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Questionnaire survey on helminth control practices in horse farms in Ireland

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Research Article

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Abstract

Knowledge regarding helminth control strategies and nematode infection of horses in Ireland is limited and only one study has been published recently. This present study was designed to investigate the current helminth control strategies followed by horse owners in Ireland. A questionnaire was formulated to collect data on general grazing, pasture management and deworming strategies including the use of fecal egg counts. Questionnaires were emailed to 700 members of the Irish Thoroughbred Breeders Association and Horse Sport Ireland. Only 78 questionnaires were returned. Respondents indicated that horses are grazed for 16–24 h day^{-1} during the summer and autumn (89% and 65%, respectively). Removing feces from the pasture was implemented by 37.6% of respondents. Few (22.2%) owners kept horses off pasture after worming. Overall, ivermectin and moxidectin were the most commonly administered anthelmintics in 2014 by 75% and 62% of respondents, respectively. Benzimidazole and pyrantel drugs were used by 53% and 35% of respondents, respectively. The majority of farms (81.4%) treated horses 4–5 times per year and 74.2% only estimated the weight of the horses visually. The findings of this study illustrates that many stud managers/owners do not follow best practice with regard to helminth control and more education is needed.

Introduction

In Ireland, the Thoroughbred (TB) and Irish Sport Horse industries are a thriving part of the economy; approximately €1 billion was contributed to the Irish exchequer by the TB industry in 2012 (Dukes, 2009) and the Irish Sport Horse industry contributed €816 million in 2016 (Corbally and Fahey, 2017). Horses can be infected with a range of gastrointestinal parasite species such as ascarids, tapeworms and strongyles. However, the small strongyles (cyathostomins) are considered the most important parasites in horses due to their ubiquity, prevalence and pathogenicity (Nielsen *et al.*, 2010*b*). Today, resistance to benzimidazoles (BZ) is highly prevalent and widespread in most countries (Kaplan and Vidyashankar, 2012; Nielsen, 2012) while pyrantel (PYR) resistance in cyathostomins is emerging in the USA, UK, Germany and Italy (Kaplan, 2004; Traversa *et al.*, 2009; Lester *et al.*, 2013; Nielsen *et al.*, 2013). Recently, resistance to ivermectin (IVM) and/or shortened egg reappearance period (ERP) of moxidectin (MOX) in cyathostomins have been reported in different parts of the world, such as the USA (Little *et al.*, 2003; Rossano *et al.*, 2010; Lyons *et al.*, 2011), Italy (Traversa *et al.*, 2009), UK (Lester *et al.*, 2013; Relf *et al.*, 2014), The Netherlands (van Doorn *et al.*, 2014; Kooyman *et al.*, 2016), Brazil (Molento *et al.*, 2008; Canever *et al.*, 2013) and Finland (Nareaho *et al.*, 2011). Frequent treatments, combined with underdosing are the main factors playing a role in the development of anthelminthic resistance (AR) (Nielsen *et al.*, 2014*a*). Several surveys from various countries, including Ireland, the UK, the USA, Italy, Sweden and South Africa, have found that many horse owners rely strongly on the interval-dose principle with intensive and long-term use of macrocyclic lactones (Matthee *et al.*, 2002; O'Meara and Mulcahy, 2002; Lind *et al.*, 2007; Relf *et al.*, 2012, 2014; Lester *et al.*, 2013; Bolwell *et al.*, 2015). Since a survey performed in 2002 (O'Meara and Mulcahy, 2002) there has been no investigation of helminth control practices on Irish horse farms. For this reason, a questionnaire survey was carried out on current helminth control practices used by horse owners in Ireland (Appendix 1). Data on helminth control practices by horse owners may pinpoint potential risk factors for AR.

Materials and methods

The questionnaire consisted of four parts: general information, grazing and pasture management, treatment strategies, and the use of fecal egg counts (FECs) in parasite control. Initially, a pilot questionnaire was sent to small number of establishments ($n = 17$) by email and based on feedback changes were made. In July 2014, a brief explanation of the survey was given to the members of the Irish Thoroughbred Breeders' Association (ITBA) at meetings held across Ireland. Between August and October, the questionnaire was emailed to approximately 700 members of the ITBA and Irish Sport Horse industries with a link to an electronic copy of the questionnaire produced using Survey Monkey. In November 2014, 265 follow-up

Table 1. Summary of the percentage and range of animal categories present on 78 horse farms in Ireland

Categories	Stallions	Geldings	Companions	Mares	Yearlings	Foals	Donkeys
Number of farms (%)	12 (15)	41 (52)	41 (52)	65 (83.3)	62 (79.5)	56 (72)	3 (3.8)
Range in the number of animals	1–7	1–8	1–25	1–100	1–125	1–100	2–3

questionnaires were posted to ITBA members with an offer of free FEC analyses for up to 20 horse samples.

