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## Seasonal Activity of Gastro-Intestinal Nematodes in Goats in Burdur Region, Turkey

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**Abstract:** In this study, the gastro-intestinal (GI) organs of 50 goats in Burdur region, Turkey, were investigated for the prevalence of GI nematodes and the seasonal activity of the parasites was examined. All the animals examined (100%) were found to be infected with GI nematodes.

Twenty-two nematode species were identified and a total of 53,759 nematodes were collected from the infected goats. The number of parasites per goat ranged from 65 to 4811 (mean 1075.18), while the number of nematode species per animal ranged from 1 to 12 (mean 6.34).

The most frequently detected nematodes in the goats were *Ostertagia circumcincta* (78%), *Marshallagia marshalli* (72%), *Nematodirus abnormalis* (66%), *Trichuris ovis* (60%), *N. spathiger* (52%), *T. skrjabini* (50%) and *Trichostrongylus vitrinus* (40%). In this study, *Parabronema skrjabini* was recorded for the first time in goats in Turkey.

The parasite counts in the goats increased in spring, declined in summer, reached maximum levels in autumn, and then tended to decline until winter, before increasing again in mid-winter. Species of *Ostertagia*, *Trichostrongylus*, *Nematodirus* and *M. marshalli* were observed in all seasons of the year. The numbers of *Trichostrongylus* spp. peaked in spring and autumn and a small rise was observed in January. *Nematodirus* spp. increased in January and April, and peaked in September. *Ostertagia* spp. and *M. marshalli* counts moved in parallel, increasing in January and April. *Ostertagia* spp. peaked in September and *M. marshalli* in October.

**Key Words:** Goats, GI nematodes, seasonal activities, Burdur.

### Burdur Yöresi Keçilerinde Sindirim Sistemi Nematodları ve Mevsimsel Aktiviteleri

**Özet:** Burdur yöresi keçilerinde mide-bağırsak nematodları ve mevsimsel aktivitelerini belirlemek amacıyla yapılan bu çalışmada, incelenen 50 keçinin tamamı (% 100) GI nematodlar ile enfekte bulunmuş ve 22 tür saptanmıştır. Enfekte keçilerden 53759 adet nematod toplanmış, bir hayvanda bulunan toplam parazit sayısı 65 – 4811 (ort. 1075.18 ), tür sayısı ise 1-12 (ort. 6.34) arasında değişmiştir.

Hayvanlarda en çok görülen türler *Ostertagia circumcincta* (% 78), *Marshallagia marshalli* (% 72), *Nematodirus abnormalis* (% 66), *Trichuris ovis* (% 60), *N. spathiger* (% 52), *T. skrjabini* (% 50) ve *Trichostrongylus vitrinus* (% 40) olarak saptanmıştır. *Parabronema skrjabini* Türkiye’de keçilerden ilk kez bu çalışmada kaydedilmiştir.

Keçilerde toplam parazit yükü ilkbaharda artıp yaz aylarında azalmış, sonbaharda en üst düzeye çıkmış, sonra kış aylarına kadar azalarak devam etmiş ve kış ortasında tekrar bir artış göstermiştir. *Ostertagia* spp., *Trichostrongylus* spp. *Nematodirus* spp. ve *M. marshalli* her mevsimde görülmüş, ancak *Trichostrongylus* türleri ilkbahar ve sonbaharda pik yapmış, Ocak ayında hafif bir yükseliş göstermiştir. *Nematodirus* türleri Ocak ve Nisan’da yükselip Eylül’de pik yapmıştır. *Ostertagia* türleri ve *M. marshalli* paralel bir seyir izlemiş, Ocak ve Mayıs aylarında yükselmiş, *Ostertagia* türleri Eylülde, *M. marshalli* ise Ekimde pik yapmıştır.

**Anahtar Sözcükler:** Keçi, mide - bağırsak nematodları, mevsimsel aktivite, Burdur

## Introduction

Animal breeding by villagers is an important feature of the regional economy in Burdur, where there are 141,970 goats. However, small-scale farming fails to reach its full economic potential (1) because diseases often prevent the achievement of optimum productivity, especially under the traditional husbandry system.

