Epidemiology and effect of internal parasitosis on bovine cattle breeding in the mountain grassland region of northwestern Argentina (NOA)

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ABSTRACT

The aim of this work was to study the epidemiology and the harmful effect of gastrointestinal nematodes (GINs) on replacement heifers in the mountain grassland region of northwestern Argentina (NOA). For this purpose, during the periods A (July 2013 to June 2014) and B (April 2014 to November 2015) weaned calves were monitored. Calves were divided into three groups: CTM (calves treated monthly with 200 mcg/kg moxidectin), CUT (calves treated at the start of the assay as usually done in the dairy farm, with 10 mg/kg albendazole for group A and 200 mcg/kg doramectin in B) and NTC: calves not receiving any anthelmintic treatment. Eggs per gram of feces (epg) were counted and feces mix cultures were performed for genus differentiation. Live weight gain (LWG) was recorded. Differences among groups were compared using least squares test. The highest epg count in weaned calves was observed in mid-winter, decreasing in spring and then increasing in late summer in yearling heifers. The genera Haemonchus, Cooperia and Ostertagia prevailed in moderately infested animals, although Trichostrongyulus and Oesophagostomum were also present throughout the observation period. During period A, there were significant differences (P<0.05) in total LWG among groups (CTM: 102.4 kg; CUT: 94.0 kg; NTC: 86.6 kg). During period B, differences among groups were significantly (P<0.0002) higher (CTM: 43.1 kg; CUT: 29.9 kg; NTC: 26.9 kg). The present study showed a post-weaning winter peak in epg and another peak at the end of summer, and a negative effect of GINs on LWG, even in moderately infected calves.

Keywords: cattle, gastrointestinal nematodes, epidemiology; northwestern Argentina.

INTRODUCTION

Internal parasites caused by gastrointestinal nematodes (GIN) are one of the main health conditions that affect bovine production worldwide as well as in Argentina (Barger, 1983; Suárez, 1993). Geographic location and animal management determine the intensity of the problem because GIN are intimately associated to climate and to the bovine host. Generally, it can be stated that GIN reduce meat (20%) and milk (6%) production through poor use of quality food and the deaths they cause. They also increase the costs - in terms of antiparasitics and other veterinary products - because they are a predisposing cause of other health problems. The studies conducted in the central region of the country show the importance of GIN in bovine production (Suárez et al., 2013).

The Argentine northwestern region (NOA) is characterized by a subtropical climate with dry winter season and summer rains that occur from late November to early April. In the region where this work was conducted, rainfall averages 650-800 mm (Bianchi, 1992). In the case of the highland grasslands (Pastizal Serrano) as one ascends the mountains above 1500 m.a.s.l., this environment appears as a grass-steppe, locally called “pampa”, comprising relatively flat surfaces that strongly contrast with the...
steep surrounding landscape. These “pampas” or highland pastures are used by the producers for livestock breeding and extend along the elevated slopes and summits of the mountain systems of the center and northwestern regions of Argentina.

Meat production in the NOA has become increasingly important in recent years, which has been intensified to adapt to the increasing demand and to increase its competitiveness. But the increasing intensification has shown limitations that remained hidden under more extensive productive regimes, such as those related to animal health. Within this problem, some recent clinical cases of GIN parasitosis reported in the region alert on the probable importance of the harmful effects of parasitic diseases in cattle breeding (Micheloud et al., 2014) and highlight the scarce information and precedents on internal parasites that parasitize cattle in the NOA (Le Riche et al., 1982; Kühne et al., 1986).

This lack of information, especially on the epidemiology and effects of GIN, evidences the need to study these nematodes, their economic incidence and sustainable control strategies in the different productive systems and environments of the NOA.

Hence, the aim of the present study was to study the epidemiology and the effects of GIN in cattle breeding in a representative region of the highland grasslands of Salta.

MATERIALS AND METHODS

General data

The study was conducted at Estancia (farm) Pampa Grande located at 1685 m.a.s.l. in the Department of Guachipas, Salta. The region has a summer rains regime that is interrupted with a dry period that extends from April to November.

The study lot was composed of red Aberdeen Angus and Pardo Suizas calves. Fodder management was based on alfalfa grazing under artificial irrigation, consociated and green pastures, and dry pastures grazing of weeping lovegrass or natural pastures at a rate of 6 to 10 calves per hectare.