Data analysis

Data from the questionnaire were entered on Microsoft Excel (Microsoft Office, 2013), and analysed using IBM SPSS Statistics (Version 24, 2016). Descriptive statistics for each question were analysed. To determine the percentage responses to each question, missing data were excluded from the total number of responses. In the results, the total number of responses (n) are indicated for each percentage.

Results

General information

The response rate was relatively low with only 78 (11.14%, n = 700) questionnaires returned. Most of the respondents were located in the east (61%, n = 74) and the south (26%, n = 74) in Ireland, few responses were received from the west (8%, n = 74) and the north (5%, n = 74). The majority of responses (47.4%, n = 37), were received from establishments that did not indicate the type of farming enterprise, while 35 (44.9%) were from stud farms and six (7.7%) were from Sport Horse farms. Of the 78 respondents, only 25 (23%) completed the electronic questionnaire. Table 1 summarizes the different categories of horses present in the 78 establishments that responded to the questionnaire. The majority of respondents (71.8%, n = 71) stated that they did not observe any signs of clinical disease due to parasites during the previous year.

Grazing and pasture management

Daily grazing, time ranged from 16 to 24 h per day during the summer and autumn (89%, n = 74 and 65%, n = 72, respectively), and 1 to 10 h per day during winter (Fig. 1). Less than half of respondents applied pasture rotation on a monthly basis (47%, n = 66) and harrowed or clipped pastures monthly or more frequently (44%, n = 69). The co-grazing by cattle and sheep was performed on a monthly, yearly and occasional basis on 27%, 22% and 21% farms (n = 71), respectively (Fig. 2). Only a few farms (37.6%, n = 75) removed feces from pasture with 26.7% (n = 75) removing feces infrequently (Fig. 3), 73% (n = 27) removed feces manually and 26% (n = 27) did it mechanically. Of the respondents, 22.2% (n = 72) kept horses off pasture for 7 days or less after treatment and almost half of the respondents (45.8%, n = 73) indicate that they move horses to clean pasture after treatment.

Treatment strategies

More than two-thirds of the respondents (74.6%, n = 67) indicated that the owner/manager was responsible for administering anthelmintic while the rest (25.4%, n = 67) reported that the groom, veterinarian or nurse was responsible for this activity. Of the respondents, 65.7% (n = 70) sought veterinary advice on helminth control; however, only 23% (n = 67) of horse owners who treated horses followed the recommendation of a veterinarian. The majority of respondents (76%, n = 67) followed a set dosing programme, while only 3% treated at signs of disease. The majority of respondents (81.4%, n = 70) reported that they treated their horses 4–5 times a year, while 15.7% (n = 70) treated the horses on a monthly basis and 2.9% (n = 70) treated their horses only once or twice a year. Most respondents (71.8%, n = 71) stated that spring and autumn were critical times for treatment, followed by summer and the foaling period by 46.5% (n = 71) and 43.7% (n = 72) of studs, respectively. Half of owners (49.2%, n = 59) rotated between drug classes ⩾4 times per year, 35.6% (n = 59) rotated once or twice per year while 11.9% (n = 59) rotated infrequently between drug classes. Overall, IVM and MOX were the most commonly administered anthelmintic in 2014 by 80% and 71.8% of respondents (n = 71), respectively. BZ and PYR drugs were used by 53% and 35% of respondents (n = 71), respectively. Only one owner indicated that doramectin (Dectomax®) was used (Fig. 4). Veterinary advice and drug rotation appeared to be the most influential factors determining the choice of drug classes as indicated by 45 and 43%, of the respondents (n = 73), respectively. The price, drug effectiveness and own experience were less important factors (27.4%, 26% and 24.7%, respectively). Only a few of the respondents (17.8%, n = 73) considered the FECs to be an important factor in their choice of an anthelmintic (Fig. 5). Only a few owners (11.3%, n = 62) weighed each horse prior to treatment; the majority (74.2%, n = 62) only estimated the weight of the horses visually and 17.7% (n = 62) administered one tube/packet of the drug per animal (Fig. 6). A total of 41.7% (n = 72) of respondents stated that they performed FECs. However, the majority (64.5%, n = 31) performed FECs infrequently (>6 months), 22.6% (n = 31) performed FECs analysis more frequently (between 1–3 monthly intervals). The rest of the respondents (12.9%, n = 31) performed FECs related to signs of illness. Only 48% (n = 31) of responses appeared to be targeting treatment of horses based on FECs ⩾200 egg per gram. Although more than half of the respondents (50.1%, n = 69) reported that they were aware of the faecal egg count reduction test (FECRT), only 12.9% (n = 70) have performed this test in the past. Only four respondents stated that eggs were observed in the post-treatment samples. A few respondents (6%, n = 65) indicated that they had tested the efficacy of the drugs being used, however none of them considered AR as a problem on their farm. A total of 33 (42%, n = 73) respondents indicated that they received horses during 2014 but only 23 (31.5%) reported placing visiting horses in quarantine. Only four of these respondents (n = 23) had a quarantine period of 1–2 days, while the majority (73.9%, n = 23) had a quarantine period ⩾7 days. A large number (61.5%, n = 71) of respondents that received horses in 2014 reported that visiting horses were treated with either IVM or MOX on arrival. A high number of establishments (83.6%, n = 74) stated that foals were treated more frequently and with different anthelmintics than adult horses (59.5% and 39.2%, respectively). One-half of respondents (50.7%, n = 67) indicated that they started treating foals between 2 and 4 weeks of age and 29.8% (n = 67) of respondents emphasized a greater attention to dosing foals at 5–6 weeks of age (Fig. 7).

