

Research Article



Sanitary and Hygienic Expertise of Seasonal Contamination of Pastures in the region North Caucasus with Invasive Elements of Nematodes of the Genus *Nematodirus* Ransom, 1907

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Abstract | Sanitary and helminthological studies of soil, grass and water samples in the lowland, foothill and mountainous zones of the North Caucasus region (Chechen Republic) revealed a different degree of their infection with eggs of nematodes of the genus *Nematodirus* Ransom, 1907. In the lowland zone of the Chechen Republic, 37.50% of soil samples, 23.00% of water samples were contaminated with invasive elements, respectively, in the foothill zone, 41.00% and 26.50% of samples, in the mountainous zone - 29.00% and 15.00% of soil and water samples. In all climatic zones, on average, 27.83% of soil and water samples were contaminated with eggs of nematodes of the genus *Nematodirus*, with an average of 10.59 ± 0.97 ind. eggs of nematodes in 4-5 g of each soil and water sample. Contamination of soil and water from pastures, places of accumulation of animals, from the banks of foothill rivers, from rural households, from agricultural territories, from the territory of hayfields with eggs of the genus *Nematodirus* amounted to 40.59%, 38.11%, respectively, 33.90%, 37.06%, 30.77%, 25.28% of soil samples, which indicates a moderate circulation of nematodiosis pathogens in the infrastructures of the foothill zone. In addition, it should be noted that these levels of environmental pollution by eggs of the genus *Nematodirus* are quite enough for the active implementation of the epizootic process of nematodiosis in animals in the North Caucasus region during the period (spring-summer-autumn).

Keywords | North Caucasian, Zone, Sanitation, Hygiene, Pasture, Pollution, Soil, Grass, Water, Egg, Nematode of the Genus *Nematodirus* Ransom, 1907.

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INTRODUCTION

Nematodiosis, belong to the list of ruminant helminthiasis hazardous to health, are caused by more than 10 species of nematodes from the genus *Nematodirus* (Ransom, 1907) of the family *Trichostrongylidae*, parasitize in the small intestine of sheep, goats, cattle, zebu, buffaloes, camels, wild ungulates. Nematodes of more than 15 species

from the genus *Nematodirus* Ransom, 1907 are found in Africa, Europe, North and South America, Asia, and Australia. (Ardavova et al., 2010; Onishchenko 2010; Bittirov et al., 2014; Kolodiy et al., 2012). Species *Nematodirus filicollis* (Rudolphi, 1802), *Nematodirus spathiger* (Railliet, 1896), *Nematodirus mauritanicus* (Mapes et Seurat, 1912), *Nematodirus normalis* (May, 1920), *Nematodirus oiratianus* (Rajewskaja, 1929) are widespread RFs of epizootolog-

ical significance. and, like many helminths, are found with high values of the extent and intensity of invasion (Vasilevich et al., 2010; Bittirov et al., 2012, 2013). Over the years (2003-2017), many authors (Bittirov; Atabiev; Kolodiy; Shikhalieva; Arkhipova, Arkhipov; Mantaeva; Onishchenko; Golubev; Vasilevich; Kabardiev; Kanokova; Sottaev; Gorokhov, Laipanov et al.) gave an epizootological assessment of the representatives of the genus *Nematodirus* (Ransom, 1907) in 18 ruminant species in the North Caucasus (Kolodiy et al., 2012; Golubev et al., 2011; Artamonova et al., 2012). According to veterinary statistics, nematodiosis caused by the species *Nematodirus oiratianus* (Rajewskaja, 1929), *Nematodirus spathiger* (Railliet, 1896), *Nematodirus abnormalis* (May, 1920), *Nematodirus filicollis* (Rudolphi, 1802) are mainly registered in sheep up to 10 species of the genus *Nematodirus* (Ransom, 1907) with invasion from 27.4% to 83.6%, in domestic goats - from 22.% to 75.5%, in cattle - from 17.6% to 68.3%. with medium and high abundance index. Many authors associate the wide spread of dangerous nematode invasion with an increase in the reproductive capacity of females of the genus *Nematodirus* in the warm season and an uncontrolled increase in pollution of soil, grass, and pasture waters by nematode eggs and larvae (Vasilevich, Bittirov, 2010; Kabardiev et al., 2015; Bittirov et al., 2010, 2019).

