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Study of spreading, dynamics of flying, attack and predominance of flies of the family Muscidae (Diptera, Insecta) in Cattle at livestock farms of Kyiv and Rivne Regions of Ukraine

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Abstract

The present investigation was conducted to study the spreading, dynamics of flying, attack and predominance of flies of the family Muscidae (Diptera, Insecta) in cattle at livestock farms of Kyiv and Rivne regions of Ukraine during September-October, 2011. Species such as *Lyperosia* spp., *Stomoxys* spp. (stable flies), *Musca autumnalis* (face fly), *M. larvipara* and flies of the family Calliphoridae (blow flies) were parasitizing on cattle in September. Genus *Lyperosia* was a dominant flies species of cows in pasture; the highest prevalence infection was up to 94%. The highest quantity of flies (II was 89.7±24.13 insects in average) fixed at 7 am, with peak of their activity at 4 pm (on the abdominal area around the udder of cows). Since 6 pm till 9 pm at artificial lighting was found by 77.59% more flies on cows in comparison with those in premises. The dominant species of flies in livestock premises of Rivne region was *Stomoxys* spp.. Tendency of their activity, the flying and attack on animals was continuing to the peak at 5 pm (II was 29.85±1.94 insects/animal in average). A highest quantity of flies was registered at 7 am (early morning), and 9 pm (late evening) on cows on the front legs of the metacarpal bones with the highest indexes of 53.52 and 52.59%, respectively; the lowest quantity of those, in the abdominal area and sacrum at 7 am and 5 pm were from 6.57 to 23.45%, respectively.

Keywords: The family Muscidae, flies, ectoparasites, lactating cows, cattle, dairy farms, Ukraine

1. Introduction

The flies of the family Muscidae Latreille, 1802 are the most widespread by the quantity and quality indexes of the suborder Brachycera order Diptera [1]. They are observed almost in all climatic zones and have an epidemiologic and epizootic significance [2]. The insects of the family Muscidae attack and bite by toxic saliva, and causes to the animals anxiety, itching, skin inflammation, stress, and lead to a decrease in productivity and quality of livestock products (Nasser Seid Mulugeta, 2002). Lachrymal and sweat-feeding flies of the family Muscidae are well-known nuisance pests [3]. Those in the genus *Hydrotaea* Robineau-Desvoidy, 1830, more than 130 species, are feeding on lachrymal secretions and lymph or even blood around fresh wounds [4]. Some *Musca* species (including *Musca sorbens* Wiedemann, 1830, *M. vetustissima* Walker, 1849 i *M. autumnalis* De Geer, 1776) cause great annoyance by feeding on open sores, cuts and body secretions [(Day *et al.*, 2004)]. Most of them are found in the feces of the cattle at livestock farms. Besides, the flies are constantly situated in opened storage food place [4, 5].

Most flies of the family Muscidae are carriers of the bacterial and parasitic agents diseases [6] and spread more than hundred diseases in humans [7, 8] and animals on livestock farms. Also the house flies act as carriers of disease causing agents such as *Escherichia coli*, *Shigella*, *Salmonella* spp. [7]. Recently, house flies have been found to be potential carriers of bird flu virus that is a threat to humans, poultry and livestock industry throughout the world [6]. The flies are the biological carriers and serve as intermediate hosts of *Thelazia* spp. [9], *Stephanophilaria* spp., *Setaria* spp., *Habronema* spp. and *Draschia megastoma* larvae of the cattle [10] and latter tree in the horses.

It is known, the existence, reproduction, development and parasitizing of a bloodsucking insects (Diptera) on animals on various geographical and climate zones is significantly differ [11, 12]. In Ukraine and most countries of the world, historically is practiced stable-pasture or grazing systems for cattle [13].

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This system suggests a close relation with the environment and, consequently, free circulation of pathogens of infectious diseases. In the area of Palearctic region, covering Europe and Asia ^[14] (from the Himalayas to the North, without the Arabian Peninsula), and the North Africa (to the southern border of the Sahara), and Australia ^[15] in the spring and summer also are causing harms to animals another bloodsucking insects, such as horse flies, mosquitoes, gnats, black flies, biting midges and sand flies.