Discussion

Anthelmintic resistance is a threatening problem to the livestock industry and posing very serious threats to the future welfare

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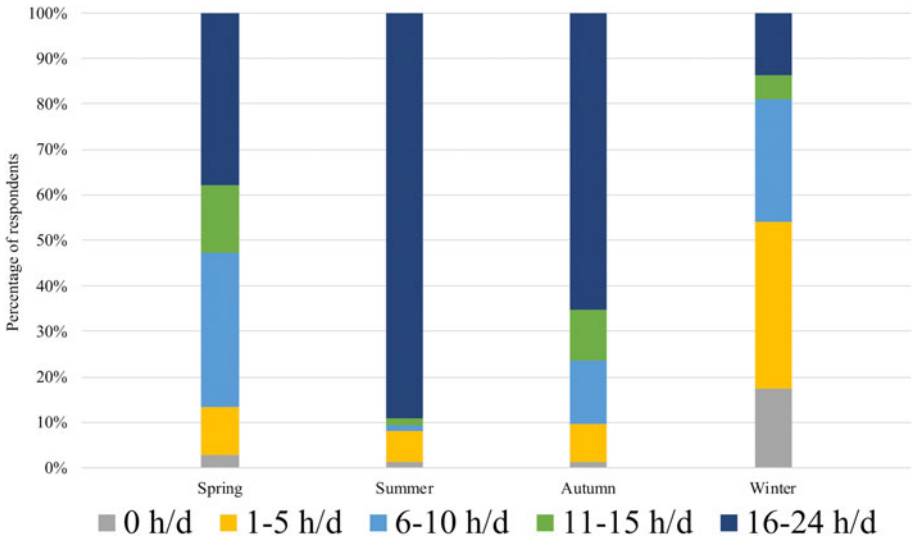

Fig. 1. The number of hours that horses spent grazing per day (h day^{-1}) during different season as reported by respondents in Ireland ($n = 74$).

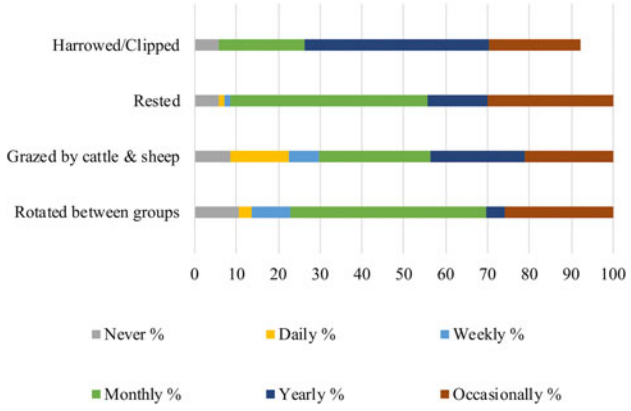

Fig. 2. Different pasture management strategies followed by Irish stud farmers ($n = 71$).

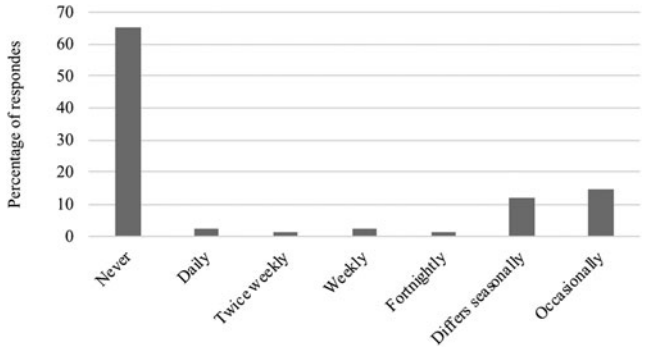

Fig. 3. Percentage and frequency at which respondents ($n = 75$) remove feces from pasture in an Irish survey.

