

## SYSTEMATIC SPRAYING OF CATTLE WITH DELCID AGAINST BLOODSUCKING MIDGES ON PASTURES

<sup>a</sup>OLGA A. FIODOROVA, <sup>b</sup>ANNA N. SIBEN, <sup>c</sup>ELENA I. SIVKOVA.

<sup>a</sup>All-Russian scientific research institute of veterinary entomology and arachnology - Branch of Federal State institution Federal Research centre Tyumen Scientific Centre of Siberian Branch of the Russian Academy of Sciences, Institutskaya Street, 2, Tyumen, Russia

<sup>b</sup>All-Russian scientific research institute of veterinary entomology and arachnology - Branch of Federal State institution Federal Research centre Tyumen Scientific Centre of Siberian Branch of the Russian Academy of Sciences, Institutskaya Street, 2, Tyumen, Russia

<sup>c</sup>All-Russian scientific research institute of veterinary entomology and arachnology - Branch of Federal State institution Federal Research centre Tyumen Scientific Centre of Siberian Branch of the Russian Academy of Sciences, Institutskaya Street, 2, Tyumen, Russia  
email: <sup>a</sup>olga.a.fiodorova@mail.ru, <sup>b</sup>812637@mail.ru, <sup>c</sup>648096@mail.ru

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**Abstract:** The effect of spraying cattle hair with Delcid on the number of midges was studied. The attack of bloodsucking midges decreases the milk productivity of cattle. According to literature data, losses can range from 5.19 to 53.4%. In Russia, synthetic pyrethroids are widely used to protect livestock from midges. Among the drugs in this group, Delcid (4% emulsifiable deltamethrin concentrate) has proven itself effective. The present research aimed to study the effect of spraying cattle hair with Delcid on the number of midges on pastures and the milk productivity of cows. Studies were conducted in livestock farms in the south of the Tyumen region in 2003–2005 and 2008. Cows before pasture were sprayed with 0.001% (by active substance) Delcid water emulsion in medium volume (0.5 l per animal) using the universal horizontal single-pipe spraying booms installed at the pen gate and developed at the All-Russian Scientific Research Institute of Veterinary Entomology and Arachnology. Midges were counted using an entomological net with removable sacks. The entomological efficiency of treatments was assessed by comparing the number of midges at the test and control pastures. Losses in milk productivity were calculated based on the "Method for determining the harmfulness of insects of the 'gnat' type for cattle" developed by the authors of the present research. The research revealed that the loss of milk productivity of cows in the south of the Tyumen region can reach 9.88% in some years. Systematic spraying of the hair of grazing cattle with a 0.001% aqueous Delcid emulsion reduced the total number of midges on the pasture by a factor of 1.7-7 and, accordingly, shortened the period of their mass swarming. This allowed getting additional 0.231 l of milk per day or 1.45% from each cow, thus increasing the profitability of cattle breeding.

**Keywords:** bloodsucking midges, cattle, Delcid, entomological efficiency, milk productivity, pasture, spraying.

### 1 Introduction

Bloodsucking midges (Diptera, Simuliidae), being ectoparasites and carrying pathogens of many infectious and invasive diseases, cause significant economic damage to animal husbandry. Simuliidae are widespread in all landscape-geographical zones of the Russian Federation. Development of animal husbandry and increase in milk and meat productivity largely depend on the timely and high-quality veterinary measures. One of such measures for increasing the profitability of livestock is prevention of invasive diseases, including entomoses, and protection of animals from bloodsucking dipterous insects: horseflies, mosquitoes, black flies and biting midges commonly known as gnat. For instance, midges attacks reduce milk productivity of animals in the south of the Tyumen Region by 5.19% [1], and in the Irkutsk Region by 53.4% [2]. In Australia, midges reduce milk productivity by 15% [3]. In Canada in some years, the loss of meat and milk amounts to hundreds of thousands of dollars [4].

