Original papers

# The annual population dynamics of gastrointestinal nematodes in breeding sheep of the Silesian Foothills, southern Poland

**Aleksandra Balicka-Ramisz[1], Grzegorz Ramisz[2], Justyna Żychlińska-Buczek[3]**

[1]Department of Biotechnology of Animal Reproduction and Environment Hygiene, West Pomerania University of Technology; Szczecin, Poland
[2]Veterinary Clinic, Bielska 3a, 43-400 Cieszyn, Poland
[3]Department of Cattle Breeding Poland, Agricultural University of Cracow, Poland

Corresponding author: Aleksandra Balicka-Ramisz; e-mail:aleksandra.balicka-ramisz@zut.edu.pl

**ABSTRACT.** The study was carried out on an organic farm. The flock of the sheep (27 individuals) was naturally infected by parasites. The aim of the study was to estimate the prevalence of infection with gastrointestinal nematodes. There were found species of 3 nematode families: Trichostrongylidae (*Trichostrongylus* spp., *Ostertagia* sp., *Nematodirus* spp., *Cooperia* spp., *Haemonchus contortus*); Strongylidae (*Oesophagostomum* spp., *Strongyloides papillosus*, *Chabertia ovina*) and Ancylostomatidae (*Bunostomum* sp.). Three nematode genera were dominant in parasite infection: *Trichostrongylus*, *Ostertagia* and *Nematodirus*. The prevalence of sheep infection with gastrointestinal nematodes were nearly 100%. The main species were *Trichostrongylus* spp. (59.2%) and *Ostertagia* sp. (46%).

**Key words**: sheep, gastrointestinal nematodes, parasite, prevalence, Poland

## Introduction

Healthy food production and animal husbandry in organic farming, the development of rural tourism, participation in agri-environmental programs, and the promotion of sustainable development within agriculture have forced changes in accommodation for different species of animals, including sheep. The breedings are concentrated within developed countries and in the most populated areas. The market demand for agricultural products that are free of chemicals also requires constant observation of the parasites present in the environment. This monitoring requires knowledge of seasonal infections and the elements responsible for the variability of such infections [1,2].

In Poland, despite the introduction of support schemes under the Common Agricultural Policy (CAP), which have favorably influenced the profitability of the sheep farm, there has been no positive response from the manufacturers [3]. In 2004, a program to protect the genetic resources of sheep was initiated in Poland, which as of 01.03.2012, involved 43,616 mothers in 666 herds [4]. Because of the costs involved, these farms don't enagage in systematic deworming programmes. Parasitological control should be adapted to suit individual farms and should incorporate knowledge about sheep farming systems, the risk, the effects of pathogens, the relationship between pollution and the presence of invasive pasture larvae. The spread of parasites in the environment poses a major threat to the future production and welfare of sheep [5].

For the sake of the well-being and humane treatment of the animals, the farmer is obliged to provide them with good health care, one aspect of this being the prevention of parasitological infections, which is usually not appreciated by the livestock owner. Parasitic diseases constitute a group of pasture diseases, which means that the infection of the host itself and the development of the parasite outside the host is in the pasture. The

Table 1. Prevalence (%) and intensity (EPG) infection with gastrointestinal nematodes in sheep

| Genre of gastrointestinal nematodes | Number of infected sheep N=27 | Prevalence (%) | Intensity range | Range of infection (EPG) |
|---|---|---|---|---|
| *Trichostrongylus* spp. | 16 | 59.2 | 50-1560 | 332 |
| *Ostertagia* sp. | 13 | 46.0 | 20-1330 | 255 |
| *Oesophagostomum* spp. | 8 | 29.6 | 30-1070 | 274 |
| *Bunostomum* sp. | 7 | 25.9 | 50-120 | 48 |
| *Nematodirus* spp. | 4 | 14.8 | 20-100 | 45 |
| *Strongyloides papillosus* | 5 | 18.5 | 50-1430 | 550 |
| *Chabertia ovina* | 2 | 7.4 | 0-100 | 36 |
| *Cooperia* spp. | 2 | 7.4 | 0-50 | 22 |
| *Haemonchus contortus* | 1 | 3.7 | 0-980 | 39 |

pathogenicity of gastrointestinal helminthiasis consists mainly of the larvae of some species feeding off the the blood of the host, causing anemia [6–9], damaging the digestive glands and causing inflammation of the mucous membranes abomasum and intestines. Most infections take a subclinical form and affect production losses, manifested mainly by poorer body weight gains or declines in milk production [10]. Furthermore, parasites damage the tissues and organs of animals, which can increase the risk of infection and reduce the resistance of the organism [11–14].