Another individual of the family Muscidae, such as horn fly (*Haematobia irritans* L.) is a significant pest of cattle throughout much of the world ^[16, 17]. Anthropogenic factors, in particular species and types of livestock housing, the species, age and characteristics of animal maintenance, are among the factors influencing the distribution, multiplication and increase in populations of flies of the family Muscidae. It was noted that the largest number of species of pasture flies in cowsheds and pigsties. Significantly less was registered in the rabbit ^[18] and stables farms ^[19, 20]. In studies of Talley ^[21], it is said that the relatively stable development of *Stomoxys calcitrans* (L.) larvae at the optimal environmental air temperature (+ 21-25 °C and + 25-30 °C degrees) depends on the composition of the fecal microflora and the presence of hay in it. Such factors indicate the seasonality of fly flies of this species in pastures ^[19, 22].

The climatic, geographical and seasonal spreading of different species of flies depends on the impact on them of various environmental factors, in particular, temperature, humidity, sources of nutrition, ultraviolet light, ionizing radiation, soil composition, etc. ^[23] (Romoser, 2004). Factors of microclimate in the premises, such as air humidity, air speed movement and lighting, have an indirect effect on the vital and daily activity of insects ^[24] which is associated with the regime (time of schedule) also ^[25].

Thus, many scientists' studies are testifying to the widespread and development of temporary ectoparasites of cattle, in particular such as the family Muscidae flies. Their considerable species diversity, life cycle and distribution places are due to the specific climatic conditions of individual geographic zones due to the presence of aquatic and biological resources and animals. Therefore, it is urgent to study the ecology of zoophylic flies to create or improve effective methods for regulation of population quantity, and animals and people protection against their attack.

Currently in Ukraine the spreading, flying, duration of the attack and staying on the animals of flies, their development on pastures, in the livestock enclosure and around it, has not full determined yet.

The objective of study was to investigate the spread, period of flying, activity during the day-time, attack, and predominance of flies of the family Muscidae in cattle at livestock farms of Kyiv and Rivne regions of Ukraine.

2. Materials and Methods

The present study was carried out during September-October, 2011, in conditions of laboratory entomological and acarological animals diseases of Rivne Research Station of Epizootology (Institute of Veterinary Medicine of the National Academy of Agrarian Sciences of Ukraine), of the livestock farm of "Nemishaievo Agrotechnical College" (Structural Division of the National University of Life and Environmental Science of Ukraine), and private farm "Volyn" Rivne region of Ukraine with lactating dairy cows (3-8-years old).

Dynamics of flying, attack and predominance of the temporary parasitizing flies of the families Muscidae and Calliphoridae species in livestock premises and pasture conditions was investigated. Their activity, flying and attack was carried out at the daylight hours from 7 am till 9 pm.

Collection of flies from animals for laboratory testing was carried out with the entomological net and bleached with chloroform. The material was stored in the freezer. When identifying the species of dipterous insects, the determining tables were used. Insects species were studied and identified with determinants proposed by Gregor [and others] (2002) ^[1], Haponov (2004) ^[26], Oosterbroek (2007) ^[27], and Beutel [and others] (2013) ^[28].

For to fix flies (of flying up to the animals, and blood sucking up insects) on cows, was used the Author's technique (Patent of Ukraine, № 69220, 2012) by digital camera Nikon Coolpix 8400 with optical and digital zoom ^[29]. Insects were fixed on each animal part area with device. Total flies counting were carried out with magnification for 50–100% of each picture on personal computer monitor display.

Total numbers of flies (Intensity of Infection, No. of insects per individual), and all infected animals (Prevalence of infection, %) was calculated ^[30]. Air temperature, lighting, wind speed, relative humidity and atmospheric pressure we recorded with appropriate devices.

3. Results and Discussion

Total number, up to 94% flies of the genus *Lyperosia* were dominants on cattle; much more less numbers of *Stomoxys* species, *Musca autumnalis* *Musca larvipara* of the family Muscidae were identified in livestock State farm of "Nemishaievo Agrotechnical College". Flies of the family Calliphoridae and blood-sucking flies *Hippobosca* spp. of the family Hippoboscidae Samouelle, 1819 also were fixed with camera.