Currently, protective spraying of animal hair with emulsions of insecticides from the group of synthetic pyrethroids, which turned out to be the most effective and promising, is recommended. One of these domestically produced drugs is Delcid, a 4% emulsifiable deltamethrin concentrate developed at the LLC 'Agrovetzashchita – Animal Health', Russia. In the

recommended amounts [5, 6], the residual insecticidal effect of this drug on hair (with the efficiency higher than 84% against horseflies as the most stable components of the gnat) remains for 2-3 days in the conditions of grazing. Spraying with Delcid not only protects animals directly but also reduces the number of horseflies on pastures 6 times in average [5] and that of mosquitoes 2.6-2.9 times [5, 7]; no such data was identified on midges. Deltamethrin-based preparations are used worldwide due to their valuable insecticidal activity against pests and parasites. With the increasing use of deltamethrin, its toxic effects on animals and humans attract a lot of attention; however, neither Russian, nor foreign literary sources provide a complete picture of the studies on Delcid toxic effects on bloodsucking midges. Foreign studies mostly focus on the effect of deltamethrin (caused by pyrethroids) on mosquitoes (Diptera: Culicidae) as they pose a danger to humans and animals; it is also believed that pyrethroid insecticides are less toxic to mammals [8-16]. Measures against gnat and especially against bloodsucking midges (Diptera: Simuliidae) are more relevant today in connection with the purchase of cattle from Western Europe for many areas of Russia.

The present research aims at studying the effect spraying cattle hair with Delcid has on the number of midges on pastures and the milk productivity of cows.

### 2 Materials and methods

The Tyumen Region is characterized by a pronounced latitudinal zonality.

The work was carried out in the laboratory of entomology and pest control of the All-Russian scientific research institute of veterinary entomology and arachnology – Branch of Federal State Budgetary Institution of Science of the Federal Research Center of Tyumen Scientific Center of the Siberian Branch of the Russian Academy of Sciences, as well as in field in all the three climatic zones.

Studies were carried out in the south of the Tyumen region in the JSC 'Bolshevik' of the Nizhnetavdinsky district (southern taiga) in 2003-2005 and in the JSC 'Chaika' of the Yalutorovskiy district (subzone of deciduous aspen-birch forests) in 2008.

Spraying was carried out in accordance with the "Methodological guidelines ..." [17] and instructions [7] with 0.001% (by active ingredient) aqueous Delcid emulsion in medium volume (0.5 l per animal) when the cattle was lead out to pasture after the morning milking with universal horizontal spraying booms [18] and universal horizontal single-pipe spraying booms [19-21] installed in the pen gate. Delcid is an insecticide-acaricide drug in the form of emulsion concentrate for external use, designed against animal ectoparasites and Acari, and for pest control of livestock buildings. Its active substance is the synthetic pyrethroid deltamethrin (4.0%) and its auxiliary components are tween 80, nonoxynol and petroleum solvent. Delcid is oily transparent liquid coloured from yellow to brown; when mixed with water, it forms stable white emulsion.

In the Nizhnetavdinsky district, studies were carried out on the same test and control pastures. In 2003-2004 on the test pasture (summer camp 'Dachi'), 300-350 cows of the two herds of the Nizhnetavdinsky farm were sprayed with Delcid 30 and 16 times during the season, respectively. In 2005, these animals grazed on another site – the adjacent pasture 'Lipnyaki', located 3 km away. On the control pasture 'Yermachiha', 170-250 cows of two herds of the private sector of Nizhnyaya Tavda village were not subjected to treatment, since it is located more than 8 km away from the test pasture.

In 2008 in the Yalutorovskiy district (LLC 'Chaika' in the village of Kievo), 200 cows began grazing on July 7; previously, they were kept without grazing in a pen near the livestock

building. From July 9 to July 25, the animals were treated with the same preparation 6 times. The control pasture for 100 cows of the private sector was located 5 km from the test pasture, and these animals were not subjected to treatment.

On the test and control farms and pastures of the forest type, surveys were carried out of the number of attacking midges by trapping them with an entomological net with removable sacks. The average data for 10 sweeps in 10 replications was taken as a standard unit [22]. The midges were counted twice a decade between 7 and 8 p.m.

The entomological effectiveness of spraying cows with Delcid was evaluated according to the results of a comparative survey of the number of midges on the test and control pastures according to the "Methodological recommendations ..." [23].

Loss of milk productivity was estimated based on the harmful number of midges expressed in conventional units (cu) and on loss of productivity of 1 cu. [24].