and production of livestock throughout the world. Recently, several studies have been evaluating the control and management of gastrointestinal helminth (GIH) in horses in the UK and other countries in the EU (Matthee *et al.*, 2002; Lind *et al.*, 2007; Relf *et al.*, 2012, 2014; Lester *et al.*, 2013; Bolwell *et al.*, 2015; Papini *et al.*, 2015; Lester *et al.*, 2018). An intensive use of anthelmintic drugs, use of the same drug class and underdosing have been reported as the main factors contributing to the development of resistance in horse nematodes (Shalaby, 2013). Knowledge regarding helminth control strategies of horses and donkeys in Ireland is limited and only one study has been published over 15 years ago (O'Meara and Mulcahy, 2002). The findings from our questionnaire survey reported critical information on helminth control strategies used on Irish equine farms. The response rate to the questionnaire was low, in contrast to the last survey in 2002 by O'Meara and Mulcahy (2002) where 55% responses were received. However, several other studies have reported similar low response rate in their surveys (Joost *et al.*, 2002; Oppenheim, 2005; Relf *et al.*, 2012). A number of factors could have influenced the response rate including the length of the questionnaire; owners being unwilling to spend time completing long postal surveys, or unwilling to answer questions that require them to consult their records for factual information. From the survey, the respondents confirmed that they did not observe clinical disease associated with equine intestinal parasites. The largest number of responses came from stud farms in the east of Ireland where a high proportion of Irish TB stud farms are located. These responses were from large public stud farms to small individual enterprises. Control of helminth parasite infection in horses is an important element of applied management in the field. Good pasture management practices can reduce the incidence of clinical disease in horses (Relf *et al.*, 2013; Nielsen *et al.*, 2014*a*, 2014*b*, 2014*c*). Quarantine of newly arrived or visiting animals is considered important to decrease pasture contamination with resistant parasite populations (Eysker *et al.*, 2006). Within the present study, only four stud farms receiving visiting animals ($n = 23$) performed quarantine for 1–2 days. It is difficult to compare the attitude towards the implementation of quarantine because it is influenced by factors such as the number of animals, size of the farms and other infectious diseases. This is similar to other countries, such as the UK and Germany where there was a poor level of quarantine (Traversa *et al.*, 2009; Fritzen *et al.*, 2010; Relf *et al.*, 2012). Most of the participants (61.5%) treated visiting horses; this was similar to results from the UK (74%) (Relf *et al.*, 2012), and Scotland (89%) (Stratford *et al.*, 2014) but more than in Swedish farms (38%) (Lind *et al.*, 2007). On the other hand, the majority moved the horses to clean pasture after treatment. Moving animals to clean pasture after treatment allows for the increase in contamination of these pastures with resistant strains after an anthelmintic treatment kills most or all of the susceptible helminths (Eysker *et al.*, 2006; De Graef *et al.*, 2013). In summer and autumn, the infective stages of parasites on the pasture reaches their highest level; this leads to a high probability of helminth infection (Nielsen *et al.*, 2007). In this study, the majority of horses had access for more than 11 h to pastures during these seasons which is similar to that in the UK (Relf *et al.*, 2012) and other European countries, including Denmark (Lendal *et al.*,

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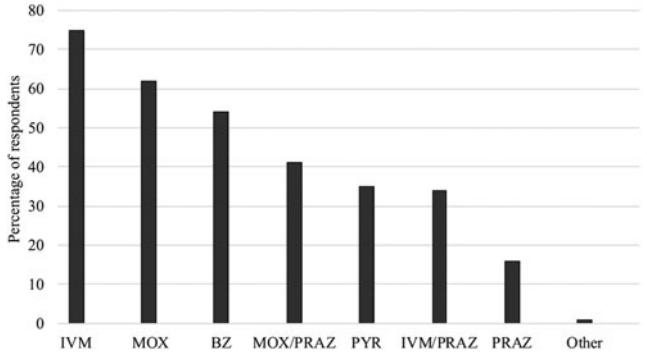

Fig. 4. Different anthelmintic drugs used by respondents ($n = 71$) in Ireland during 2014. IVM, ivermectin; MOX, moxidectin; BZ, benzimidazole; MOX/PRAZ, moxidectin and praziquantel; PYR, pyrantel; IVM/PRAZ, ivermectin and praziquantel, other (doramectin).