MATERIALS AND METHODS

The work was carried out on the basis of the parasitology laboratory of the Pre-Caspian Research Veterinary Institute in 2017-2020. For this purpose, in the spring, summer, autumn and winter, 200-600 soil samples were taken from the places of grazing, watering and resting animals in the lowland, foothill and mountainous zones of the Chechen Republic for testing for the presence of eggs of the genus *Nematodirus* (Ransom, 1907) of grassland and water. In the biotopes of the lowland, foothill, and mountainous zones, of we conduct experiments to determine the developmental time of eggs of the genus *Nematodirus* (Ransom, 1907) at altitudes of 200, 400, 600, 800, 1000, 1500, 2000, 2500, 3000 m above sea level. The experiments were carried out using fresh eggs and larvae of the genus *Nematodirus*, washed from the uterus of females. Samples of eggs nematodes in the amount of 10-15 thous were and placed on the experimental site every month from March to November to determine their viability in winter. For this, eggs were placed in glass jars, which were then placed on a biological platform. Samples of soil and water with eggs of the genus *Nematodirus* were taken every decade to determine the viability of invasive elements. In each case, 100 ekz of eggs of the genus *Nematodirus* were examined under a microscope from samples of soil and water. The vitality of eggs of the genus *Nematodirus* after the winter period was studied using helminthoscopy and MUK "Methods of

sanitary-parasitological studies" [1-14]. The data were subjected to statistical processing by the computer program "Biometry".

RESULTS AND DISCUSSION

Sanitary-helminthological studies of soil and water samples in the lowland, foothill, and mountainous zones of the Chechen Republic revealed their different levels of contamination with eggs of nematodes of the genus *Nematodirus* (Table 1). In the lowland zone, 37.50% soil samples, 28.00% water samples were contaminated by invasive elements, respectively, in the foothill zone, 41.00%, 31, 00% and 26.50% samples, in the mountain zone - 29.00%, 19.50% and 15.00% of soil and water samples. In all climatic zones of the Chechen Republic, an average of 27.83% of soil, grass, and water samples were contaminated with eggs of the genus *Nematodirus* (Ransom, 1907) when an average of 10.59 ± 0.97 ekz. of eggs in 5 g of each sample of soil and water. In of the plains, foothills and mountains zone of the Chechen Republic, the most eggs of the genus *Nematodirus* (Ransom, 1907) contaminated discovered of soil, grass and water in places livestock grazing, watering, and resting animals (Table 1).

The seasonal assessment of soil and water pollution in the lowland zone by eggs of nematodes of the genus *Nematodirus* (Ransom, 1907) (according to ovoscopy and larvoscopy of samples) showed an increase in their contamination in the warm season (spring, summer, autumn) when a multiple decrease of in the of number eggs and larvae aftermath in soil, water in the winter, which is associated with sexual depression of female nematodes and the death of invasive elements at low temperature in the external environment.

In of the plains zone in spring, 27.00% of soil samples were contaminated with eggs of nematodes of the genus *Nematodirus* (Ransom, 1907), in summer - 35.00% of samples, in autumn -42.00% of samples, in winter - 13.00% of soil samples, of respectively season, 18.00%, 24.00%, 30.00%, 8.00% grass samples, 11.00%, 19.00%, 25.00%, 5.00% water samples. On average, of in the lowland zone, eggs of nematodes of the genus *Nematodirus* (Ransom, 1907) contaminate 22.50% of soil and water samples with an increase in the number of nematode eggs in 5 grams of each sample of from 3.0 ± 0.2 to 17.6 ± 1.7 ekz. (average 8.83 ± 0.87 ekz. per 5 g of each sample), which indicates the formation of the plains pasture biotopes of animal nematodiosis invasion in the region in any season (Table 2). In the foothill zone, the dynamics of soil and water pollution by eggs of nematodes (according to the data of ovoscopy and sample larvoscopy) differs from the plain zone by higher rates of

Table 1: Sanitary and hygienic studies of soil and water samples for the presence of eggs of the genus *Nematodirus* from places grazing, of watering and of resting animals in the plains, foothills and mountains zones

Natural and climatic zone	Samples investigated	The number of contaminated samples	% contaminated samples	The number of eggs of the genus <i>Nematodirus</i> (Ransom, 1907) in 5 g of samples, instance
Soil				
Lowland zones	200	75	37,50	14,7±1,3
Foothill zones	200	82	41,00	16,4±1,5
Mountainous zones	200	58	29,00	9,2±0,9
Water				
Lowland zones	200	46	23,00	8,0±0,7
Foothill zones	200	53	26,50	11,6±1,1
Mountainous zones	200	30	15,00	5,0±0,4
Total:	1200	344	-	-
Average:	-	-	28,67	10,59±0,97

Table 2: Seasonal assessment of soil and water pollution in the flat zone by eggs of nematodes of the genus *Nematodirus* (Ransom, 1907) (according to ovoscopy of samples of soil and water in 2017-2020)