The aim of this study was to determine the species composition and the level of gastrointestinal nematode invasion in sheep in their natural habitat, and monitor an annual invasion.

## Materials and Methods

The study was carried out on a sheep farm located on the Silesian Foothills, southern Poland, which employs the traditional system of farming. The flock of sheep used in the study was naturally infected and had never been dewormed. The fodder base was made of vegetation available on pasture. The summer grazing period in which the study was conducted lasted from mid-May to late September. The farm is located in the temperate climate zone with an average annual temperature of 9°C and rainfall about 750 mm.

The parasitological study population comprised 27 individuals: all the sheep on the farm. Parasitological monitoring was conducted on an annual basis. Stool samples were collected regularly at monthly intervals. The study was based on a quantitative method (Fecal Egg Counts – FEC) using the McMaster technique, which allowed the number of eggs to be determined in 1 g of feces (EPG factor) [15].

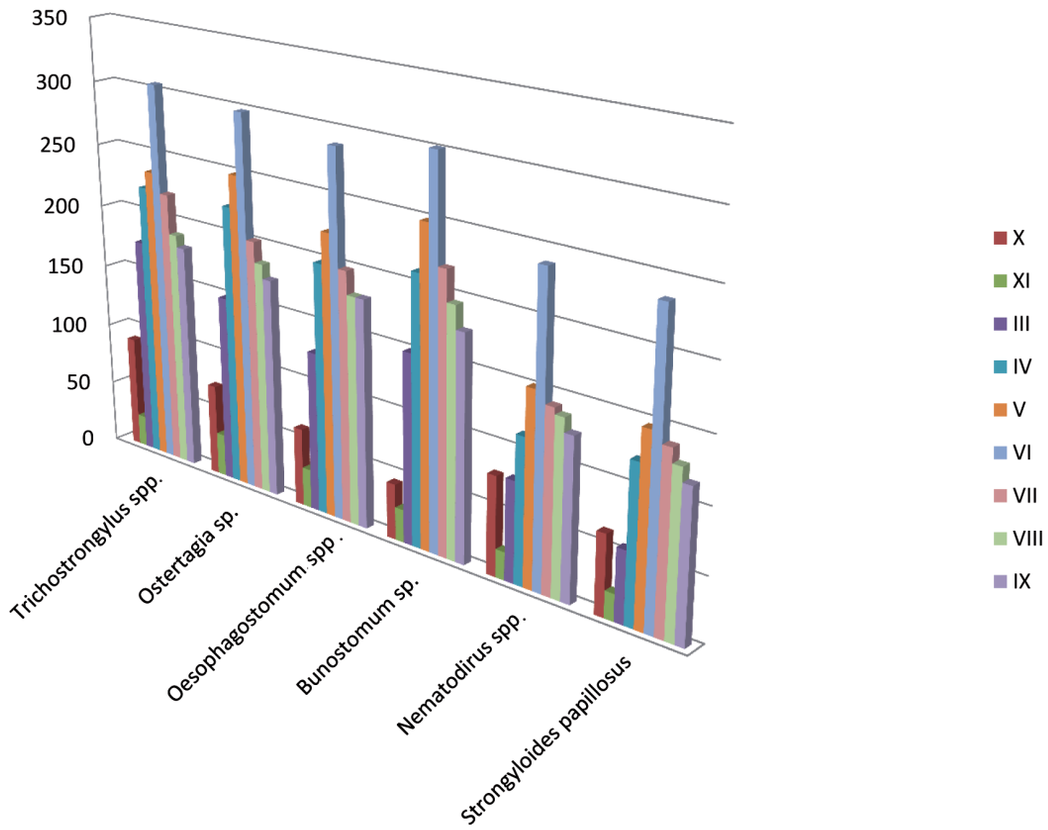
In addition to the coproscopy tests, larvae were cultured in the faeces in order to identify the species of gastrointestinal nematodes. The cultures were incubated at 25°C for 7–10 days [16], the invasive stages (L3) were obtained after isolation in coproculture as recommended by the MAFF [17–19].

## Results

The course of parasitic infection in sheep depends largely on factors associated with geoclimate and breeding. Therefore, the problem of parasites should be considered as a common resultant of the interaction between animals, parasites and breeding methods positioned in the environment in which they reside [20]. The sheep were naturally infected by parasites, the infections were mixed and the total prevalence was 100%.