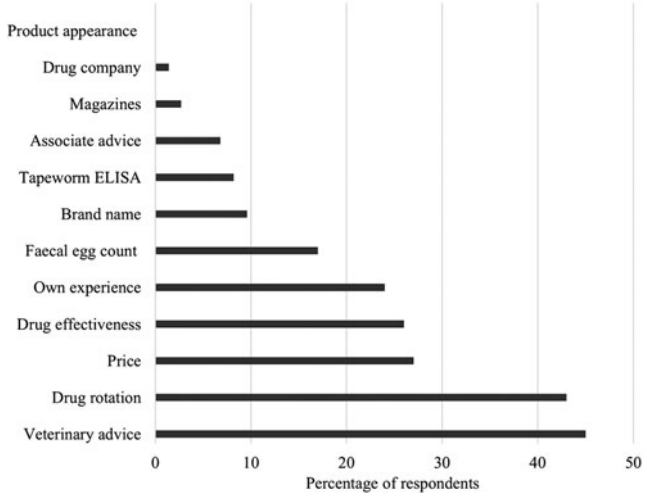

Fig. 5. Factors that influenced the choice of anthelmintic drugs used by respondents ($n = 73$) to treat horses in Ireland.

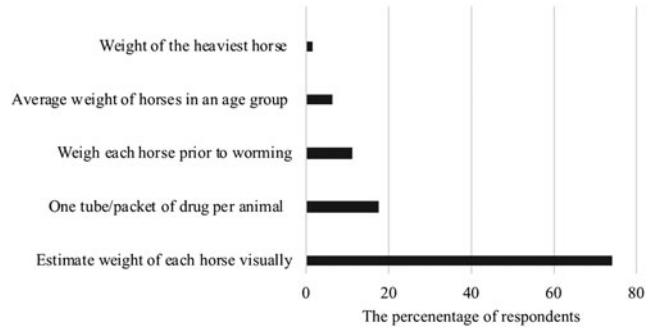

Fig. 6. The methods used by Irish horse owners ($n = 71$) to calculate the dose of an anthelmintic drug to be administered to horses.

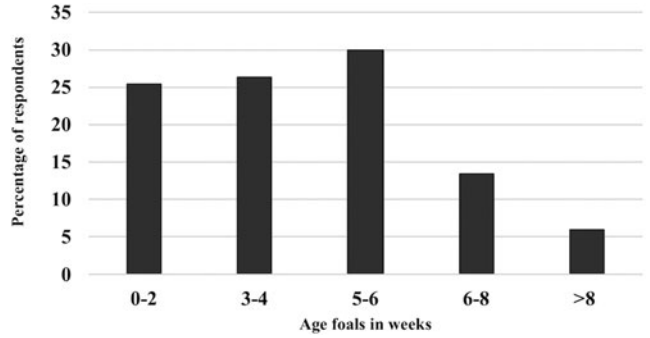

Fig. 7. The age at which foals receive their first anthelmintic treatment on Irish horse farms ($n = 67$).

1998), Germany (Hinney *et al.*, 2011) and Italy (Papini *et al.*, 2015). Less than half of Irish stud farms reported performing monthly rotation of pastures or resting pastures for a period of time. These measures are important to allow the reduction of infective larvae on the pasture.

Pasture harrowing and/or clipping and co-grazing by other livestock species during the year is considered important to reduce the level of parasite burdens on pasture. Co-grazing by other species allows sheep and/or cattle to ingest horse parasites. Almost all Irish horse owners (91.5%) used co-grazing by sheep and/or cattle during the year which is in agreement with previous findings by O'Meara and Mulcahy (2002) who reported rotational or mixed grazing with ruminants was found to be practised by 71% of Irish establishments. This is in contrast to UK where 49% of stud farms implemented such practices (Relf *et al.*, 2012). Moreover, very few establishments used co-grazing in Denmark (Lendal *et al.*, 1998) and Italy (Papini *et al.*, 2015). On the other hand, mixed grazing with ruminants has important implications for transmission of liver fluke or *Trichostrongylus axei*. In Ireland, *Fasciola hepatica* is a common trematode parasite in Irish livestock. A recent study in Ireland found that the prevalence of *F. hepatica* in horses was 9.5% (Quigley *et al.*, 2017). A list of lines was mentioned in the last paragraph. Another study found that mixed grazing between ponies and sheep reduced strongylid infection but the prevalence of *T. axei* increased in the horses (Eysker *et al.*, 1983, 1986).