Parasitic infections, especially gastro-intestinal (GI) nematodosis in animals, are a cause of considerable economic loss in Turkey (2,3) and the world (4,5). Hoste and Chartier (6) reported that sub-clinical and clinical GI nematodosis in goats induced body weight loss and a persistent decrease in milk yield, ranging from 2.5% to 10% and 13.0% to 25.1%, respectively.

Turkey has a sub-tropical climate and therefore GI nematodes are prevalent in goats (4). Although there are a large number of reports concerning the prevalence and/or epidemiology of GI nematodes in Turkey (7-12), there has been no study in Burdur region.

The prevalence, seasonal activity, epidemiology, and pathogenicity of GI nematodes vary with animal species, race and age, with nematode species and with geographical region. There are many articles concerning this subject in other countries (13-22). In general, the mean worm burdens increase with favourable climatic conditions (18). Thus, prevention methods differ in relation to climatic factors (22).

The aim of the present study was to determine the prevalence and seasonal fluctuations of GI nematodes in goats slaughtered during a 12-month period in local abattoirs in Burdur region, a sub-tropical and semi-humid Mediterranean zone.

## Materials and Methods

This study was conducted between September 2000 and August 2001. Each week for 50 weeks one gastrointestinal tract from a slaughtered goat was randomly selected at a local abattoir (The Trade Association of Burdur or Bucak Municipality or Antalya Grand Municipality) and brought to our laboratory. The abomasa, and small and large intestine were ligated to prevent worms from spilling from one location to another.

In the laboratory, the GI tracts were separated anatomically, then each organ was opened separately and

its contents and mucosa were washed in water to remove all parasites. The contents of the abomasum and small intestine were washed through a 90- mesh sieve, and of the large intestine through a 250-mesh sieve for the collection of mature and immature parasites. On the other hand, abomasa and small intestines were opened with scissors, examined by the naked eye for parasitic nodules, put into a digestion solution (Pepsin 5 g, HCl 7 ml, distilled water 1000 ml) and incubated at 37 °C for 2 h. The fluids were washed by the same method mentioned above (8).

The contents of the abomasum and small intestine were diluted to permit the collection of 100 nematodes from each organ. The total content of the large intestine was examined in large petri dishes (13 cm) by the naked eye under a light. The contents of the large intestine were also examined on a stereomicroscope for *S. ovis* and other larval nematodes.

Every nematode recovered from the contents was cleaned with physiologic saline and fixed in hot 70% alcohol. The nematodes were then cleared in lactophenol and identified on the microscope. Fifty sexually mature male and 50 sexually mature female worms from each organ were identified with reference to the literature (4,5,23,24) and then kept in nematode storing solution (8).

Weather data for the Burdur region, including total rainfall, mean monthly temperatures and average relative humidity, were obtained from the Government Meteorological Department in Ankara.

## Results

All the animals examined (100%) were found to be infected with gastro-intestinal nematodes and 22 nematode species were identified in the study. The prevalence, organs affected, mean worm burdens, total parasite counts and the ranges within which parasite numbers fell are given in the Table. *Parabronema skrjabini* was recorded for the first time in goats in Turkey.

A total of 53,759 nematodes were collected from the infected goats. The mean counts of the commonest parasites among the 50 goats examined were determined as follows: *M. marshalli* (483.3), *O. circumcincta* (337.5), *N. abnormalis* (257.3), *N. spathiger* (207.7), *N. filicollis* (154.7) and *T. vitrinus* (104.6). The mean count

Table. Species, prevalence and range of GI nematodes found in infected goats.