In the environment where the study was performed, the gastrointestinal nematodes belonging to three families, were identified in the larval cultures: Trichostrongylidae, Strongyloidae and Ancylostomatidae. The highest prevalence was observed in nematode larvae from the Trichostrongylidae, of which three species were identified, *Trichostrongylus* spp., *Ostertagia* sp. (*Teladorsagia* spp.) and *Nematodirus* spp., whose prevalence was found to be 59.2%, 46.0% and 14.8%, respectively. The highest average rate of EPG was 550 eggs per gram of faeces, found in the species *Strongyloides papillosus*, while the lowest was found in *Cooperia* spp. – 22 eggs per gram of

**Fig. 1. The level of gastrointestinal infection during the year**




faeces. The proportions of occurrence of these nematodes evolved over the course of the grazing season. Detailed test results are presented in Table 1.

The annual dynamics of gastrointestinal nematodes reveal that even before being let out to pasture in the middle of May, the prevalence was very high and underwent only slight fluctuations until September (Fig. 1). In months December and January there was observed no eggs. The highest prevalence (24.6%) coincided with the high intensity of infection.

## Discussion

Gastrointestinal nematodes (GIN) are the main obstacle in the sheep breeding. Since many years the control of these parasites was not only based on using many times the synthetic medicine against worms [21].

Research indicates that the gastrointestinal nematode infection of sheep is still one of the most widespread parasitic diseases contributing to economic losses worldwide [10]. Information regarding the occurrence of gastrointestinal nematodes comes from both the countries where sheep farming is highly developed (UK, Spain, Italy and France, the U.S.) and countries where animal husbandry constitutes rooted tradition (Greece, Romania, Jordan, Turkey, Ethiopia). In Poland, the research on parasites in sheep has been conducted for many years in research centers in various cities. Research conducted in Poland concerns mainly the impact of infection of sheep on performance [22,23] and the occurrence of drug resistance [24]. In many countries, research into the problem of gastro-intestinal nematodes is limited to epidemiological studies, studies of prevention programs, and to undertake pharmacological therapies [25]. In 80s research on the dynamics of nematodes invasion in sheep's stomach was carried in Warsaw region. Sheep were infected in 95.1%. the main species were *Trichostrongylus axei* (75.9%), *Ostertagia circumcincta* (44.9%) and *Haemonchus contortus* (23.7%). The eggs were the most excrete in April and August; there was also observed that the development of larva is stopped in autumn-winter period [26].Szczepanik et al. showed a universality of gastrointestinal nematodes infection in sheep

[27]. Elaboration of programmes to fight against parasites should contain a dynamics and course of invasion in a year period [28]. A lack of interest polish growers to the deworming programmes is the result of low profitability of inbreeding these animals in Poland [3].

Improper deworming in recent years has contributed to resistance to anthelmintics [29]. However, in recent years, scientific research centers have mainly focused on the detection of this resistance [25,30,31].

The introduction of sustainable agriculture and organic animal husbandry, and the emergence of drug-resistant parasites, have contributed significantly to the exploration of new alternative formulations useful in the prevention of parasitological infection. Current research projects must include a balanced strategy to mitigate the impact of global changes on helminth infections in ruminants and to develop alternative treatment strategies for sustainable control of parasites (projects Cost B16 and FP6-UMBRELLA). The aim of these projects is also to implement better ways to detect resistance to antiparasitic preparations. In this project, a consortium of renowned experts in the field working in independent laboratories finished a series of studies on the topics of drug resistance and the ability to inhibit the migration of larvae [31,32].

In recent years, a rapid diagnostic test confirming the presence of parasites in small ruminants has been developed and implemented for husbandry practice. The FAMACHA© system has been thoroughly tested in South Africa, and is based on a clinical assessment of the anemia in the mucous membrane of the eye caused by gastro-intestinal nematodes [6–9]. It has since been successfully introduced to farming practices in many countries [33]. This diagnosis allows rapid treatment, and has contributed to improved economic benefits for many farms [34,35]. These changes have addressed the need for constant parasitological monitoring sheep in their natural environment.

In the organic farm, parasitic infections may represent a serious economical, biological and environmental problem.

## References

[1] Garcia-Romero C., Valcarce-Sancho F., Rojo-Vazquez F.A. 1995. Contaminación de los pastos por Tricostrongilidos ovinos en la comarca de Oropesa (Toledo). *Investigaction Agraria. Produccion y Sanidad Animales* 10: 19-28.