Insects activity of the family Muscidae highly dependent on seasonal and weather conditions and the duration of daylight hours. The daylight time (sunrise at 6:33 am, the sunset at 7:12 pm) was observed as favorable for activity of the family Muscidae parasites which is quite similar to reports from Talley ^[21]. According to data of the Ukrainian Meteorological Center, the temperature registered at 7 am with peak at 4 pm (+ 8 °C and + 20 °C degrees, respectively) during sunny day was observed the increasing of attack and activity of *Stomoxys* spp. and *Musca autumnalis* on animals which is in agreement with earlier studies by Ovcharuk and Vesiolkina ^[9, 22]. Our study confirmed that, flies attack and their localization were detected on warmed sun animal's part of body with higher flies infestation than on non-warmed body's parts of cattle in generally. This may be due to the fact that the peculiarity of poikilothermic features of flies ^[3] help to find them on the cows. Flies of *Stomoxys* genus gradually moved to the dorsal surface of thoracic part, behind the scapula, during increasing air temperature until 12 pm (Figure 1). Flies of the family Muscidae were found on the front of animal's head by feeding with tears and secretions from the eyes. In contradiction to attack of *M. autumnalis*, *Stomoxys* spp. flies appeared periodically for bloodsucking only, with localization on animal's legs mainly.



Fig 1: Flies of the family Muscidae on dorsal part of cow’s body.

The beginning of the flies activity fixed at 7 am; it was 15.7 ± 13.07 insects per animal, in average (Table 1).

Table 1: Flies activity indexes during the day ($M \pm m$, $n=7$).

S. No.	No. of flies in open-air		S. No.	No. of flies at animals’ shelter	
	Fixed time, hours	Infection intensity, No. of insects, (mid)		Fixed time, hours	Infection intensity, No. of insects, (mid)
1	07:00 AM	15.7 ± 13.07			
2	09:00 AM	35.6 ± 7.26			
3	10:00 AM	30.6 ± 4.0	8	11:00 AM	27.9 ± 3.74
4	12:00 PM	34.9 ± 9.20			
5	02:00 PM	51.6 ± 13.44			
6	04:00 PM	89.7 ± 24.13			
7	07:00 PM	16.6 ± 5.98	9	07:00 PM	29.4 ± 7.48

The highest number of insects ($II=89.7 \pm 24.13$ flies, with range from 61 to 178 of those/each animal) was on cows in pasture at 4 pm (Figure 2), with coincidence of flying peak and rising up of the air temperature, which is in agreement to Aheeva [16].

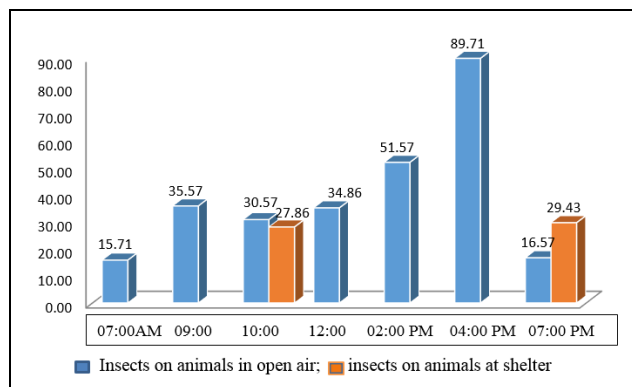


Fig 2: Dynamics of activity of the family Muscidae flies.

M. larvipara species was registered with *M. autumnalis* (at the frontal part of the animals’ head) also on cows at 7 pm, with the highest quantity for September and with range of 4-5 insects/animal. Interesting fact, that after 7 pm these species have not found, what is in contradictions with reports from Mashkey [19] while reports showed a much longer activity of those.

The keeping cows under shelter is very important action for protection against flies attacks of the family Muscidae. At 10

am till 12 pm at shelter by 9.74–25.13% were less flies, in comparison with those on cows at pasture conditions. By 77.59% more flies were found on cattle at sunset under artificial lighting in comparison to those on animals in livestock enclosures. *Hyppobosca equina* attack was recorded on cows also, which were kept together with horses in premises, which is in agreement with earlier studies [24]. The active ectoparasites attack with predominance of *Stomoxis* species was 90% of those, and less of *M. domestica* flies, was 10% amount all, were fixed on cows in premises conditions at private farm “Volyn”. A peculiarity of the development and reproduction of Muscidae family flies in premises at this farm were the feed remains in the troughs, feces in the conveyors, rotten straw and manure storage located near by which is similar to reports of Shevchenko and Novikov [24, 25].

It is known, that flies with a licking or piercing-sucking type of mouthpiece is most common in Europe [1]. Their quantity increases in the second half of summer and early autumn. With the onset of cold weather, their numbers are significantly reduced. However, in closed warm premises, *M. domestica* and *St. calcitrans* can active reproduce and develop over whole year [1, 20], what was registered such as favorable conditions for reproduction and development of the family Muscidae flies at “Volyn” farm of Rivne region. The most flies quantity on animals’ body for flies attacks and bloodsucking was found on the lower part of legs and around thorax (a some special areas) with less hair cover. Therefore, insects quantity in these places was insignificant (Figure 3 a-d), which is in agreement to Mashkei [20].



