

Protection of Beef Cattle from Gnats and Gadflies in the South of the Tyumen Region

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ABSTRACT

One of the urgent tasks for the successful development of animal husbandry in Russia is to eliminate the harm caused by blood-sucking Dipteran hematophagous insects that carry pathogens causing several dangerous diseases for humans and animals and to develop comprehensive measures to protect animals from them.

The article presents long-term observations on the establishment of the summer dates of blood-sucking Dipterans commonly referred to as "gnats" (horseflies, mosquitoes, midges, biting midges) and gadflies in the south of the Tyumen region. For each natural and climatic zone of the region, the authors identified the periods of mass flight of these insects, during which it is necessary to carry out measures to protect cattle. For subzones of the southern taiga and small-leaved aspen and birch forests, such protective measures should be organized from the last days of May to the end of August, and in the forest-steppe zone from the beginning of June to the end of the first five days of September.

Keywords: Beef cattle, Gadflies, Blood-sucking dipterans, Mass flight, Protective measures.

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INTRODUCTION

One of the main components of the agro-industrial complex of the Russian Federation is beef cattle breeding. In the Tyumen region, despite the difficult climatic conditions, agriculture is successfully developing, including cattle breeding. The Tyumen region has been engaged in the development of beef cattle breeding since 2002. Based on the experience of beef cattle breeding in Russia and abroad, a regional program for the development of beef cattle breeding was developed, where the main task was to develop beef cattle breeding and increase beef production to meet the needs of processing enterprises and increase the sale of purebred meat animals within the region and beyond. The development of beef cattle breeding

in Russia allows creating conditions for sustainable development of rural areas, fulfilling the task of providing the population with high-quality beef, the achievement of which will ensure food security, and also increase the competitiveness of the Russian economy and the welfare of citizens. In the Tyumen region, the livestock of specialized beef cattle has grown by 5.8% over the past three years, and in 2018 it amounted to 14,032 heads. Currently, the beef cattle breeding industry in the Tyumen region continues its active development. On the territory of the Tyumen region, 50 economic entities are engaged in breeding cattle of specialized beef breeds, where 10 are legal entities and 40 are individual entrepreneurs and private farm enterprises [1].

The development of beef cattle breeding largely depends on preserving the livestock and

increasing productivity by eliminating the harm caused by parasitic arthropods, in particular the insects commonly referred to as "gnats" and gadflies.

On the territory of the Tyumen region, blood-sucking Dipterans (gnats) are one of the most significant reasons for the shortage of livestock products in the summer grazing period. It is generally accepted that during the mass summer of the midge, the weight gain of young animals decreases by 25-40% [2, 3].

The harmful effects of blood-sucking Dipteran insects on the animals' bodies include blood loss, intoxication with saliva introduced during bloodsucking, subsequent inflammatory processes at the bite sites, accompanied by a deterioration in the general condition, as well as a decrease in resistance. A massive attack of midges can lead to severe intoxication called simuliidotoxicosis, often resulting in the death of animals. Blood-sucking Dipterans are carriers of several infectious and invasive diseases in humans and animals [4-9].

Mosquitoes carry about 50 different infectious (bacterial, viral, and parasitic) diseases. Mosquito-borne malaria, encephalitis, dengue, and yellow fever claim millions of lives each year [10].

Many species of horseflies are carriers of the pathogens that cause anthrax, tularemia, leptospirosis; anaplasmosis, horse infectious anemia, reindeer necrobacteriosis, cattle besnoitidosis, setariosis, emphysematous carbuncle, poliomyelitis, trypanosomiasis (*Su-auru*), hemosporidiosis, etc. [11].

Midges are mechanical carriers of the causative agent of tularemia, anaplasmosis, onchocerciasis in cattle, anthrax, glanders, leprosy, and plague [12].

Some Russian and foreign researchers have proven the participation of blood-sucking biting midges in the transfer of pathogens of bluetongue, tularemia, onchocerciasis, bird heposporidiosis, and other diseases [13].

Hypodermatitis caused by subcutaneous gadflies (*H. bovis* and *H. lineatum*) also causes significant damage to animal husbandry. Animals affected by gadfly larvae lose appetite and subsequently lose weight. In lactating animals, a decrease in milk yield from 80 to 200 liters is noted, young animals lag in growth and development, while weight gain in young animals

and feeding animals is reduced by 13-18 kilograms [Ministry of Agriculture of the Russian Federation, order No. 514 of November 16, 2004 "Guidance on subcutaneous gadflies control and prevention of cattle hypodermatitis"].