### 3 Results

The study of seasonal dynamics revealed the swarming period of midges in the Nizhnetavdinsky district begins in the end of May till the beginning of June and lasts up to the first decade of August (70-75 days). The number of midges on the test pasture remained at a lower level during the spraying seasons than on the control pasture. In 2003 on the test pasture, it averaged 33.1 specimens per season, while on the control pasture it was 84.6 specimens; in 2004, the numbers were 21.6 and 23.8, respectively. In 2005 (when the test cattle grazed on the adjacent test pasture 'Lipnyaki') the number of midge on the control pasture 'Yermachikha' averaged to 35.6 for the season, on the test pasture 'Dachi' – 97.5, and on the pasture 'Lipnyaki' – 88.6 specimens. The number of midges on the pasture 'Dachi' was close to that of 'Lipnyaki' where cattle grazed; thus, to calculate the effect of spraying on the number of midges, the 2005 season was used as a control period.

According to the calculations, the number of midges on the test pasture 'Dachi' in 2003 compared with the control pasture 'Yermachikha' (taking into account the number of midges on these pastures in the control year of 2005) decreased by 85.7%, and in 2004 by 66.9% or, respectively, 7 and 3 times.

The expected loss of milk productivity was calculated based on the average number of midges during the mass swarming. In 2003 (according to the economic abundance threshold of 0.8 cu – 57 individuals on a one-time record), the mass swarming of midges on the control pasture lasted from the middle of the first decade to the end of June (25 days). During this period, the average number of midges was 190; this corresponds to the harmful number of 2.67 cu at which the expected loss of milk productivity averaged 9.88%. On the experimental pasture (where cows were treated with Delcid), the mass swarming period lasted from the second to the fifth five-day period of June (20 days). The average number of midges during this period was 74.3 individuals or 1.04 cu at which the loss of milk productivity was 3.85%. With average daily milk yield in June being 12.96 l, each cow in the control group lost 1.28 l per day (32 l in total during the 25 days of the mass swarming), and each cow in the test group lost 0.5 l per day (10 l in total during the 20 days of the mass swarming).

Thus, the protection of livestock from midges with Delcid allowed saving 22 l of milk for each cow (7,634 l for 637 cows in total) since both the number of midges and the period of the mass swarming were shortened.

In 2004, the mass swarming was observed on the control pasture only at the beginning of the third decade of June and at the end of July (10 days) with an average number of 63.2 specimens or 0.88 cu registered. The estimated loss in productivity of cows during these days amounted to 3.2%, which slightly exceeds the economic threshold. In fact, midges had no economic value as a gnat component.

On the experimental pasture, the mass swarming of midges was observed only at the beginning of the second decade of June (5 days) with 70.9 specimen or 0.99 cu on average; the expected loss of milk was 3.66%. With average daily milk yield of 13.03 l, on the control pasture, each cow lost 0.417 l per day (4.17 l for 10 days of mass swarming), and on the test pasture, the figures were 0.474 l per day (2.385 l for 5 days, 1.785 l less than on the control pasture). Thus, with almost equal numbers, spraying shortened the mass swarming period and thus saved 598 l of milk from 335 cows, against 7634 liters in 2003. The significantly lower estimated economic effect of spraying in 2004 can be explained by the low number of midges (and of gnat in general) in the given season. The average number of midges per season did not reach the economic threshold, and slightly exceeded it only for 10 days (control) and 5 days (test).

In 2008 in the Yalutorovsky district, the swarming on the control pasture with continuous grazing of cows lasted from the second decade of June to the end of August (more than 2.5 months). Mass swarming lasted from the middle of the third decade of June to the first decade of July (15 days) with 88.6 specimens per account on average. The average number of midges per season was 50.7 specimens or 0.71 cu which is below the economic threshold. The expected loss of milk productivity with this number was 2.63% (Table 1).

Table 1: The number of midges before and during the spraying of grazing cows on test and control pastures (the Yalutorovsky district, 2008)

Account periods and dates	Number of midges per account	
	Test pasture	Control pasture
Before spraying: 24.06 30.06 4.07 On average	49.7	32.4
	114.6	97.5
	65.6	99.6
	86.6	76.6
During spraying: 9.07 16.07 23.07 On average	31.8	63.1
	21.5	45.0
	27.6	14.5
	27.0	40.9
Entomological efficiency, %	41.6	-

On the test pasture, the mass swarming was observed in the last five days of June and the first five days of July (10 days), with an average number of 105 specimens per account. The average number of midges per season was 49 specimens or 0.68 cu, at which the expected loss of milk was 2.5%. Grazing on this pasture began on July 7<sup>th</sup>; from July 9 to July 25, the animals were sprayed six times. To estimate the impact of spraying on the number of midges, indicators before and during treatment on both pastures were used [19]. Before treatment on the test pasture, the number of midges was 86.6, and during treatment it was 27.0 specimens per account; on the control pasture, the numbers were 76.6 and 40.9, respectively. The calculations show that the entomological efficiency was 41.65%; in other words, spraying the grazing cows with Delcid reduced the number of midges 1.7 times.

