction and possesses high reproductive potential – in average 5-6 cubs per litter. Such high reproductive potential combined with voles' capability to breed monthly all over the year, makes them a risk factor in agriculture and subject to people's attention because of expected possible damages. Obtaining a real risk assessment of development of voles' populations under specific ecological conditions and applied agrotechnologies in different agricultural regions would afford the opportunity to work out a balanced approach in application of rodenticides in chemical pest control, which would keep the crops without excessive environmental changes.

Both climate and factors determining it vary widely over large territories; as larger the areas, more inaccurate become the averaged characteristics. At the same time, because of diverse relief, soils, micro-climatic features, vegetation, type and quality of applied agrotechnologies, living conditions for pest rodents are heterogeneous and shift asynchronously over the territory of the country. In different regions, in the same year, there could be different combinations of ecological conditions influencing voles' ability to breed and survive. For that reason, the integral analysis of numbers dynamics of voles should include typical and compact region, as regards climatic conditions, structure and composition of main agricultural ecosystems inhabited by voles.

The present report aimed to analyze the data obtained during the examination of population development of common vole in rapeseed and autumn cereals fields in the regions of Razgrad, Pleven and Bourgas, carried out together with the local Regional Plant Protection Offices in order to assess the risk of pest rodents outbreak in 2009 as well as the necessity of chemical pest control.

Materials and Methods

The density of voles in invaded rapeseed and autumn cereals fields characterized vole populations in each studied operational unit. According to the number of colonies found in the studied fields, vole's population density was divided into following groups: a) single colonies; b) 10–20 colonies per ha; c) 20–50 colonies per ha; d) 50–80 colonies per ha; e) over 80 colonies per ha. The analysis included autumn observations carried out in October, when voles' reproductive cycle came to an end under typical climatic conditions of the studied regions and their numbers reached annual peak.

Results and Discussion

Voies' population density in rapeseed and autumn cereals fields in autumn of 2009 established as number of colonies per hectare as well as year observations on local climatic conditions allowed drawing following inferences.

Significant increase of voles' numbers was observed in stubbles, reaped sunflower and maize fields, and roadside strips in agricultural regions of Razgrad, Pleven and Bourgas districts. The available information allowed suggesting that a similar process – increase in voles' numbers during the studied period – took place in agricultural regions of Montana, Vratsa, Rousse, Dobrich and Varna. The density in autumn cereals was also high – 40 to 80 colonies per ha.

Rapeseed is very vulnerable to voles' attack, especially in the initial vegetation stages, when the plants are still small and voles gnaw them through. A single vole could destroy 1–3 m² daily depending on the sowing density. The damages significantly decrease as the plants grow up and accumulate foliage, as voles feed on separate leaves instead of eating the whole plant. These biological features of cultivated plants together with the biological features of the "pest" species itself necessitate immediate voles control; crops, sowed later and germinating in the middle of October – beginning of November should be treated as well as ones with 3–4 small leaves and 2–4 cm high.

According to general criteria for assessment of cyclic nature of voles' population development [2]; [3], established density in colonies per hectare and relationship between common vole numbers and climatic characteristics in Bulgaria [4] unambiguously suggested that the common vole responded to the favorable climatic and trophic conditions during the second half of summer and in autumn by large-scale reproduction and increase of population numbers. Forecasts for the near future suggested as favorable climatic conditions for voles as they were during the study; and it is quite possible to expect an extended reproductive period implying increase in numbers and damages caused to crops. An outbreak of voles is likely to take place in the central part of Danube plain, in Loudogorie, Dobroudzha, and South-Eastern parts of the country as well as in the fields of Western Bulgaria.

Common vole is a species experiencing very unstable, moreover, cyclic changes in numbers, so the complex investigation of both biotic and abiotic factors impact on voles' numbers is of great importance for successful rational regulation of species numbers in agricultural ecosystems. The obtained results could help in working out a scientifically well-grounded strategy for forecasts and regulation of numbers of these agricultural pests, both under standard climatic conditions and in case

of extreme changes in ecological conditions of agricultural ecosystems. In order to assess the risk of pest rodents outbreaks, to create a basis for adequate reaction in case of possible future voles' outbreaks in Bulgarian agricultural ecosystems, and to carry out voles' control commensurate to danger of losses of agricultural production, considering different degree of harmfulness and different course of numbers dynamics in some regions of the country, National Agency for Plant Protection should organize:

1. Stations for permanent specialized observation of voles' populations in Regional Offices for Plant Protection in Vratsa, (Montana), Pleven, Rousse, (Razgrad), Dobrich, Sofia (Pernik), Stara Zagora (Sliven).
2. The rest regional offices should carry out standard minimum spring and autumn observations. In case of danger, control should become more frequent and intensified.
3. It is mandatory to carry out voles' control based on integral approach and mainly on autumn populations.

In all cases of chemical pest control the relevant chemicals should be applied only in amounts corresponding to the degree of anthropogenic transformation of treated lands.

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