Season of year	Investigated samples, ekzemplyar	Discovered samples with eggs of the genus <i>Nematodirus</i> (Ransom, 1907), ekz.	% contaminated samples	Amount eggs of the genus <i>Nematodirus</i> (Ransom, 1907) in 5 g samples, ekzemplyar
Soil				
Spring	100	27	27,00	10,8±1,1
Summer	100	35	35,00	14,2±1,3
Autumn	100	42	42,00	17,6±1,7
Winter	100	13	13,00	6,3±0,5
Water				
Spring	100	11	11,00	4,6±0,5
Summer	100	19	19,00	6,8±0,7
Autumn	100	25	25,00	9,2±1,0
Winter	100	5	5,00	3,0±0,2
Total:	800	177	-	-
Average:	-	-	22,13	8,83±0,87

detection of positive samples in all seasons of the year. An increase in the pollution of soil, pasture grasses and water by eggs of nematodes is also observed in the warm season. (spring, summer, autumn) with a multiple decrease in the number of eggs in soil and water in winter, which is associated with sexual depression female nematodes and the death of invasive elements at low temperature in the external environment (Table 3). In the spring of infected in the foothill zone were of eggs nematodes of the genus *Nematodirus* 36.00% of soil samples, in summer - 48.00% of samples, in autumn - 55.0% of samples, in winter - 19.0% of soil samples, respectively of season, 18.00%, 28.00%, 36.00%, 9.00% water samples (Table 3). On average, in the foothill zone, eggs of the genus *Nematodirus* contaminate 30.00% of soil and water samples with an increase in the number of nematode eggs in 5 g of each sample from 5.4 ± 0.5 to 22.0 ± 1.8 ekz. (average 12.73 ± 1.04 ekz.), which

is associated with a favorable temperature and humidity regime of the foothill zone for the formation of permanent pasture biotopes of animal nematodiosis in the region in all seasons (Table 3).

In the mountainous zone, the dynamics of pollution of soil and water by eggs of nematodes of the genus *Nematodirus* (Ransom, 1907) differs from the foothill zone by lower rates of detection of positive samples in all seasons the year. In the mountainous zone, the level of contamination of soil and water by eggs of nematodes was significantly lower in all seasons. (spring, summer, autumn, winter), which is associated with the death of invasive elements at low temperature in the environment. In the mountain zone in the spring, 16.00% of soil samples were infected with eggs of nematodes of the genus *Nematodirus* of in the summer - 23.00% of samples, in the autumn - 29.00% of samples,

Table 3: Seasonal assessment of soil and water pollution in the foothill zone by eggs and larvae of nematodes of the genus *Nematodirus* (Ransom, 1907) (according to ovoscopy of samples of soil and water)

Season of year	Investigated samples, ekzemplyar	Discovered samples with eggs of the genus <i>Nematodirus</i> , ekz.	% contaminated samples	Amount eggs of the genus <i>Nematodirus</i> in 5 g samples, ekzemplyar
Soil				
Spring	100	36	36,00	14,7±1,1
Summer	100	48	48,00	18,4±1,5
Autumn	100	55	55,00	22,0±1,8
Winter	100	19	19,00	10,6±0,9
Spring	100	18	18,00	8,9±0,7
Summer	100	28	28,00	10,5±0,9
Autumn	100	36	36,00	12,8±1,1
Winter	100	9	9,00	5,4±0,5
Total:	1200	360	-	-
Average:	-	-	30,00	12,73±1,04

Table 4: Seasonal assessment of soil and water pollution in the mountain zone by of nematodes of the genus *Nematodirus* (according to ovoscopy of samples of soil and water)

Season of year	Investigated samples, ekzemplyar	Discovered samples with eggs of the genus <i>Nematodirus</i> , ekz.	% contaminated samples	Amount eggs of the genus <i>Nematodirus</i> in 4- 5 g samples, ekzemplyar
Soil				
Spring	100	16	16,00	7,8±0,7
Summer	100	23	23,00	10,4±1,0
Autumn	100	29	29,00	13,1±1,2
Winter	100	13	13,00	4,4±0,3
Water				
Spring	100	6	6,00	3,3±0,2
Summer	100	10	10,00	5,1±0,4
Autumn	100	13	13,00	7,2±0,6
Winter	100	3	3,00	1,8±0,3
Total:	800	113	-	-
Average:	-	-	14,13	6,51±0,59

in winter - 13.00% of soil samples, respectively seasons, 10.00%, 15.00%, 18.00%, 5.00%, water samples- 6.00%, 10.00%, 13.00%, 3.00% On average in the upland zone, eggs of nematodes *Nematodirus* (Ransom, 1907) contaminate 13.42% of soil and water samples with an increase in the number of nematode eggs in 5 g of each sample from 1.8±0.3 to 13.1±1,2 ekz. (average 6.51±0.59 ekz.), which is associated with a less favorable temperature and humidity regime of the mountain zone for the formation of permanent pasture biotopes of animal Nematodirosis in the region in all seasons of the year (Table 4).