Experimental design

During the 2013-2014 and 2014 periods two cohorts (A and B) of calves naturally infested with GIN were monitored. (A) We monitored from July 5, 2013 to June 26, 2014 the parasite infestation of 60 calves (weaned in April), from 8 to 20 months of age. (B) From April 8, 2014, we monitored a batch of 60 calves weaned on March 21, age 5-6 months, until November 4, 2014 when they reached one year of age.

To that end, three groups of 20 weaning calves were assigned to each follow-up group, (A) and (B) to compare a possible response against anthelmimtic treatments and the effect of parasites on weight gain. The groups were: untreated group (NTC); group with monthly treatment (CTM) with subcutaneous moxidectin (MXD) at a rate of 200 mcg/kg; group subject to the treatment implemented locally according to the sanitary management of the farm (CUT). This group during monitoring A was treated only with oral albendazole (ABZ: 10 mg/kg) at the beginning (June 2, 2013), while during monitoring B was treated with doramectin (DRM: 200 mcg/kg) at weaning, 18 days before the beginning (March 21, 2014). The groups grazed along with the entire 350 heifers lot.

Parasitological methods

Egg counts (epg) and genus differentiation of GIN were performed monthly, in addition to the Baermann technique to recover larvae from pulmonary worms (Suárez, 1997). The Fasciola diagnosis was performed using the sedimentation and methylene blue staining method described by Viñabal et al. (2015) for the observation of eggs of this trematode.

Productive evaluation

The live weight gain (LWG) was evaluated by means of monthly weights of the cattle with previous smoothing down of 18 h.

Analysis of data

Differences between weight gain and egg counts were compared by least squares using the InfoStat program.

RESULTS

Meteorological data:

The average monthly mean temperatures and precipitations of the last 40 years and the monthly precipitations occurred during the test are shown in Figure 1.

Parasitological data:

At the beginning of the A monitoring egg counts (epg) show a natural decline in the NTC, very marked from July to late August, and the decline continued until early summer. The CUT indicates a good efficacy of the initial treatment, that after reaching zero shows a small elevation in the spring after grazing alfalfa under irrigation. Then, both the NTC and CUT show a subsequent decline of the epg in green forage that increases in mid-summer, when summer rains begin. Finally, yearling heifers show an decrease in autumn of epg (Figure 2).

The B monitoring also presents low epg at the beginning of April, probably due to a low infestation at the feet of the mothers, since they had been weaned at the end of March (Figure 3) and probably this caused a contamination dilution effect of the paddock, and therefore reducing the calves’ infestation chances. The CUT group was treated with doramectin 17 days prior to the beginning of the observations (April 8, 2014). This group showed that the treatment efficacy was absolute since the epg was zero. Then, the
samplings show an increase of the epg of NTC and CUT by the beginning of spring, when a reduction towards the end of the observations is observed.

The epg of CTM groups systematically dewormed in periods A and B initially dropped to zero, and then maintained very low values, indicating good activity of the MXD.

As for the prevalence of GIN genera, the same trend can be described (Figure 4) by integrating monitorings (A and B) in the NTC or CUT batches without and with a single treatment, respectively. Since weaning at the beginning of autumn, a predominance of the genus Cooperia, Haemonchus and Ostertagia is observed until August, although a decrease of Haemonchus is observed in June and July. Towards the spring the percentage of Ostertagia decreases, and by the time calves are about 1 year old Cooperia Cooperia, while the presence of Trichostrongylus increases. Towards the end of summer the heifers’ summer peak is due to an increase of Haemonchus and Oesophagostomum, although all the genera are present.

Fasciola hepatica eggs were recovered in low quantity in the autumn samplings. The pools showed an average of 9 and 8 eggs per gram in August and November, respectively. The Fasciola eggs recovered in the (B) monitoring were lower than in the (A) monitoring, not exceeding 2 eggs per gram in the pools. No differences between groups were observed at any time.

Only Dictyocaulus larvae were recovered in a small number of pools in the May, July and August sampling in the NTC and CUT groups.

**Production data:**

During both periods no clinical signs of verminous gastroenteritis were observed in the calves, nor were there any signs of other health problems evident in the cattle.

During the A monitoring, a significant difference (p<0.004 and p<0.001) was observed at baseline in the CUT and CTM treated groups in the post-treatment LWG when compared with that of NTC. Later, the gains between groups were similar, until the heavy weighing in March where significant differences (p<0.02) were obtained between the LWG obtained during the summer of the CTM when compared to those of NTC. At the end of the observations there were significant differences (p<0.05) between the total LWG among groups. Table 1 summarizes these results.