Species	Organ	Prevalence %	Mean worm burden	Range	Total worms
<i>Marshallagia marshalli</i>	Ab+SI	72	483.3	11-2620	17,398
<i>Ostertagia circumcincta</i>	Ab+SI	78	337.5	18-2525	13,162
<i>O. occidentalis</i>	Ab	38	74.4	11-315	1414
<i>O. trifurcata</i>	Ab	26	48.2	10-210	626
<i>Haemonchus contortus</i>	Ab	12	43.8	4-95	263
<i>Parabronema skrjabini</i>	Ab	2	5.0	5-5	5
<i>Trichostrongylus vitrinus</i>	Ab+SI	40	104.6	8-356	2092
<i>T. capricola</i>	Ab+SI	10	27.6	15-50	138
<i>T. axei</i>	Ab	6	62.3	35-96	187
<i>T. colubriformis</i>	Ab	4	7.5	7-8	15
<i>T. skrjabini</i>	Ab	2	5.0	5-5	5
<i>Nematodirus abnormalis</i>	SI	66	257.3	11-2790	8492
<i>N. spathiger</i>	SI	52	207.7	9-1775	5400
<i>N. filicollis</i>	SI	14	154.7	6-580	1083
<i>N. lanceolatus</i>	SI	6	22.7	10-44	68
<i>Trichuris ovis</i>	LI	60	20.3	3-103	608
<i>T. skrjabini</i>	LI	50	37.6	4-132	939
<i>T. globulosa</i>	LI	26	5.3	1-18	69
<i>T. discolor</i>	LI	20	3.2	1-9	32
<i>Skrjabinema ovis</i>	LI	34	98.9	5-935	1682
<i>Oe. venulosum</i>	LI	10	4.4	2-8	22
<i>Chabertia ovina</i>	LI	8	14.8	5-31	59

Ab: Abomasum, SI: Small Intestine, LI: Large Intestine

for other species was less than 100 in each case. The number of large intestine parasites ranged from 3.2 to 37.6, while the number of *S. ovis* was 98.9.

The number of nematode species per animal ranged from 1 to 12. Most of the infected goats had 5 or 6 species of nematode (40%), while the mean number of species was 6.34. The total number of parasites per goat ranged from 65 to 4811. The average number of parasites per goat was found to be 1075.18.

No larvae were found in the digested materials collected from abomasa and small intestines.

The meteorological characteristics of Burdur region with its local climatic zones reflect its proximity to the Aegean, Anatolian and Mediterranean regions. Moreover, it is a region of many lakes. While rainfall in the period of this study was irregular, relative humidity was over 50% (except in July). The climatic features of the region are conducive to the development of GI nematodes (Figure 1).

Seasonal fluctuations in the total numbers of GI nematodes are shown in Figure 2. The total parasite counts in the goats increased in spring (from March to May), declined in summer (from June to July), reached their maximum levels in autumn (in September), tended to decline until winter and increased again in midwinter (in January) (Figure 2). The springtime increase in the total of worms tended to parallel the increase in rainfall. Species of *Ostertagia*, *Trichostrongylus*, *Nematodirus* and *M. marshalli* were observed in all seasons of the year. *Trichostrongylus* spp. peaked in spring and autumn and a small rise was observed in January. The numbers of *Nematodirus* spp. increased in January and April, and peaked in September. *Ostertagia* spp. and *M. marshalli* counts moved in parallel, increasing in January and April. *Ostertagia* spp. peaked in September and *M. marshalli* in October (Figure 3).

*Trichuris* spp. and *S. ovis* were observed in the large intestine of the host in all seasons of the year, but there

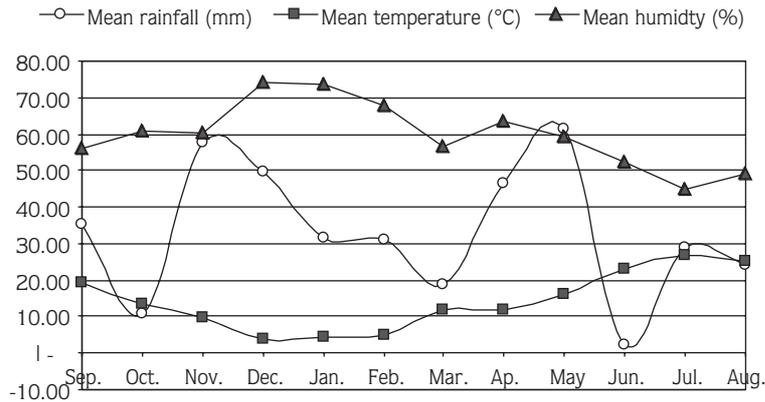


Figure 1. Climatic data of Burdur district (Turkey).