Animals become less resistant to various diseases. Significant damage is caused to the leather industry, as the cost of skin damaged by the larvae of the subcutaneous gadfly is reduced by 60%. The carcasses of animals killed in the spring/summer period in the places where the larvae are found, often have an unmarketable look. After cleaning such carcasses, up to 1.5 kg of meat is lost. Severe anxiety from the attack of gadflies and gnats, and running in search of shelter often lead to various injuries, contributing to infection with necrobacteriosis, and even abortion of pregnant animals [14]. Hypodermatitis is widespread both in the territory of the Russian Federation and abroad. According to VV Marchenko *et al.*, on the territory of the Stavropol territory, the extensiveness of cattle hypodermatitis infestation varies from 12.0 to 38.0% [15]. In Kabardino-Balkaria, subcutaneous gadfly infestation occurs with an average extent of 13.8% [16]. It is also widespread in the Chechen Republic of the Russian Federation. Thus, in the low-lying zone the number of *H. bovis* and *H. lineatum* was 56.7% and 43.3%, in the foothill zone it equaled 64.3% and 35.7%, and in the mountainous zone, it was 97.6 and 2.4%, respectively [17].

Outside the Russian Federation, the incidence of hypodermatitis in cattle varies and depends on the diagnostic methods used. Thus, according to research carried out in 2003 in Spain, the infection rate of livestock varied from 21.0 to 79.0%, in Belgium it was 43.0%, and in Italy 85.0%. Studies carried out in Greece (2004) indicate the infestation of animals by subcutaneous gadflies at the level of 44.2% [18]. For the treatment of animals infected with the larvae of subcutaneous gadflies, both in the Russian Federation and abroad, preparations from the group of macrocyclic lactones are widely used, such as ivermectin, eprinomectin, hypodectin, dermacin, avermectin, and abamectin [19, 20].

Today, one of the urgent tasks for the successful development of animal husbandry in the country is to eliminate the harm caused by blood-sucking Dipteran hematophagous insects that carry

pathogens causing several diseases dangerous to humans and animals and to develop comprehensive measures to protect animals from them.

MATERIALS AND METHODS

The Tyumen region is a special region that plays a key role in the Russian economy. However, despite the difficult climatic conditions, agriculture is successfully developing there and the development of beef cattle breeding is a priority.

The Tyumen region is characterized by pronounced latitudinal zoning. In the southern agricultural part (the region without the Khanty-Mansiysk and Yamalo-Nenets Autonomous districts), due to the peculiarities of the climatic regime, the different ratios of heat and moisture, three natural and climatic subzones (zones) are distinguished, namely southern taiga, small-leaved aspen and birch forests, and forest-steppe. The work was carried out in the laboratory of entomology and disinsection, in the laboratory of animal entomosis of the All-Russian Scientific Research Institute of Veterinary Entomology and Arachnology (VNIIVEA) a branch of the Tyumen Scientific Center of the Siberian Branch of the Russian Academy of Sciences (SB RAS), as well as in the field in all three natural and climatic subzones (zones) in the period from 2017 to 2019. The seasonal dynamics of the number of insects commonly referred to as "gnats" and gadflies were studied by systematic pasture counts throughout the summer season. The number of horseflies was counted once every 5–7 days using cone-shaped traps [21]. Mosquitoes, midges, and biting midges were counted at 7-8 pm by trapping them with an entomological net with removable bags [22]. For the intensity of the attack, we took the average data for 10 strokes out of 10 repetitions, which corresponded to a one-time attack on animals. The surveys were carried out at intervals of 5 days.

The activity and dynamics of the number of adult gadflies were taken into account visually using binoculars, while counting was carried out simultaneously for at least 10 animals. The counts were carried out during the hours of the highest insect activity, from 11 am to 3 pm during the entire flight period, followed by the calculation of the average values [23].

When establishing the terms of mass flight, we used the "Method for determining the harmfulness of insects commonly referred to as "gnats" for cattle" [24].

RESULTS AND DISCUSSION

On the territory of the Tyumen region, there are 154 species of blood-sucking Dipterans, where horseflies are represented by 43 species and one subspecies, mosquitoes by 44 species, midges by 45 species, and biting midges by 22 species [25-27]. In the south of Tyumen oblast, only one species of gadflies, *Hypoderma bovis*, is parasitic in cattle [28].

