Introduction

Gastrointestinal nematode parasitism is an important cause of livestock disease, reduced productivity and welfare. In most cases, control of parasites is based on the use of anthelmintics or on the combination of anthelmintics and pasture management or recently, other alternatives to the use of chemicals. However, the frequent use of anthelmintics can select for resistant nematodes. Anthelmintic resistant nematodes have been described throughout the world from many farm animals including sheep, goats, horses, cattle and pigs. In contrast to sheep, goats and horses, where plenty cases of anthelmintic resistance have been reported, only very few cases have been reported in cattle. The presence of resistant parasites in cattle still remains a sporadic phenomenon, partly because of the relatively unfrequent use of anthelmintics in this animal species [4].

In Greece, despite the decreasing number of working equines, there is an increasing number of riding studs. Most of the horses kept in riding stables are well looked after and receive regular anthelmintic treatment. Contrary to small ruminants and horses, cattle are treated with anthelmintics very rarely, either because of the belief that animals raised indoors do not carry any parasites or the limited advantage for treated animals [8, 21]. Another reason reducing the use of anthelmintics in cattle is the greater natural immunity acquired by parasitised grazing bovines, especially by the young ones [16].

While anthelmintic resistant nematodes have been identified in sheep and goats from Greece [14], there is no information for other farm animals. To address this lack of information, faecal egg count reduction (FECR) tests [3] were carried out in horses and cattle.

Materials and methods

HORSES

The 96 animals included in FECR tests were selected from a total of 219 horses examined for positive (natural infection)
strongyle eggs. The animals were saddle horses and in one case brood mares and yearlings. All tested animals were aged between 1 to 20 years old. The 96 horses were located in 10 farms from northern and central Greece and were found to expel more than 300 strongyle eggs per g (epg). Apart from the eggs of *Strongylus* spp., eggs of *Trichostrongylus* spp., *Anoplocephala perfoliata* and *Para-scaris equorum* were detected. All animals were pastured during the day, at least for several hours and had been routinely treated 3-4 times per year with ivermectin or benzimidazoles. The anthelmintics used in these trials were ivermectin (Valaneq, MSD) at a dose rate of 0.2 mg/kg BW and oxfendazole (Systamex, Coopers) at a dose rate of 10 mg/kg BW, in paste formulations given orally. These two anthelmintics are the most commonly used antiparasitic drugs in horses in Greece. The control animals received water per os.

**CATTLE**

The 76 cattle selected for these trials were from 3 farms in northern Greece and aged between 6 months to 4 years old. They were selected from a total of 256 cattle from 24 farms. All the animals selected for this study were found (prior to treatment), to have more than 200 trichostrongylid eggs per g of faeces as detected by the modified McMaster technique. In addition to the trichostrongylid eggs, there were also eggs of *Fasciola hepatica*, *Toxocara vitulorum*, *Dicrocoelium dendriticum*, *Moniezia benedeni* and *Paramphistomum spp.* detected. Most of the animals had been treated previously with anthelmintics (benzimidazoles or avermectins) for at least once. The anthelmintics tested were albendazole (Albendazole bolus, Veterin) at a dose rate of 7.5 mg/kg BW po, levamisole (Stozzon bolus, Veterin) at a dose rate of 7.5 mg/kg BW po, moxidectin (Cydectin inj., Cyanamid) at a dose rate of 0.2 mg/kg BW and ivermectin (Valaneq inj., MSD) at a dose rate of 0.2 mg/kg BW sc. The control animals received water po.

**Results**

**HORSES**

The arithmetic means with the standard deviations (X ± sd) of the strongyle epg counts pre- and post-treatment, together with the % efficacy of the treatments, are presented in table I. Benzimidazole resistance was detected in 2 studs (24/96 horses) from the 10 studs tested. No ivermectin resistance was detected. The genera of the nematode larvae identified in the coprocultures were *Strongylus*, *Triodontophorus*, *Gyalocephalus* and *Trichonema*. The benzimidazole resistant strain was *Trichonema* spp. in all cases of resistance.