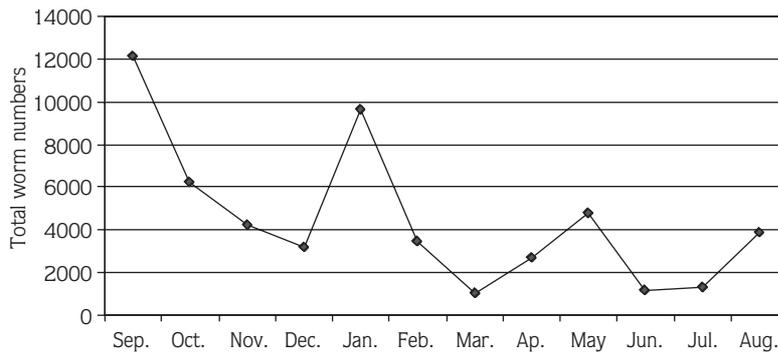


Figure 2. Seasonal activity of GI nematodes according to total worm burden in goats.

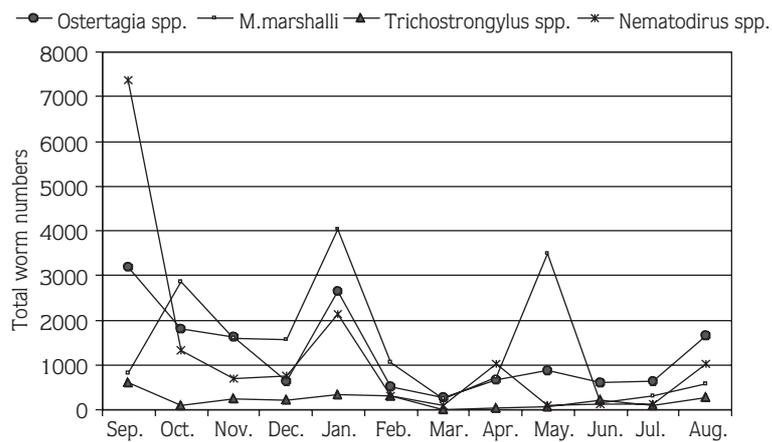


Figure 3. Seasonal activity of some abomasum and small intestine nematodes

was a peak in late winter and early spring. For the remainder of the year, the numbers of these nematodes

were low and changed little from one month to another (Figure 4).

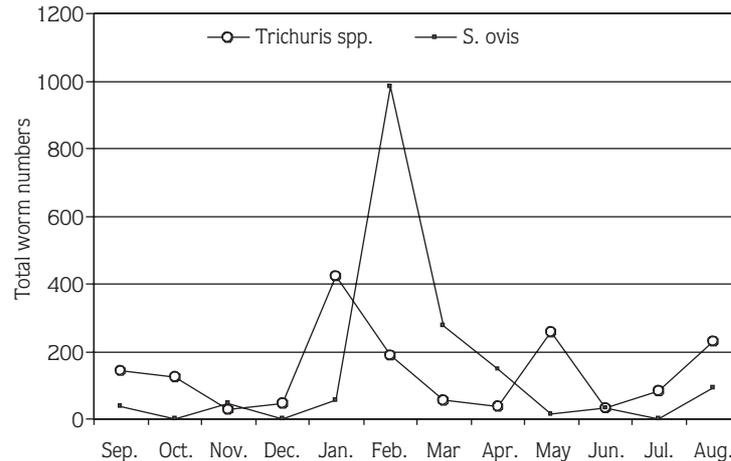


Figure 4. Seasonal activity of some large intestine nematodes.

## Discussion

There are numerous species and genera of gastrointestinal nematodes which parasitise domestic animals (4,5,23,24). The prevalence and seasonal activity, life cycle and pathogenicity of each species vary with animal species, country and/or climatic region (5,13,16, 18,21,22).

Le Riche et al. (13) examined 889 sheep and goats in Cyprus and reported the prevalence of various species of GI nematode as: 77% *O. circumcincta* and *O. trifurcata*, 67% *T. colubriformis* and *T. vitrinus*, 53% *T. axei*, 23% *H. contortus*, 55% *Trichuris ovis*, 38% *C. ovina*, 15% *N. filicollis* and *N. spathiger*, 12% *Oe. venulosum*, 6% *B. trigonocephalum* and 1.6% *P. skrjabini*. Another survey in sheep and goats in Nigeria (19) recorded the prevalence of GI nematodes as follows: 87% for *H. contortus*, 63.8% for *Trichostrongylus* spp., 22.4% for *Oe. columbianum*, 18.8% for *Strongyloides* spp., 17.2% for *Cooperia* spp., 6% for *Gaigeria pachyscelis*, 4.3% for *B. trigonocephalum*, 3.5% for *T. ovis*, and 0.9% for *Capillaria* spp. A study undertaken in Venezuela (15) reported 69.5% *H. contortus*, 75.3% *T. axei*, 96.9% *T. colubriformis*, 17.4% *Cooperia curticei*, 57.9% *Oe. columbianum*, 36.2% *Trichuris globulosa* and 20.3% *S. ovis*.

