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Original Article

Evaluation of activity of fenbendazole, oxibendazole, piperazine , and pyrantel pamoate alone and combinations against ascarids, strongyles, and strongyloides in horse foals in field tests on two farms in Central Kentucky in 2014 and 2015

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ABSTRACT

Activity of fenbendazole (FBZ), oxibendazole (OBZ), piperazine (PIP) and pyrantel pamoate (PRT) alone and combinations of OBZ and PIP and of OBZ and PRT was evaluated against parascarids, strongyles and strongyloides in horse foals (n = 281).This was on two farms – Farm A – mixed light-horses (n = 26) and Farm B-Thoroughbreds (n = 255) – in Central Kentucky in field tests in 2014 and 2015. Foals on both farms were treated one to three times each; an exception was that seven foals on Farm A were nontreated controls. Before treatment, the foals on Farm A were all weighed on scales but weights for Farm B were estimated. Evaluation of the anthelmintics was by recording the number of foals passing specific types of nematode eggs before and after treatment using qualitative and/or quantitative (EPG) methods. Results are: 1) ascarids (parascarids) — efficacy was excellent for OBZ, PIP, OBZ-PIP, and OBZ-PRT; likewise for PRT for one group (in 2014) of Farm A foals but not another group (2015) there. FBZ was inactive against these parasites. 2) strongyles — activity was lacking or incomplete for all of the compounds alone or in combination; it was the best for OBZ-PIP, OBZ-PRT and PRT alone. 3) strongyloides — data indicated no or incomplete activity; it was highest for OBZ and OBZ-PIP. The level of drug activity against parasites in Farm B foals may in some instances have been different if exact rather than estimated body weights had been obtained before treatment like for Farm A foals.

1. Introduction

Horses are infected with internal parasites throughout the world. The most pathogenic internal parasites (*Strongylus* spp. especially *Strongylus vulgaris*) in horses currently are rare on farms with routine deworming programs. Ascarids (*Parascaris equorum*), commonly present in young horses, particularly in foals, are still very important nematodes. These parasites can be quite harmful, causing poor health and even death. Control of ascarids has become more difficult the last few years mainly because of the diminished activity of ivermectin (IVM) and moxidectin which was initially highly active on these parasites (Armstrong et al., 2014; Craig et al., 2007; Hearn and Peregrine, 2003; Little et al., 2003; Matthews, 2014; Reinemeyer, 2009). Also there are only a few other compounds [fenbendazole (FBZ), oxibendazole (OBZ), and pyrantel pamoate (PYR)] approved for treatment of ascarids in the USA. Efficacy of PYR has declined precipitously against these parasites in some geographical areas and there are indications that FBZ has become less effective. OBZ currently seems to remain as the most effective compound against ascarids (Lyons and Tolliver, 2014). Piperazine (PIP) was used extensively, and was highly effective, for removal of ascarids before the benzimidazoles (BZs) became commercially available but is not commonly utilized now in horses. Small strongyles, which can in certain circumstances be detrimental, are now resistant to the BZs and PRT (Canever et al., 2013; Matthews, 2014; Chapman et al., 1996; Stratford et al., 2014). Also there are indications that small strongyle egg counts (EPGs) are returning sooner now after treatment with IVM and moxidectin compared to initial high activity on these parasites (Lyons et al., 2008). These compounds are less effective on luminal stages of small strongyles now and thus the life cycle is completed much quicker than previously (Lyons et al., 2009). *Strongyloides westeri* has been incriminated occasionally as the cause of diarrhea but this is difficult to document. Only OBZ and IVM are labeled for control of these threadworms. The purpose of the present

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Table 1
Parasite data from studies on Farm A in November 2014 and April 2015 on anthelmintic treatments of mixed lighthorse-type foals (born in 2014 or 2015): number of foals positive/examined (pos/exam) (%) by qualitative/quantitative methods for recovery of nematode eggs pretreatment and posttreatment.

Types of nematode eggs										
Drugs	Ascarid				Strongyle				Strongyloides	
	Pretreatment		Posttreatment		Pretreatment		Posttreatment		Pretreatment	Posttreatment
	No. pos/exam (%)	EPG[1]	No. pos/exam (%)	EPG	No. pos/exam (%)	EPG	No. pos/exam (%)	EPG	No. pos/exam (%)	No. pos/exam (%)
November 2014										
PIP	5/5 (100%)	10–290	0/5(0%)	0	5/5 (100%)	300–880	2/5 (40%)	0	4/5 (80%)	1/5 (20%)
PRT	5/5 (100%)	10–10	0/5 (0%)	0	5/5 (100%)	320–2650	4/5 (80%)	70–100	5/5 (100%)	3/5 (60%)
Non-treated	2/5 (40%)	0	2/5 (40%)	0	5/5 (100%)	250–1730	5/5 (100%)	680–1860	2/5 (40%)	2/5 (40%)
April 2015										
OBZ	3/3 (100%)	10–880	0/3 (0%)	0	3/3 (100%)	350–4420	3/3 (100%)	90–640	0/3 (0%)	0/3 (0%)
PRT	2/3 (67%)	350	2/3 (67%)	70–200	3/3 (100%)	360–3730	2/3 (67%)	40–60	0/3 (0%)	0/3 (0%)
OBZ + PRT	3/3 (100%)	20–160	0/3 (0%)	0	3/3 (100)	670–2590	1/3 (33%)	10	0/3 (0%)	0/3 (0%)
Non-treated	2/2 (100%)	30–280	2/2 (100%)	30–290	2/2 (100%)	1170–1330	2/2 (100%)	460–1010	0/2 (0%)	0/2 (0%)