Fig 3: Flies counting process on the lactating cows. a. on the forelimbs; b. on the hind limbs; c. on thorax and scapula area; d. over the croup

Duration of the flies attack and their bloodsucking on animals was ranged from 1 to 60 minutes. It is showed in diagram (Figure 4), their attack on cattle continued throughout the light period of the day with tendency to increase their activity until 5 pm. This is due to a certain fixation of animals during

milking, the presence of a significant quantity of insects in one place, the lack of a prolonged movement and the possibility of avoiding the attack of flies due to temporary fixation, what is similar to reports from Novicov and Saffiulin in Russia [25].

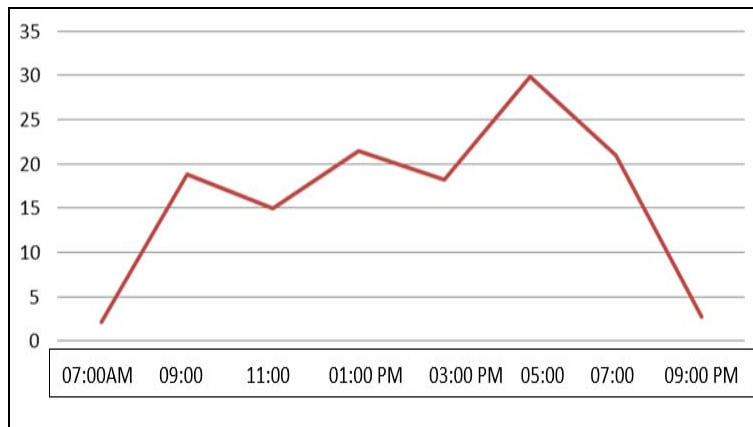


Fig 4: Dynamics of daily stable flies activity.

The activity and attacks of the stable flies was directly proportional to the inception and duration of the day. The less insects quantity registered at 7-8 am (II= 2.1 ± 0.3 flies/cow) (Table 2).

Table 2: Family Muscidae flies activity of attack and flying in accordance to localization area on cows (M±m, n=7).

S. No	Day time indexes, hours	Infection intensity, II No. of insects per animals' area				Infection intensity, II No. of insects per animals (mid)
		Fore legs	Hind legs	Frontal part of animals' body	Back & croup of animals' body	
1	07:00 AM	1.1±0.26	0.3±0.18	0.6±0.20	0.1±0.14	2.1±0.3
2	09:00 AM	8.1±0.82	3.4±0.78	4.4±0.36	2.8±0.26	18.6±0.59
3	11:00 AM	8.0±0.61	3.7±0.68	4.0±0.31	1.9±0.60	15.0±2.58
4	01:00 PM	9.9±1.01	3.0±0.81	6.1±0.77	2.4±0.86	21.4±1.49
5	03:00 PM	8.9±0.98	3.3±0.64	4.0±0.65	2.1±0.34	18.2±1.3
6	05:00 PM	10.1±0.82	7.1±0.26	7.9±1.22	7.7±0.97	29.9±1.94
7	07:00 PM	10.6±0.89	3.7±0.42	5.1±0.59	1.6±0.57	21.0±1.39
8	09:00 PM	1.4±0.2	0.4±0.29	0.6±0.20	0.3±0.8	2.7±0.28

The warming up of the air temperature stimulates activities and attacks flies as well [38]. Total quantity insects of the Muscidae family was 18.9 ± 0.59 at 9 am with decreasing to 15.0 ± 2.58 at 11 am, with peak of increasing of intensity infection to 29.9 ± 1.94 flies/animal at 5pm, respectively. Species such as *Lyperosia* spp., *Stomoxys* spp., *Musca autumnalis* and *M. larvipara* were detected with range from 22 to 37 parasites per counted area of animals' body. Flies activity in the evening since 7 pm till 9 pm was characterized towards a gradual decrease, from 21.0 ± 1.39 to 2.7 ± 0.28

insects/animal. The results are in agreement with the findings of [21, 22] who reported for the activity of stable flies, their feeding and habitat sites on cattle pastures and premises. The main sites of flies attack (Figure 5) were on the animals' fore legs. The highest quantity of insects registered around dactylus bones (53.52, 48.4 and 53.52% at 7 am, 3 pm and 9 pm, respectively), which is meaning the difference of statistics of stable flies on variety parts of the cows' body during attacks.