Only a small number of owners (44%) applied harrowing and/or clipping of pastures on a regular basis. One possible explanation for the low uptake would be that the Irish environment is wet throughout the year making it difficult to perform pasture harrowing and/or clipping. This is in contrast to Germany where frequent clipping was used (Fritzen *et al.*, 2010). In Sweden, clipping was also performed more frequently (76%) (Lind *et al.*, 2007). Removing feces in large establishments requires special equipment which is expensive and time consuming; however, on small-to-middle size establishments this can be performed manually which is considered beneficial in reducing worm burden on pastures. A study by Corbett *et al.* (2014) indicated that establishments removing feces experienced an approximate 20% reduction in FECs every month during the study period. Still, owners at Irish stud farms did not appreciate the benefits of picking up feces from pastures as indicated in this study. However, applying this practice has increased by 5% from since the previous study in 2002 (32%) (O'Meara and Mulcahy, 2002). In the UK, this was used by 75% (Relf *et al.*, 2012), South Africa (61%) (Matthee *et al.*, 2002) and in Sweden (41%) (Lind *et al.*, 2007). However, Irish horse owners performed this management better than in Germany (10%) (Fritzen *et al.*, 2010), Italy (5.3%) (Papini *et al.*, 2015) and Brazil where feces are never removed (Martins *et al.*, 2009).

Reports of AR in equine parasites are increasing across the world and this is presumably due to treatment practices traditionally based on frequent treatments, rapid rotation of drugs, incorrect dosing and little or no parasite surveillance. High frequency of treatments can result in the selection of resistance strains, especially when treatment intervals are equal to or shorter than either the parasite's prepatent period or the ERP (Lloyd *et al.*, 2000; Coles *et al.*, 2006; Nielsen *et al.*, 2014*c*). This traditional approach is still widely used in several countries (Lloyd *et al.*, 2000; Relf *et al.*, 2012; Robert *et al.*, 2015). Results from this and the previous

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survey (O'Meara and Mulcahy, 2002) confirmed that most of the horse owners are still basing helminth control on frequent treatments often more than four times a year despite the fact that no signs of clinical disease were observed and with little veterinary involvement in helminth control programmes.

Drug rotation has historically been recommended (Drudge and Lyons, 1966) when the rotation was required to achieve effective control with the few drugs available at the time. Since a direct relationship has been shown between the frequency of treatment and AR (Kaplan and Nielsen, 2010), but in the absence of scientific evidence to support that rotation delays/slows the evolution of resistance, drug rotation is no longer recommended (Lloyd *et al.*, 2000; Kaplan and Nielsen, 2010). The findings in this study were similar to the previous Irish survey (O'Meara and Mulcahy, 2002) and other studies from the UK (Lloyd *et al.*, 2000; Relf *et al.*, 2012) where rapid rotation between drug classes was generally applied in the field.

Similar to other studies, IVM and MOX were the most common anthelmintics used in this study (Lendal *et al.*, 1998; Nielsen *et al.*, 2006; Martins *et al.*, 2009; Relf *et al.*, 2012). Despite resistance to BZ having been confirmed throughout the world, it is still used by 50% of Irish establishments and 14.3% reported it as the most frequently used drug without any concern for efficacy or resistance. However, in the questionnaire, the question did not clarify if BZ was used as a single dose or 5-day larvicidal dose.

The correct dose should be used to prevent the development of AR. The calculation of the dose according to the body weight of each animal is critical to avoid underdosing (Nielsen *et al.*, 2014*a*). A common cause for incorrect dosing is the use of inaccurate weight by estimating weight visually, which was reported in this study by 74.2% of respondents and in the previous Irish study by 60% of respondents (O'Meara and Mulcahy, 2002), which was similar in turn to other studies in Germany (94.4%) (Fritzen *et al.*, 2010), Italy (57.85%) (Papini *et al.*, 2015), South Africa (45%) (Matthee *et al.*, 2002) and the UK (36%) (Relf *et al.*, 2012).

The FECs allow the quantification of gastrointestinal parasite eggs within horse feces. It is easy to perform and inexpensive. For more than two decades, adoption of parasite control strategies such as performance of regular FECs and treatment of horses that have consistently high counts has been recommended to prevent the development of AR (Nielsen *et al.*, 2014*c*). Leaving horses with low FECs (<200 EPG) untreated will have little impact on the health of horses (Schneider *et al.*, 2014). The small numbers of eggs shed may provide critical levels of refugia that will greatly dilute the contribution to pasture contamination with resistance populations. Such an approach will succeed in reducing selection pressure for resistance while improving overall parasite control (Nielsen, 2015). Recent studies have shown that selecting horses for treatment based on FECs was successful in keeping the worm burden low with little clinical disease or development of resistance (Lloyd *et al.*, 2000; Fritzen *et al.*, 2010; Nielsen *et al.*, 2010*a*; Relf *et al.*, 2013; Schneider *et al.*, 2014). However, in the present study and other studies, this approach has not been adopted where the majority of owners are unwilling to adjust their treatment strategies and only rarely combined FECs with reduced or selective anthelmintic treatment. There also seems to be a lack of awareness of AR, where none of the respondents were concerned about AR and the efficacies of available drugs while only a few have implemented FECR tests. Half of the respondents initially administered anthelmintics to foals at 2–4 monthly intervals which are in agreement with studies conducted in the UK and Germany (von Samson-Himmelstjerna *et al.*, 2009; Relf *et al.*, 2012). Typically, young horses have a higher prevalence of strongyle infections, due to less developed immunity related to age (Lloyd *et al.*, 2000; von Samson-Himmelstjerna *et al.*, 2009; Fritzen *et al.*, 2010; Peregrine *et al.*, 2014).