EPG[1] = number of eggs/gram of feces; OBZ = oxibendazole; PIP = piperazine; PRT = pyrantel pamoate; OBZ + PRT = combination of the two drugs. Note: In some instances the EPG values were negative but the fecal samples were considered positive because eggs were found on qualitative examination.

research in field tests was to compare current efficacy of FBZ, OBZ, PIP and PRT alone and in combinations of OBZ-PIP and OBZ-PRT against ascarids, small strongyles, and strongyloides. Particular interest was on drug activity, especially for PIP, on ascarids.

2. Materials and methods

2.1. Field tests—general information

They were completed in 2014 and 2015 testing activity of FBZ, OBZ, PIP, and PRT alone and in combinations of OBZ + PIP and OBZ + PRT against ascarids, strongyles and strongyloides in horse foals (n = 281) on two farms (A and B) (Tables 1-3). Farm A foals (n = 26) were mixed light horse-type and Farm B foals (n = 255) were Thoroughbred. Pretreatment weights were obtained by weighing Farm A foals on portable scales whereas weights were estimated for Farm B foals.

2.2. Fecal sampling and determining presence of parasite eggs

Most fecal sampling was by rectal collection but a few samples were from the ground of stalls. Qualitative detection of parasite eggs and quantitative egg counts (EPGs) in/for foal feces were as described previously (Lyons et al., 1976, 1988, 2007).

2.3. Ages of the foals

At time of treatment they varied. Farm A foals, treated only once, were five to seven months old in the April 2014 study and four to five months old in the November 2015 study (Table 1). Farm B foals were treated, according to month of birth, either once at three months old, twice at three and six months old or three times at three, five, and six months old (Tables 2-3).

2.4. Anthelmintics

OBZ paste (Anthelcide-EQ-Pfizer) (at 10 mg/kg) and PYR paste (Strongid Paste-Pfizer) (at 6.6 mg base/kg) were administered intraorally. PIP liquid (Wazine-34-Fleming Labs), used Off Label, is a product marketed for poultry and swine and was administered to foals via intranasal-gastric tube. It contains 34 g of piperazine sulphate salt/100 cm^3 which equals 112 mg base/kg. The piperazine used was Off Label because the authors don't know of any commercial source for horses now compared to many years ago.

3. Results

3.1. Summary of data for the two farms (A and B)

3.1.1. General

Evaluation of the activity of FBZ, OBZ, PIP and PRT alone and combinations of OBZ-PIP and of OBZ-PRT against ascarids, strongyles and strongyloides in foals on Farm A and Farm B.

3.1.2. Farm A

Data are summarized (Table 1). The November 2014 study showed that PIP and PRT alone had excellent activity against ascarids (Table 1). These drugs were essentially inactive on strongyles relative to number of foals infected after treatment but the EPG values were reduced highly. *S. westeri* infections were reduced some after treatment In the April 2015 study, OBZ and OBZ-PRT treatment revealed great activity against ascarids. Poor activity of PRT alone on ascarids was evident compared to excellent reduction in the 2014-born foals. Strongyle data indicate all foals were positive before treatment. Posttreatment strongyle EPG values were reduced for all treated foals. In order from highest to lowest reduction of strongyle EPGs and number of foals

Table 2
Qualitative data on studies in 2014 on Farm B on treatment of 106 Thoroughbred foals (born in 2014) with oxibendazole or piperazine alone and in combination in 2014.

Treatment	Nematode eggs (number of foals positive/examined)					
Drug	Ascarid		Strongyle		Strongyloides	
	Pretrt	Posttrt	Pretrt	Posttrt	Pretrt	Posttrt
Summary of all treatments						
OBZ	12/24 (50%)	0/24 (0%)	16/24 (67%)	16/24 (67%)	14/24 (58%)	4/24 (17%)
OBZ + PIP	28/48 (58%)	0/48 (0%)	45/48 (94%)	7/48 (15%)	16/48 (33%)	2/48 (4%)
PIP	13/34 (38%)	7/34 (21%)	24/28 (86%)	4/34 (12%)	12/34 (35%)	12/34 (35%)

Pretrt = pretreatment; Posttrt = post treatment; % = percent positive.
OBZ = oxibendazole; PIP = piperazine; OBZ + PIP = combination of both drugs.