[2] Uriarte J., Llorente M.M., Valderrábano J. 2003. Seasonal changes of gastrointestinal nematode burden in sheep under an intensive grazing system. *Veterinary Parasitology* 118: 79-92.

[3] Nowakowski P., Chudoba K. 2011. Ekonomia chowu owiec w Polsce na początku XXI wieku. *Wiadomości Zootechniczne* 3: 37-43.

[4] Sikora J., Puchała M. 2012. Current state of breeding native breed sheep in Poland. In: Proceedings of International Scientific Conference „Presence and future of animal science" Cracow, Poland; 21-22. 06.2012: 179.

[5] Papadopoulo E. 2008. Anthelmintic resistance in sheep nematodes. *Small Ruminant Research* 76: 99-103.

[6] Kaplan R.M., Burke J.M., Terrill T.H., Miller J.E., Getz W.R., Mobini S., Valencia E., Williams M.J., Williamson L.H., Larsen M., Vatta A.F. 2004. Validation of the FAMACHA© eye color chart for detecting clinical anemia in sheep and goats on farms in the southern United States. *Veterinary Parasitology* 123: 105-120.

[7] Leask R., van Wyk J.A., Thompson P.N., Bath G.F. 2013. The effect of application of the FAMACHA© system on selected production parameters in sheep. *Small Ruminant Research* 110: 1-8.

[8] Malan F.S., Van Wyk J.A., Wessels C.D. 2001. Clinical evaluation of anemia in sheep: early trials. *Onderstepoort Journal* of *Veterinary Research* 68:165-174.

[9] Moors E., Gauly M. 2009. Is the FAMACHA chart suitable for every breed? Correlations between FAMACHA scores and different traits of mucosa colour in naturally parasite infected sheep breeds. *Veterinary Parasitology* 166: 108-111.

[10] Cringoli G., Veneziano V., Jackson F., Vercruysse J., Greer A.W., Fedele V.L. Mezzino L., Rinaldi L. 2008. Effects of strategic anthelmintic treatments on the milk production of dairy sheep naturally infected by gastrointestinal strongyles. *Veterinary Parasitology* 156: 340-345.

[11] Manga-Gonzalez M.Y., Gonzalez-Lanza C., Cabanas E., Campo R. 2001. Contributions to and review of dicrocoeliosis, with special reference to the intermediate hosts of *Dicrocoelium dendriticum*. *Parasitology* 123: 91-114.

[12] Hoste H., Torres-Acosta J.F., Paolini V., Aguilar-Caballero A., Etter E., Lefrileux Y., Chartier C. 2005. Interactions between nutrition and gastrointestinal infections with parasitic nematodes in goats. *Small Ruminant Research* 60: 141-151.

[13] Rinaldi L., Veneziano V., Cringoli G. 2007. Dairy goat production and the importance of gastrointestinal strongyle parasitism. *Transactions of the Royal Society of Tropical* Medicine *and* Hygiene 101: 745-746.