During the B monitoring at baseline there were no post-treatment differences between groups, although as epg increased, there were differences in LWG. These were significant in the weightings of July (p<0.02), September (p<0.003) and November (p<0.02). The weight gain of this period is summarized in Table 2. Also, at the end of this period the differences between the weight gains of the groups were significant (p<0.0002).
Figure 2. Average egg counts (epg) of rearing during period A (July 2013/June 2014) in groups CTM (systemic treatment), CUT (local treatment) and NTC (untreated).

DISCUSSION

The total rainfall recorded during the 17-month trial (801 mm), although somewhat lower than the average of the last 40 years (944 mm), show the same historical trend for this region, giving these results a greater epidemiological validity due to the close relationship between GIN and climate.

The parasitological results show that when weaning - at the beginning of autumn - epg is low in calves, and the number depends mainly on the late summer rains and the consequent probable infestation of calves by the foot of the mother. After weaning, we observed an elevation of epg, similar to that observed in the Pampas plain (Fiel et al., 2013; Suárez et al., 2013). This can be explained because contaminated pastures concentrate them due to the replenishment by weaning - the most susceptible category - and maximizes the multiplication of the ingested nematodes, thus contaminating the studs. The infestation by the foot by late summer or early fall is maintained by the humidity or rains in case they are prolonged until mid-autumn, and by the artificial irrigation of some pastures. Then, mid-winter, the dry period would minimize the availability of larvae in the paddocks, which reflects in the reduction of the epg towards summer. Also, the strengthening of one year-old calves immunity would reduce oviposition of nematodes. Then, the increase in the epg observed towards the midsummer in the replenishment would respond to a greater parasitic supply favored by the rains. Finally, the onset of the dry period together with the consolidation of the heifers' immunity and grazing in non-irrigated pastures would mark the drop in the epg.

These results are similar to those obtained in 1979-80 by Kühne et al. (1986) who noted two peaks in epg: the first from weaning until late winter and the second - lower - in replacement females in early fall. A similar epg variation was described in the central Pampa region (Suárez et al, 1999; Suárez et al, 2013).

When analyzing the the seasonal variation of the nematode genera eliminated by fecal matter from the untreated group (Figure 4) we noted a winter decline of Haemonchus, probably due to the fact that low temperatures affected the survival of free-living larvae, thus reducing their availability in paddocks while, conversely, the genus Ostertagia could have been favored, since it was found in increasing numbers.

Towards the end, the percentage of Cooperia decreased drastically, while Haemonchus increased. Probably,
Figure 3. Average egg counts (epg) of rearing during period B (April 2014 / November 2014) in groups CTM (systemic treatment), CUT (local treatment) and NTC (untreated).

Figure 4. Proportion of nematode genera recovered from stool cultures in relation to the average egg count (epg) of the entire experience.
Cooperia’s decline is due to the consolidation of immunity to this worm. Also, there is a spring reduction in the genus Ostertagia. This could be due to a seasonal retardation of its development as “inhibited larvae” in spring as to reactivate in mid-summer, as it was described in the Pampas plain (Suárez, 1990). This hypothesis arises from a case of mortality due to verminous gastroenteritis in yearling and adult cattle observed in February 2013 by Micheloud et al. (2014). Necropsy showed lesions of the rennets with type II ostertagiasis, similar to those found in central Argentina (Suárez et al., 1999, Fiel et al., 2013). This would indicate that the Ostertagia cycle could be similar with an inhibition of the spring development of the ingested larvae.

Productive results show that at the beginning of the A monitoring there was a post-treatment response in the weight gains of the treated groups, both under MXD and ABZ, evidenced by the drop of epg. This answer shows the efficacy of winter treatment, when nematode loads rise. This treatment at the beginning of July also prevented the contamination of the paddocks for a long time, while the drought period continued. Then, in the summer, significant differences between the LWG of the groups were estimated, and results showed that the treated group (CTM) was favoured, coinciding with the epg increase. Similar responses to the treatments were observed in the central region of Argentina, which are explained by the effect of the disinhibition of the 4th instar larvae of Ostertagia ostertagi, whose development slowed in spring (Steffan et al., 1985; Suárez et al, 1999).

B monitoring began with younger weaning calves and at the beginning of autumn with low infestations. Because of this, there was no response to treatment between batches at baseline, and only differences in weight gains were observed in favor of CTM from mid-autumn to the end of winter, when the infestation of calves increased.