To compare the milk productivity of the test and the control herds, the following data were used:

- the milk yield of LLC 'Chaika' in 2008, when the animals were kept in the pen during the first half of the mass swarming of midges (June 16 - July 6), and when the animals grazed daily and were periodically treated during the second half of the mass swarming (July 7 - July 25);

- the milk yield of the same farm in 2007 (the control season), when the animals grazed daily without treatments.

In the control period before treatment, the average daily milk yield of cows was  $16.126 \pm 0.023$  l in the test herd and  $15.978 \pm 0.135$  l in the control herd. In the test period the numbers were  $14.923 \pm 0.211$  and  $13.437 \pm 0.128$  l, respectively. Therefore, milk yields decreased in both herds. Calculations according to the methodological recommendations [19] showed that spraying animals with Delcid to protect them from gnat resulted in an additional 1,362 l or 10.04% from each cow. (Additional productivity =  $14.923 - 16.126$  ( $13.437/15.978$ ) = 1.362 l;  $E = 100$  [ $(14.963/16.126) \cdot (15.978/13.437) - 100 = 10.04\%$ ). Based on the fact that in 2008, average seasonal harmful numbers of midges were 0.71 cu or 17% of 4.17 cu of gnat, spraying the animals saved 0.231 l or 1.45% of milk per day from each cow, and 877.8 l of milk from 200 cows for the test period (19 days).

In comparison with expected losses (2.63%), calculated based on the harmful number of midges, spraying with Delcid prevented losses by 1.45% or more than half of the expected.

#### 4 Discussion

The natural conditions of the south of the Tyumen Region favor the mass emergence of bloodsucking dipterous insects of the 'gnat' type; they are widespread and cause significant damage to agriculture.

Experiments (under productivity conditions) to study the effect of spraying animals with water emulsions of synthetic pyrethroids preparations on the number of midges on pastures revealed that (compared to control) in the southern taiga subzone in 2003, 30-fold spraying of 300 cows with 0.001% Delcid emulsion reduced the number of midges by 84.75% (more than 6.5 times), and in 2004, 16-fold spraying of the same livestock reduced the number of midges by 69.78% (3.3 times).

The productivity experiment in the subzone of aspen-birch forests in 2008 was unique since the animals were sprayed with the newly designed universal horizontal single-pipe spraying booms developed at All-Russian scientific research institute of veterinary entomology and arachnology, and since during the first half of the mass swarming of gnat, the cows were kept in a farm pen. Grazing began only on July 7, and for the remaining period of the mass swarming (until July 23), the animals were sprayed six times. On the animals in the pen, there were practically no midges, and protection from them was not required. As a result of spraying animals before grazing, the number of midges on the test pasture decreased by 41.6% or 1.7 times.

Thus, when animals were sprayed with a 0.001% Delcid aqueous emulsion, the entomological efficiency varied from 41.6 to 84.75% and depended directly on the number of treatments. In addition, the entomological efficiency of spraying animals against midges was higher than against horseflies and mosquitoes, which can be explained by their greater contact with treated animal hair, that is, the nature of their attack for blood sucking (Rubtsov, 1962).

In the experiments of V.U. Mitrokhin (1975) as a result of spraying cattle with a 3% aqueous emulsion of hexamidum during the mass swarm of midges, 0.41 l or 5.36% of milk was saved in the total milk yield of cows.

#### 5 Conclusion

Systematic medium-volume spraying of the hair of grazing cattle with a 0.001% aqueous Delcid emulsion against gnat, including bloodsucking midges, provides not only immediate protection but also reduces the total number of midges 1.7-7 times and shortens the period of their mass parasitic activity which requires treatment. The harmful number of midges (expressed in conventional units) makes the expected loss of milk productivity reach 9.88% in some years on the southern taiga pastures in the Tyumen region, and 2.63% on pastures of aspen-birch forests

with the mass parasitic activity period of 25 and 15 days respectively. Spraying cows with a 0.001% aqueous emulsion of Delcid allowed obtaining additional 0.231 l of milk per day (1.45% from each cow) which reduces the losses from the attacks of these insects by more than half.

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