**CATTLE**

The arithmetic means with the standard deviations (X ± sd) of the trichostrongylid epg counts pre- and post-treatment, together with the % efficacy of the treatments, are presented in Table II. No evidence of anthelmintic resistance was detected. The genera of the nematode larvae identified were *Ostertagia sp.*, *Trichostrongylus sp.*, *Haemonchus sp.* and *Chabertia* or *Oesophagostomum sp*. No larvae were detected in the coprocultures of the treated animals post-treatment.

**Discussion**

Anthelmintic resistance of horse nematodes has become a practical problem in many countries. In certain cases, the pre-

<table>
<thead>
<tr>
<th>No. of horses treated</th>
<th>Anthelmintic</th>
<th>X ± sd pre-treatment (D0)</th>
<th>X ± sd post-treatment (D + 14)</th>
<th>% Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>Ivermectin</td>
<td>1120.8 ±204.5</td>
<td>0 ± 0</td>
<td>100</td>
</tr>
<tr>
<td>17</td>
<td>Oxfendazole</td>
<td>1290.3 ±142.5</td>
<td>50.1 ±30.5</td>
<td>96.1</td>
</tr>
<tr>
<td>24</td>
<td>Oxfendazole</td>
<td>1460.4 ±156.1</td>
<td>980.5 ±80.7</td>
<td>32.9</td>
</tr>
<tr>
<td>(Resistant strain)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Controls</td>
<td>1208.0 ±205.4</td>
<td>1330.6 ±97.8</td>
<td>-</td>
</tr>
</tbody>
</table>

Table I.— The arithmetic means with the standard deviations (X ± sd) of the epg counts of the tested horses pre- and post-treatment and the % efficacy of their treatment.
Valence of resistant strains is extremely high, particularly for the benzimidazole group of anthelmintics. Bauer et al. [1] reported the presence of benzimidazole resistant small strongyles in all the thoroughbred studs examined in Germany. Most cases of anthelmintic resistant strongyles are referred to small strongyles, since its prevalence has become significantly higher the large ones [5].

Several reports, in the past, have been published with the prevalence and the parasitic genera of horse strongyles in Greece [7, 12, 2, 11, 15]. In the most recent ones, the prevalence of infected horses varies from 62.4 % [15], to 68.1 % [7]. According to our results, the prevalence of horses expelling more than 300 strongyle eggs in faeces was 43.8 %. This percent is obviously lower than the previous reported ones, because it includes only the number of horses expelling more than 300 strongyle eggs in faeces and not all the infected animals.

This is the first report for the presence of anthelmintic resistance in horses in Greece. Its prevalence is still low (20 %) and is restricted to the benzimidazole chemical group. However, it should be emphasized that the present results refer to well-cared horses and not to working animals, the later receive only occasional, irregular or no anthelmintic treatment.

In one of the horse stables included in our study, where a benzimidazole resistant strain was detected, a susceptible strain was also existing. This was explained with the horses of this stud being kept into 2 groups and grazed constantly two similar pastures, each group at its own pasture. The animals of one of these groups were infected with the resistant strain while the other group had a susceptible strain. As no differences existed in the management of these 2 groups, it is suggested that the resistant strain was imported into the stud by introducing new stock or by the animal movements, rather than being locally developed. This emphasizes the potential for spreading resistant parasite strains by moving animals [6].

In cattle, a growing number of reports, mostly from New Zealand and United Kingdom, describing resistance to benzimidazoles and macrocyclic lactones by gastrointestinal nematodes have appeared in the literature [20, 18-19, 9, 10, 16]. In our study the FECR tests failed to detect any anthelmintic resistant nematodes in the examined farms and the efficacy of all tested anthelmintics was practically 100 %.

The absence of trichostrongylid eggs and larvae post-treatment confirms the high anthelmintic susceptibility of the cattle nematodes in Greece. This was expected since anthelmintics are used in cattle at a significantly lower frequency than to any other farm animals in this country and as it is generally accepted, that the selection pressure generated by frequent use of anthelmintics, is the most significant contributor to the development of resistance. But nevertheless our present findings, it seems inevitable that cases of drug resistance in cattle parasites will appear sooner or later. Therefore, it is of major importance recommendations and management methods for cattle parasite control to be taken in order to delay the emergence of resistant strains or their introduction in the country.

References bibliographiques