At the end of the observations, total LWG of CTM (43.1 kg) presented an increase of 44.1% and 60.2% when compared with the gain of CUT (29.9 kg) and NTC (26.9 kg). The differences evidenced between treatments would probably have been greater if the groups grazed in separate plots since this trial, like others trying to determine the effect of the gastrointestinal nematodes, has in its design some insurmountable deficiencies under field conditions. This is because when different groups graze together in the same paddocks, they cause interference between larval ingestion and anthelmintic treatment (Brusdon, 1980). These interferences mean that the systematically treated batch (CTM) is always exposed to a larval challenge and can not express the response in weight gain under complete deworming. Tests conducted at EEA INTA Anguil - with the treatments located in separate plots but

<table>
<thead>
<tr>
<th>Groups</th>
<th>Initial weight</th>
<th>LWG</th>
<th>LWG</th>
<th>LWG</th>
<th>LWG</th>
<th>Total LWG</th>
<th>Total LWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTC</td>
<td>142.2 a</td>
<td>11.6 a</td>
<td>12.4 a</td>
<td>30.6 a</td>
<td>32.0 a</td>
<td>86.6 a</td>
<td>228.8 a</td>
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<tr>
<td>CUT</td>
<td>140.7 a</td>
<td>11.6 a</td>
<td>12.4 a</td>
<td>30.6 a</td>
<td>32.0 a</td>
<td>94.0 a</td>
<td>234.7 a</td>
</tr>
<tr>
<td>CTM</td>
<td>140.0 a</td>
<td>19.3 b</td>
<td>11.1 a</td>
<td>28.4 a</td>
<td>35.2 ab</td>
<td>102.4 b</td>
<td>242.7 a</td>
</tr>
</tbody>
</table>

Table 1. Live weight gains (LWG) in kg of calves during period A. NTC: untreated group; CTM: group with monthly treatment of moxidectin; CUT: group under the treatment of the establishment.

Columns with different letters indicate significant differences, p <0.05.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Initial weight</th>
<th>LWG</th>
<th>LWG</th>
<th>LWG</th>
<th>LWG</th>
<th>Total LWG</th>
<th>Final weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTC</td>
<td>152.5 a</td>
<td>-4.3 a</td>
<td>9.3 a</td>
<td>1.7 a</td>
<td>-0.4 a</td>
<td>20.6 a</td>
<td>26.9 a</td>
</tr>
<tr>
<td>CUT</td>
<td>148.1 a</td>
<td>-5.7 a</td>
<td>10.5 a</td>
<td>3.0 a</td>
<td>-2.1 a</td>
<td>24.2 ab</td>
<td>29.9 a</td>
</tr>
<tr>
<td>CTM</td>
<td>148.0 a</td>
<td>-4.6 a</td>
<td>15.3 b</td>
<td>2.2 a</td>
<td>5.0 b</td>
<td>25.2 b</td>
<td>43.1 b</td>
</tr>
</tbody>
</table>

Table 2. Live weight gains (LWG) in kg of calves during period B. NTC: untreated group; CTM: group with monthly treatment of moxidectin; CUT: group under the treatment of the establishment.

Columns with different letters indicate significant differences, p <0.05.
with the same forage supply - always show greater harmful effects than others under joint grazing but they have the disadvantage that it is very difficult to maintain the pastures under similar conditions in the different plots (Suárez et al., 1991).

**CONCLUSIONS**

The genera Haemonchus, Cooperia and Ostertagia were the prevalent GIN, although Oesophagostomum and Trichostrongylus were also present throughout the observations. The highest incidence of GIN on rearing was evidenced by epg, which showed two peaks, one towards mid-winter (after weaning) and another towards the end of summer in the yearling rearing. Also, during these same periods, the impact of GIN in cattle breeding was evidenced in the differences observed between treatments in the LWG, especially until animals were one year old, although they also has a minor harmful effect from mid-summer in yearling animals.

**ACKNOWLEDGEMENTS**

The authors thank Mr. Rodolphe De Spoelberch, owner of the Pampa Grande establishment for allowing us to work in his facilities and with his animals. To Mr. Antonio Leach, Mr. Nicolás Uriburu, Mr. Anselmo Seewald and all the staff not only for their help both in the organization and in the fulfillment of the tasks with the cattle but also for their hospitality.

**BIBLIOGRAPHY**