[14] Louie K., Vlassoff A., Mackay A.D. 2007. Gastrointestinal nematode parasites of sheep: A dynamic model for their effect on live weight gain. *International Journal for Parasitology* 37: 233-241.
[15] Thienpont D., Rochette F., Vanparijs O.F.J. 1979. Diagnosing helminthiasis through coprological examination. Janssen Research Foundation. Beerse, Belgium.
[16] Henriksen S.A., Korsholm H.A. 1983. Method for culture and fecovery of gastrointestinal strongyle larvae. *Nordisk Veterinaermedicin* 35:429-430.
[17] M.A.F.F. 1986. Manual of Veterinary Parasitological Laboratory Techniques. *Ministry of Agriculture, Fisheries and Food*, Reference Book 418, H.M.S.O. London: 5.
[18] Douvres F.W. 1957. Keys to the identification and differentiation of the immature parasitic stages of gastrointestinal nematodes of cattle. *American Journal of Veterinary Research* 18: 81-85.
[19] van Wyk J.A., Cabaret J., Michael L.M. 2004. Morphological identification of nematode larvae of small ruminants and cattle simplified. *Veterinary Parasitology* 119: 277-306.
[20] Sargison N.D. 2013. Understanding the epidemiology of gastrointestinal parasitic infections in sheep: What does a faecal helminth egg count tell us? *Small Ruminant Research* 110: 78-81.
[21] Heckendorn F., Häring D. A., Maurer V., Zinsstag J., Langhans W., Hertzberg H. 2006. Effect of sainfoin (*Onobrychis viciifolia*) silage and hay against gastrointestinal nematodes in lambs. *Veterinary Parasitology* 142: 293-300.
[22] Gorski P., Niznikowski P., Popielarczyk D., Strzelec E., Gajewska A., Wedrychowicz H. 2004. Natural parasitic infections in various breeds of sheep in Poland. *Archiv Tierzucht* 47: 50-55.
[23] Charon K., Moskwa B., Cabaj W., Rutkowski R. 1999. The influence of gastrointestinal nematode infection on productivity results in sheep. *Medycyna Weterynaryjna* 55: 531-534.
[24] Balicka-Ramisz A., Ramisz A. 1999. Benzimidazol resistance in nematode parasites in domesticated animals in north-west part Poland, *EJPAU Animal Husbandry*, 2.
[25] Demeler J., Schein E., von Samson-Himmelstjerna G. 2012. Advances in laboratory diagnosis of parasitic infections of sheep. *Veterinary Parasitology* 189: 52-64.
[26] Pelinski M. 1980. Seasonal dynamics of stomach nematode invasion in sheep and the effect of inhibition phenomenon of larval development on the sheep infestation in spring. *Acta Parasitologica Polonica* 27 (46/60): 493-506.
[27] Szczepaniak K., Tomczuk K., Junkuszew A., Chałbias-Mazurek A. 2010. Parasitological investigation of the sheep from open pasture farming system. In: Proceedings of XXII Congress of PPS, Pulawy (Poland ), 1-3.09.2010: 115.
[28] Skalska M, Kornaś S., Basiaga M., Nowosad B. 2010. The infection with gastro-intestinal parasites in sheep from the experimental station. In: Proceedings of XXII Congress of PPS, Pulawy (Poland), 1–3.09.2010: 127.
[29] Demeler J., Küttler U., El-Abdellati A., Stafford K, Rydzik A., Varadyf, Kenyon M, Coles G., Höglund J., Jackson F., Vercruysse J., von Samson-Himmelstjerna G. 2010. Standardization of the larval migration inhibition test for the detection of resistance to ivermectin in gastrointestinal nematodes of ruminants. *Veterinary Parasitology* 174: 58-64.
[30] Taylor M.A., Hunt K.R., Goodyear K.L. 2002. The effects of endspecific selection on the development of benzimidazole resistance in *Haemonchus contortus* in sheep. *Veterinary Parasitology* 109: 29-43.
[31] Demeler J., Kleinschmidt N., Küttler U., Koopmann R., von Samson-Himmelstjerna G. 2012. Evaluation of the egg hatch assay and the larval migration inhibition assay to detect anthelmintic resistance in cattle parasitic nematodes on farms. *Parasitology International* 61: 614-618.
[32] von Samson-Himmelstjerna, G., Coles G.C., Jackson F., Bauer C. Borgsteede F., Cirak V.Y., Demeler J., Donnan A., Dorny P., Epe C., Harder A., Hoglund J., Kaminsky R., Kerboeuf D., Kuttler U., Papadopoulos E., Posedi J., Smal J., Varady M., Vercruysse J., Wirtherle N. 2009. Standardization of the egg hatch test for the detection of benzimidazole resistance in parasitic nematodes. *Parasitology Research* 105: 825-834.
[33] Mahieu M., Arquet R., Kandassamy T., Mandonnet N., Hoste H. 2007. Evaluation of targeted drenching using FAMACHA method in Creole goat: reduction of anthelmintic use, and effects on kid production and pasture contamination. *Veterinary Parasitology* 146: 135-140.
[34] Kenyon F., Greer A.W., Coles G.C., Cringoli G., Papadopoulos E., Cabaret J., Berrag B., Varady M., Van Wyk J.A., Thomas E., Vercruysse J., Jackson F. 2009. The role of targeted selective treatments in the development of refugia-based approaches to the control of gastrointestinal nematodes of small ruminants. *Veterinary Parasitology* 164: 3-11.
[35] Fleming S.A., Craig T., Kaplan R.M., Miller J.E., Navarre C., Rings C. 2006. Anthelmintic resistance of gastrointestinal parasites in small ruminants. *Journal* of *Veterinary Internal Medicine* 20: 435-444.

*Received 3 September 2013*
*Accepted 4 November 2013*