Overall, the results in this study regarding management practices and treatment strategies to control parasites in Irish equines are similar to the results of O'Meara and Mulcahy (2002). Both sets of results show that horses were treated on a regular basis and they frequently rotate between drug classes. IVM and MOX were the most common drug class used in the treatment of GIH in both these studies. In the previous report in Ireland, 40% of respondents weighing animals and calculated the dose according to the body weight (O'Meara and Mulcahy, 2002), while in the current study, only 11% of horse owners reported weighting their horses. There is a general lack of awareness on the part of horse owners of the need to do FECs prior to treatment of their horses. It is interesting to note that in the 2002 study 56% of respondents reported that they did carry out FECs responding to a perceived problem while in the present study this decreased to 41% of respondents carrying out FECs, of these 22.5% performed FECs examinations on a regular basis.

Taken together, these results indicate a greater need to educate horse owners on proper management practices and treatment strategies to control parasites and delay the development of AR in horses in Ireland.

Conclusions

The finding from this study illustrates that stud owners do not follow best practice with regard to parasite control. The evaluation of the factors influencing horse owners in their parasite control strategy showed that monitoring FECs was of minor importance and that intensive treatment (>4 times per year) was the most common dosing regimen followed often in conjunction with underdosing and rapid rotation of anthelmintics. The findings highlight the continuing need to educate owners on best practice with regard to parasite control.

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Conflict of interest. None.

Ethical standards. Not applicable.

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Appendix

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Questionnaire on Worm Control Practices

Stud Information

1. Stud and veterinary practice details ***Optional information**	Stud name * County Email* Vet Practice
2. How many of the following **permanently reside** at your stud?	Stallions Geldings Companion horses/teasers Broodmares Youngstock (1-3 years) Foals Donkeys
3. On average, how many horses **visit** your stud per year?	
4. On average, how long do visiting equines stay?	N/A ☐ 1 Week ☐ 1 Month ☐ Stud season ☐ 1 Year ☐ Varies depending on individual horses/owners ☐
5. Do you quarantine visiting equines? If yes, please check appropriate length of quarantine (in days)	Yes ☐ Days <1 ☐ 1-2 ☐ <7 ☐ 7 ☐ >7 ☐ No ☐ N/A ☐

Grazing and Pasture Management

6. Do you co-graze visiting and resident equines?	Yes ☐ No ☐ N/A ☐

7. How frequently are grazing areas on your establishment…

	Never	Daily	Weekly	Monthly	Yearly	Occasionally
Rotated between groups of equines	☐	☐	☐	☐	☐	☐
Rested from grazing	☐	☐	☐	☐	☐	☐
Harrowed and/or clipped	☐	☐	☐	☐	☐	☐
Grazed by cattle or sheep	☐	☐	☐	☐	☐	☐

8. On average, how much access to grazing (hours per day) do horses have during…

Hours per day grazing	0	1-5	6-10	11-15	16-24
Spring (Mar. – May)	☐	☐	☐	☐	☐
Summer (June – Aug.)	☐	☐	☐	☐	☐
Autumn (Sept. - Nov.)	☐	☐	☐	☐	☐
Winter (Dec. – Feb.)	☐	☐	☐	☐	☐

9. How often do you remove faeces from pasture?	Never ☐ Daily ☐ Twice weekly ☐ Weekly ☐		Fortnightly ☐ Monthly ☐ Differs seasonally ☐ Occasionally ☐
10. How are faeces removed from pasture?	Manually ☐		Machine ☐