When of studying pollution soil and water of eggs nematode the genus *Nematodirus* from pasture areas, from places of animal gathering, from of the banks of foothill rivers, from rural households, from farm territories, hay-

fields of the Chechen Republic, were established moderate pollution of soil, grass and water. The number of soil, grass, and water samples contaminated with invasive elements of nematodes was relatively high in areas with a higher concentration of animals sick with nematodirosis. Contamination of soil, grass and water from pasture areas, from animal gathering places, from the banks of foothill rivers, from rural households, from farm territories, from the territory of hayfields of the Chechen Republic with eggs of nematodes of the genus *Nematodirus* amounted, respectively, 40.59%, 38.11%, 33.90%, 37, 06%, 30.77%, 25.28%, of samples soil, which indicate a moderate circulation of Nematodirosis pathogens in the infrastructures of the foothill zone. Moreover, it should be noted that these levels of environmental pollution by eggs of nematodes of the genus *Nematodirus* (Ransom, 1907) are quite

Table 5: Soil and water pollution of foothill pastures of the Chechen Republic by eggs of nematodes of the genus *Nematodirus* (according to ovo-- and larvoscopy of samples of soil of pasture and water)

Objects	Number of objects soil, grass and water, units	Investigated samples soil, grass and water, units	Samples soil, grass and water with eggs of the genus <i>Nematodirus</i>	% contaminated samples soil, grass and water	Power contaminated soil, grass and water
Soil and water of grassland	27	50=1350	548	40,59	++
Soil and water from places of concentration of animals	36	50=1800	686	38,11	++
Soil. water from the coasts of foothill rivers	20	50=1000	339	33,90	++
Soil and water from rural households	44	50=2200	815	37,06	++
Soil. water from of territories farms	62	50=3100	954	30,77	++
Soil. of territories hayfields	50	50=2500	632	25,28	+

sufficient for the active implementation of the epizootic process of animal Nematodiosis in the region North Caucasus during the entire warm season (spring-summer-autumn) (Table 5).

CONDITIONAL DESIGNATIONS

+ - weak power pollution; ++ - medium power pollution; +++ - strong degree of s contamination.

The obtained data indicate moderate pollution of soil, grass and water of pastures, places of concentration of livestock, from of the banks of foothill rivers, from rural households, from farms, from hayfields of the Chechen Republic with eggs and larvae nematodes of the genus *Nematodirus* (Ransom, 1907). However, moderate circulation of invasive elements of nematodes of the genus *Nematodirus* (Ransom, 1907) in the flat, piedmont, and mountain infrastructures is quite sufficient for the active implementation of the epizootic process of animal Nematodiosis in the region North Caucasus throughout the entire warm, which is consistent with the data of the prof. A.M Bittirov et al. (2010, 2013, 2019), Academician of the Russian Academy of Sciences F.I. Vasilevich et al. (2010).

CONCLUSION

When of studying pollution soil, grass, and water of eggs nematodes the genus *Nematodirus* (Ransom, 1907) from pasture areas, from places of animal gathering, from of the banks of foothill rivers, from rural households, from farm territories, hayfields of the Chechen Republic, were established moderate pollution of soil, grass and water. The number of soil, grass, and water samples contaminated with invasive elements of nematodes was relatively high in areas with a higher concentration of animals sick with Nematodiosis. Contamination of soil, grass and water from pasture areas, from animal gathering places, from the banks of foothill rivers, from rural households, from farm

territories, from the territory of hayfields of the Chechen Republic with eggs of the genus *Nematodirus* (Ransom, 1907) amounted, respectively, 40.59%, 38.11%, 33.90%, 37, 06%, 30.77%, 25.28%, of samples soil, which indicate a moderate circulation of Nematodiosis pathogens in the infrastructures of the foothill zone. Moreover, it should be noted that these levels of environmental pollution by eggs of nematodes of the genus *Nematodirus* (Ransom, 1907) are quite sufficient for the active implementation of the epizootic process of animal Nematodiosis in the region North Caucasus during the entire warm season of the year (spring-summer-autumn).

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors took part in the sanitary-hygienic examination of seasonal pollution of pastures in the North Caucasus region with invasive elements of nematodes of the genus *Nematodirus* Ransom, 1907, collected materials, analyzed the material and participated in writing the manuscript. Collectively reviewed the manuscript. All authors read and approved the final version of the manuscript.

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