In this study, all of the randomly selected 50 goats were found to be infected (100%) with GI nematodes. The prevalence of each species identified was as follows: *M. marshalli* (72%), *O. circumcincta* (78%), *O. occidentalis* (38%), *O. trifurcata* (26%), *H. contortus*

(12%), *P. skrjabini* (2%), *Trichostrongylus vitrinus* (40%), *T. capricola* (10%), *T. axei* (6%), *T. colubriformis* (4%), *T. skrjabini* (2%), *Nematodirus abnormalis* (66%), *N. spathiger* (52%), *N. filicollis* (14%), *N. lanceolatus* (6%), *Trichuris ovis* (60%), *T. skrjabini* (50%), *T. globulosa* (26%), *T. discolor* (20%), *S. ovis* (34%), *Oe. venulosum* (10%) and *C. ovina* (8%). Although these results share some similarities with those of other studies (13,15,19), this is not always the case. This variation was clear especially in *H. contortus* (19) and may be explained by the fact that the incidence of nematode parasites in an area is directly related to environmental conditions and to the species of animal affected (5,22).

*Parabronema skrjabini* has been reported rarely in Turkey (22,25) and in other countries (13). Although this nematode has been seen in sheep and cattle, there was no record of *P. skrjabini* in goats in Turkey prior to this study.

*Trichuris* species have been observed frequently in Turkey in domestic ruminants (4,7-9,22). The commonest *Trichuris* species is *T. ovis* and the other species are *T. skrjabini*, *T. globulosa* and *T. discolor* (8,9). The results of studies undertaken in other countries (16,20) are similar to those for Turkey. In this study, prevalence rates were determined as 60% for *T. ovis*, 50% for *T. skrjabini*, 26% for *T. discolor* and 20% for *T. globulosa*.

*Marshallagia marshalli* was one of the dominant species (72%) in this study. This species has been

reported as a predominant species in goats in Turkey (7-10), and in other countries (5). This species is evaluated in the *Ostertagia* genus in some classical books (4,5) and by some researchers (21); the *Teladorsagia* genus is likewise evaluated in the *Ostertagia* genus. For this reason, these genera are not seen in some studies. In the latest taxonomic reviews (24), some of the *Ostertagia* species (*O. circumcincta*, *O. trifurcata* and *O. occidentalis*) have been transferred to the *Teladorsagia* genus. However, since there is no agreement upon this transfer in Turkey, the classical taxonomy was preferred in this study.

The commonest species of *Ostertagia* in small ruminants in Turkey are *O. circumcincta* and *O. trifurcata* (8,12,21,22). The commonest species in this study was determined to be *O. circumcincta* (78%). Other common species of *Ostertagia* recorded were *O. occidentalis* and *O. trifurcata*.

*Trichostrongylus* species are one of the major agents of GI nematodosis in goats (7,8,15). In our study, they were also found to be a common species in the goats. However, the dominant *Trichostrongylus* species in goats is found to vary. For example, Umur (8) observed that the commonest *Trichostrongylus* species in Angora goats was *T. axei* (39%). Similarly, Cantoray et al. (7) reported that the commonest *Trichostrongylus* species in hairy goats in Konya was *T. axei* (54.7%). In contrast, Şenlik et al. (12) recorded that the common species in hairy goats in the southern Marmara region was *T. capricola* (36%). In the present study, the prevalence of *Trichostrongylus* species was recorded as *T. vitrinus* (40%), *T. capricola* (10%), *T. axei* (6%), *T. colubriformis* (4%) and *T. skrjabini* (2%).