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Worming	
11. Have there been any instances of worm-related illness at your stud? (tick all that apply)	Colic ☐ Lower weight gain ☐ Weight loss ☐ Worms in faeces ☐ Vet. diagnosis ☐ Vet. opinion ☐ Diarrhoea (lasting less than 1 week) ☐ Diarrhoea (lasting between 1 and 4 weeks) ☐ No signs of illness ☐
12. Do you seek veterinary advice on parasite control?	Yes ☐ No ☐
13. Are wormers administered to horses at your stud?	Yes ☐ Proceed to question 14 No ☐ Go to question 34
14. Who administers the wormers? (state persons role)	
15. On what basis do you decide to worm horses?	Set treatment/dosing programme ☐ At signs of disease ☐ Following veterinary recommendation ☐
16. How frequently do you administer wormers?	4 Weeks or less ☐ 5-6 Weeks ☐ 7-8 Weeks ☐ 2-3 Months ☐ 4-6 Months ☐ 7-12 Months ☐
17. If you receive visiting equines, do you worm them on arrival?	Yes ☐ Drug of choice No ☐
18. Are equines kept off of pasture after worming? If yes, please check appropriate number of days	Yes ☐ Days <1 ☐ 1-2 ☐ <7 ☐ 7 ☐ >7 ☐ No ☐
19. Are equines moved to "clean" pasture after worming?	Yes ☐ No ☐
20. Which wormers have been used at your stud in the past 12 months? (tick all that apply)	**Ivermectin** (e.g. Eqvalan; Eraquell; Bimectin; Vectin; Noromectin) ☐ **Moxidectin** (e.g. Equest) ☐ **Benzimidazoles** (e.g. Panacur; Panacur 5 Day Guard; Telmin) ☐ **Pyrantel** (e.g. Strongid P; Pyratape-P) ☐ **Praziquantel** (e.g. Equitape) ☐ **Ivermectin/Praziquantel** (e.g. Eqvalan Duo; Equimax) ☐ **Moxidectin/Praziquantel** (e.g. Equest Pramox) ☐ Other
21. Do you consider any of the following occasions particularly important for administering wormers? (tick all that apply)	Spring (March; April; May) ☐ Summer (June; July; August) ☐ Autumn (September; October; November) ☐ Winter (December; January; February) ☐ Prior to grazing turnout ☐ Prior to introduction of new equines ☐ Foaling ☐ Suspicion of parasite-related illness ☐
22. Do you know what is meant by the term wormer/drug **class**?	Yes ☐ Proceed to question 23 No ☐ Go to question 24
23. How often do you rotate between wormer/drug **classes**?	After every application ☐ Every 2-3 months ☐ Every 6 months ☐ Every year ☐ Infrequently ☐ Never ☐

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24. What wormer do you use most frequently?	
25. What wormer did you last use?	
26. Do you weigh each horse prior to worming to determine the dosage required?	Yes ☐ Go to question 28 No ☐ Proceed to question 27
27. If you do not weigh each individual animal prior to worming, how do you determine the amount of wormer required?	Estimate weight of each horse by eye ☐ One tube/packet of drug per animal ☐ Dose according to the weight of heaviest horse ☐ Average weight of horses in an age group ☐
28. When choosing a wormer, what influences your decision? (tick all that apply)	Brand name ☐ Magazines ☐ Product appearance ☐ Own experience ☐ Price ☐ Drug company rep. ☐ Veterinary advice ☐ Associate advice ☐ Drug rotation ☐ Drug effectiveness ☐ Faecal egg count ☐ Tapeworm ELISA ☐
29. Are you concerned about resistance to wormers?	Yes ☐ No ☐
30. In your experience, do any wormers appear to be less effective than they used to be? Please name product/drug	
Worming of FOALS	
31. At what age (in weeks) are foals **FIRST** wormed?	0-2 ☐ 3-4 ☐ 5-6 ☐ 7-8 ☐ >8 ☐
32. Are foals wormed differently to adult equines?	Yes ☐ Proceed to question 33 No ☐ Go to question 34
33. How does worming of foals differ to adult equines (i.e. different drugs, more frequent worming)?	
Faecal Egg Counts	
34. Do you have faecal egg counts performed on samples from your horses?	Yes ☐ Proceed to question 35 No ☐ Go to question 38
35. Who performs the faecal egg counts?	On site laboratory ☐ Veterinary practice ☐ Diagnostic laboratory ☐
36. How frequently are faecal egg counts performed?	Monthly ☐ Every 2-3 months ☐ Every 6 months ☐ Annually ☐ Infrequent/randomly ☐ At quarantine ☐ Under suspicion of a parasite-related illness ☐
37. Upon receiving faecal egg count results do you treat all horses…	Regardless of egg counts ☐ With positive egg counts ☐ With egg counts of 200 eggs per gram or more ☐
38. Do you know what a faecal egg count reduction test (FECRT) is?	Yes ☐ No ☐
39. Has a FECRT been performed at your stud?	Yes ☐ No ☐
40. If a FECRT has been performed on samples from your horses, please state the following	Date test performed Drug/product tested Egg observed post-treatment? Yes ☐ No ☐
41. Would you be interested to participate in a wormer resistance survey? If **yes** please provide contact email/telephone number	Yes ☐ No ☐

Questionnaire completed by (please print name) Date

Thank you for taking the time to complete this questionnaire

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