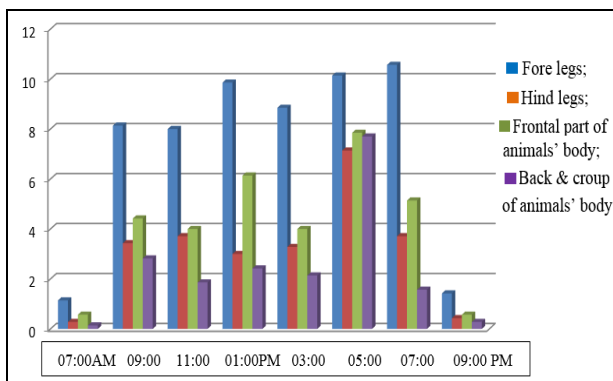


Fig 5: Dynamics of flies activity and site localization on cows' body.

Table 3: Daily localization of the family Muscidae flies on cows.

S. No	Day time indexes, hours	Insects quantity per animals' body, %			
		Fore legs	Hind legs	Frontal part of animals' body	Back & croup of animals' body
1	07:00 AM	53.52	13.15	26.76	6.57
2	09:00 AM	43.27	18.23	23.5	14.99
3	11:00 AM	45.53	21.12	22.77	10.59
4	01:00 PM	46.03	14.01	28.66	11.3
5	03:00 PM	48.44	17.95	21.89	11.71
6	05:00 PM	30.89	21.75	23.91	23.45
7	07:00 PM	50.36	17.68	24.49	7.48
8	09:00 PM	52.59	15.93	21.11	10.37

It is showed (Table 3), the tendency to rising up of 21.75% till 5 pm and decreasing down to 15.93% at 9 pm, with less ectoparasites quantity of the family Muscidae during day-time localization on hind legs in cows. The lowest quantity of insects was on back and hind part of cows' body, with 6.57, 7.48 and 10.37% at 7 am, 7 pm and 9 pm, respectively, in accordance to total counted flies. This study confirms the results of investigations of the daily activity of the family Muscidae flies in premises in Ukraine farms by Mashkei and Mashkei [19, 20] and in Russia farms by Novikov and Vesiolkin [25, 37].

Thus, in conditions of the dairy cattle farms of Kiev and Rivne regions of Ukraine, during September 2011, was recorded favorable conditions for the reproduction and development of flies of the families Muscidae (*Lyperosia* spp., *Stomoxys* spp., *Musca autumnalis*, *M. larvipara*), and Calliphoridae. These species were predominance on cows. Species of the genus *Lyperosia* was dominant flies on cows in pasture conditions. The present results of study of flying and attacks are in accordance with the results by Mashkei [19]. Regarding to his research, the prevalence species of flies on cows in premises were *M. domestica*, *Stomoxys calcitrans* Linnaeus, 1758 and *M. autumnalis* in Chernivtsi, Cherkassy, Poltava, Kharkiv regions of Ukraine; species such as *M. autumnalis*, *M. simplex* and *Fannia canicularis* Linnaeus, 1761 [19, 20] were recorded by Mashkei [20] at North of Ukraine. Some dependence of activity and attacks on cattle of some flies species from the day-time, air temperature, illumination, and from their flying and predominance on the ground, at shelter, in premises was revealed. Peak of their activity was studied during September, 2011 at the highest indexes environmental air temperature. Peculiarity of flies localization on cows was studied, which is due to their poikilothermic characteristic is to bite on areas with less hair of naturally warmed up by sun of animals' body during mouth apparatus penetration into blood vessels.

An efficacy of the Author's technique of recording and counting insects in special parts of cows' body was

established for the first time in Ukraine. High efficiency of the photographic fixation method with a digital camera for counting flies on animals was proved. It is highly accurate in quantitative indexes. Its efficacy was 100%.

4. Conclusions

As per our present study, it was clearly shown that cattle at premises and pasture conditions in Rivne and Kyiv regions of Ukraine are considerably attacked with ectoparasites of the families Muscidae and Calliphoridae flies leading to a risk of decreasing of milk yield and contracting telaziosis disease. The moderately warm climate and weather conditions of the regions in September provides a conducive environment for the development and spread of flies. Moreover, animal husbandry practicing may be improved in the flies control strategies. Therefore usage of adequate sanitary techniques as well as proper application of insecticides could help in the flies control under dairy farm conditions.

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