*Nematodirus abnormalis*, *N. spathiger* and *N. filicollis* are causes of GI nematodosis and their prevalence is high in young small ruminants in Turkey, but *N. lanceolatus* is seen rarely (7,11,21). However, the identification of the *N. filicollis* and *N. lanceolatus* is subject to error because of morphological similarities (8). For this reason, the prevalence of the *N. lanceolatus* may be presented as lower than its true rate. The prevalence of *Nematodirus* species was recorded as *N. abnormalis* (66%), *N. spathiger* (52%), *N. filicollis* (14%) and *N. lanceolatus* (6%) in this study. These results are compatible with those of other surveys carried out in Turkey (7,9).

In this study, the number of nematode species per animal ranged from 1 to 12; most of the goats were

infected with 5 or 6 nematode species (40%), while the mean number of species was 6.34. The total number of parasites for each animal ranged from 65 to 4811. The average number of parasites per goat was determined as 1075.18.

Morales et al. (15) recorded that the mean counts of GI nematodes in sheep and goats in Venezuela were 166.5 for *H. contortus*, 462.3 for *T. axei*, 860.6 for *T. colubriformis*, 8.2 for *C. curticei*, 7.9 for *Oe. venulosum* and 2.9 for *Trichuris globulosa*. Çetindağ and Biyikoğlu (9) reported the number of species and the number of parasites per goat in Angora goats as ranging from 1 to 10 and 190 to 3037, respectively. Şenlik et al. (12) observed that the number of species was 16 in infected goats, and that the number of parasites per goat and the number of species in a mixed infection ranged from 1 to 2489 and from 1 to 9, respectively.

The number of parasites per goat varied from 33 to 16,152 in this study. The mean numbers of parasites were recorded as 483.3 for *M. marshalli*, 337.5 for *O. circumcincta*, 257.3 for *N. abnormalis*, 207.7 for *N. spathiger*, 154.7 for *N. filicollis* and 104.6 for *T. vitrinus*.

The seasonal activity of the parasites differs according to the animal species, parasite species and the literature in Turkey (21,22) and other countries (13,16,18). According to Le Riche et al. (13), *H. contortus*, *Oe. venulosum* and *C. ovina* increased in spring and autumn, *Ostertagia* spp. increased in autumn and *Trichostrongylus* spp. increased in spring, in sheep and goats in Cyprus.

The present study revealed that the worm burdens increased in spring, peaked in autumn, declined towards winter, increased again in midwinter and declined to spring. The midwinter increase was very evident and was almost in parallel with the rainfall. The Burdur region lies at the crossroads of the Mediterranean, Anatolian and Aegean regions. Since the minimum mean temperature is higher than 5 °C, animals may be put to graze on the pastures. However, grazing is not the only cause of the midwinter increase in parasite counts. Hypobiosis may be another cause (4,5,22).

The total worm burdens may change according to the season. While *Trichostrongylus* species existed in low numbers with only slight seasonal fluctuation, *Ostertagia* spp., *Nematodirus* spp. and *M. marshalli* increased in January and May (except *Nematodirus* spp.), remained at low levels in June and July and increased again in August.

Nematodirus spp. increased to their highest level in September, but decreased dramatically in October. The reason for the increase in May may be related to an insufficient resistance to the parasites in young animals and also to the use of young animals in the study. The reason for the increase in September may be related to heavy contamination of the pasture with eggs of the parasites by infected young animals and to the use of the pasture for the grazing for other animals. Nematodirus species in Turkey are more affected by age-related resistance than the other GI nematodes. Large intestine nematodes showed a similar pattern. The parasites increased in January, February and May and August, and existed at low levels in other months. The reason for the increase in January and February may be related to the grazing of the animals on the pasture. The reason for the increase in May may be related to the increase in rainfall.

In conclusion, we found that the goat population in Burdur was rich in nematode species and that the goats

were infected by the nematodes during all seasons of a year. The common parasites were *Ostertagia*, *Trichostrongylus*, *Nematodirus* and *Trichuris* species, *M. marshalli* and *S. ovis* and we found that the severity of the infections was low or moderate. Worm burdens peaked in spring and autumn and also increased dramatically in midwinter.

To decrease the harmful effects of the parasites; animal transfers should be made under controlled conditions, epidemiological control and eradication studies should be organised and goats should be treated with appropriate anthelmintic drugs.

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