Monitoring the seasonal dynamics of the number of parasitic Diptera insects makes it possible to establish the periods of their flight and mass attack, the level of numbers, and the estimated loss of cattle meat productivity, which makes it possible to substantiate the feasibility and timing of protective measures for animals.

In the southern taiga, the total flight period of insects commonly referred to as "gnats" is 130-145 days, from mid-May to the end of the first 10 days of October, while the total mass flight lasts about 90 days, from the last days of May to the end of August.

In the subzone of aspen-birch forests, gnats are active from the second 10-day period of May to the end of the first 10 days of October, that is, for about 150 days. In the summer seasons favorable for the development of the gnats, the mass flight is observed from the last five days of May to the end of August, that is, for 90-95 days.

The forest-steppe zone is characterized by a longer flight period of blood-sucking insects, from mid-May to mid-October. Mass flight is recorded from the first days of June to the middle of the first 10 days of September and equals about 95 days.

The flight times of gadflies in different climatic zones of the region also differ. The emergence of adult gadflies in the southern taiga subzone begins in the first 10 days of July. From the second 10-day period of July to the first ten days of August, the largest number of flies is observed. The gadfly activity continues until the end of August, so the total flight period is about 2 months.

In small-leaved aspen and birch forests, the first gadflies begin to fly in the third 10-day period of

July. Their maximum number is observed from the second 10-day period of July to the end of the first 10 days of August. Single gadflies fly until the end of the first 10 days of September.

The general period of flight of gadflies in the forest-steppe zone lasts from the second 10-day period of June to the third 10-day period of August and equals about 70 days. Mass flight is observed in July. Depending on the meteorological conditions of the season, these phenodates vary within 20 days.

Analysis of the data on the periods of flight of blood-sucking Dipterans shows that with the advance from north to south of the region, the total duration of the flight period and the period of mass flight naturally increases. The hydrometeorological conditions of the season have a significant effect on the dynamics and level of the number of these insects, depending on which the timing of the appearance and disappearance of blood-sucking Dipterans within

the zone can vary significantly. Long-term preservation of breeding sites from drying out contributes to a favorable completion of the development of preimaginal phases and a high number of adult insects. Sharp temperature fluctuations (cooling) and prolonged precipitation during the flight reduce the level of the gnat population.

Based on the duration of the periods of mass flight of different insects understood after the term "gnat", **Table 1** shows the time when it is necessary to take protective measures for animals against the attack of these insects. In the subzones of the southern taiga and aspen-birch forests, protective measures should be planned from the end of May to the end of August, in the forest-steppe zone from June to the end of August. However, depending on the hydrometeorological conditions of the spring-summer season, these dates can shift by 10-20 days.

Table 1. Flight times of gnats and gadflies, and carrying out protective measures in the south of the Tyumen region

Insects	Flying insects by a 10-day period															
	May		June			July			August			September			October	
	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2
Southern taiga																
Horseflies																
Mosquitoes																
Midges																
Biting midges																
Gadflies																
Dates of protective measure implementation																
Aspen and birch forests																
Horseflies																
Mosquitoes																
Midges																
Biting midges																
Gadflies																
Dates of protective measure implementation																
Forest-steppe																
Horseflies																
Mosquitoes																
Midges																
Biting midges																
Gadflies																
Dates of protective measure implementation																
Note:																
	total flight period															
	mass flight period															

CONCLUSION

The duration of the period when it is necessary to carry out protective measures for cattle against the attack of insects commonly referred to as "gnats" and gadflies depends on the number of these insects and the season of their mass flight. In the natural and climatic zones of the region, these periods vary: in the subzones of the southern taiga and small-leaved aspen and birch forests mass flight is observed from the last days of May to the end of August, and in the forest-steppe zone, it usually happens from the beginning of June to the end of the first five-day period in September.

Depending on the meteorological conditions of the season, these dates can be shifted by 10-20 days. The main indicator for determining the feasibility of protective measures is the number of gnats and gadflies, which can vary greatly. In years unfavorable for the development of these insects, when there are sudden cold snaps in summer or, on the contrary, very high temperatures and droughts, a low number of Dipterans is observed, and the period of mass flight may be disrupted or absent altogether. In such seasons, when the "gnat" and the gadfly do not bother the animals, it is not profitable to carry out systematic protective measures.

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