Haemonchus spp. in sheep farmed under resource-poor conditions in South Africa – effect on haematocrit, conjunctival mucous membrane colour and body condition

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ABSTRACT

A longitudinal study was conducted on the differential faecal egg counts, haematocrits and body condition scores of sheep belonging to resource-poor farmers at Rust de Winter, Gauteng province, and Kraaipan, North West Province, South Africa. The animals were scored for level of anaemia using the FAMACHA© method, an assay for the clinical evaluation of anaemia caused by *Haemonchus* spp. Periods of higher *Haemonchus* egg counts occurred from October to March for sheep at Rust de Winter and from September/October to February or April for sheep at Kraaipan. Lower haematocrit values were registered during these periods as was a higher incidence of anaemic conjunctival mucous membrane colour scores compared to the period April to September. No clear relationship between the faecal egg counts and the body condition scores was evident. Although wider application of the FAMACHA© system in sheep raised by resource-poor farmers should be investigated, the present study indicates that this method may certainly prove to be a valuable worm control strategy for such livestock owners.

Key words: body condition, conjunctival mucous membrane colour, FAMACHA©, haematocrit, *Haemonchus* spp., sheep.

Vatta A F, Krecek R C, van der Linde M J, Motswatswe P W, Grimbeek R J, Van Wijk E F, Hansen J W ***Haemonchus* spp. in sheep farmed under resource-poor conditions in South Africa – effect on haematocrit, conjunctival mucous membrane colour and body condition.** *Journal of the South African Veterinary Association* (2002) 73(3): 119–123 (En.). Onderstepoort Veterinary Institute, Private Bag X05, Onderstepoort, 0110 South Africa.

INTRODUCTION

Although helminths have been studied in sheep raised under commercial farming conditions in the summer rainfall region of South Africa[7,8] and some work has been done in indigenous goats[3], little is known of the effects of worms on production of sheep raised by resource-poor farmers. The objective of the current investigation was to evaluate, by means of a longitudinal study, the effect of *Haemonchus* infection on haematocrit, conjunctival mucous membrane colour and body condition score (BCS) in sheep farmed under resource-poor conditions in South Africa. The study ran concurrently with one on goats in the same resource-poor areas and had a similar aim[15,16,17].

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Received: December 2001. Accepted: July 2002.

MATERIALS AND METHODS

Study sites, animals and sampling

Two study sites situated within the summer rainfall region of South Africa were selected: one near Rust de Winter (25°16′52″S, 28°38′51″E), Gauteng province, and one in Kraaipan (26°19′16″S, 25 °16′44″E), North West Province, South Africa. At Rust de Winter all the weaner and adult sheep were sampled/scored during each visit. At Kraaipan a representative sample of the sheep flock was selected based on the 1st animals brought into the crush during the 1st visit, and when available the same sheep were sampled/scored throughout the trial period. Unfortunately the initial sample size started to dwindle and for this reason every 10th sheep brought into the crush in May 1999 was added to the sample group. This resulted in 4 sheep being added to the representative sample groups. A summary of the trial periods and frequencies of visits, breeds of animals, sample sizes, anthelmintics used, grazing practices, vegetation types, winter supplementation, and rainfall is given in Tables 1 and 2.

During the day the sheep at Rust de Winter grazed on natural vegetation to which goats and cattle also had access, but from May 1999 they were grazed separately in an enclosed paddock of fallow land. At Kraaipan the sheep were grazed together with the farmers' goats on communal pasture tended by a shepherd. The animals at both sites were penned in kraals at night.

A faecal egg count reduction (FECR) test was carried out on the sheep at Kraaipan towards the end of the trial. Except for 1 sheep, the animals used for this purpose were not included in the sampling group mentioned above. Four of the sheep included in the test had 2–6 permanent incisors while the rest had deciduous incisors only. None of the animals had been treated with an anthelmintic effective against nematodes for 12 weeks prior to the start of the FECR test.

Diagnostic techniques

Faecal samples were collected at each visit from all the sheep at Rust de Winter and the representative sample at Kraaipan (the 'trial' animals). Additional samples were collected from April 1999 onwards at Kraaipan to ensure that there would be sufficient faeces for a good yield of 3rd-stage nematode larvae (L_3) when cultures were made (see below). The faecal samples were processed for nematode faecal egg count (FEC)[10] at a sensitivity of 100 eggs per gram of faeces (epg). *Strongyloides, Nematodirus* and *Trichuris* eggs were counted separately from the other nematode eggs, herein referred to as 'strongyle' eggs (order Strongylida Molin, 1861).

Samples were screened for trematode eggs by the sedimentation method[11] modified for pooled samples as follows: 0.5 g of faeces (1 g for the sheep at Rust de Winter) was taken off each of 10 faecal samples (5 faecal samples for the sheep at Rust de Winter) randomly selected from those collected at each visit to a site. The faeces were pooled and sieved through a

Table 1: **Study sites: summary of trial periods and frequencies of visits, breeds of animals, sample sizes and anthelmintics used.**

Study site	Trial period	Frequency of visits	Breed	Approximate numbers of animals present at each visit	Mean number of animals sampled/scored (range)	Anthelmintic used (oral dosage)[b]
Rust de Winter	Sep 1998 – Apr 2000	Fortnightly	Dorper sheep crossbreed	3–7	5 (3–7)	Levamisole (7.5 mg/kg)[b]
Kraaipan	Oct 1998 – Apr 2000	Monthly[a]	Indigenous fat-tailed sheep crossbreed	±60	14 (5–22)	Levamisole (7.5 mg/kg)[b]

[a]Except for 2 visits over 3 months at start of trial.
[b]Predominantly Tramisol™ liquid (Hoechst Roussel Vet, now Intervet); on a few occasions initially Levisol™ liquid (Bayer).

Table 2: **Study sites: summary of grazing practices, vegetation types, winter supplementation** (1999) **and rainfall.**

Study site	Grazing	Vegetation (ref. 1)	Winter supplementation	Rainfall*
Rust de Winter	Private farm of 620 ha	Mixed bushveld	Bone meal and salt lick	610 (Rust de Winter, 10)
Kraaipan	Communal	Sourish mixed bushveld	Bone meal and salt lick	539 (Mmabatho, 60)

*Long-term average annual rainfall in mm (weather station, approximate kilometres in a direct line from study site). Source: South African Weather Bureau.

sieve with 150 μm apertures onto a 38 μm sieve. The contents of the latter sieve were washed into a 2- or 3-ℓ glass jar. This was filled with water and allowed to stand for at least 15 min. The supernatant was then decanted and the sediment agitated by filling the jar again. This process was repeated approximately 3 times until the resulting supernatant was clear. Thereafter the sediment was poured into a measuring cylinder and a 10 % aliquot was examined for trematode eggs under a stereomicroscope.

Faeces remaining after the FECs had been completed were cultured for L_3 at a temperature of approximately 25 °C until November 1999 when a new incubator room was taken into use with the temperature set to ~26 °C. Where possible, at least 50 L_3 per culture were identified[6,12]. No attempt was made to differentiate *Teladorsagia* larvae from those of *Trichostrongylus* spp. The proportional FECs of the various strongyle worm genera were calculated from the proportions of the strongyle L_3.

The animals were bled from the jugular vein into evacuated ethylene diamine tetra-acetic acid (EDTA) tubes (Vacutainer Systems™, Becton Dickinson, France). Two heparinised microhaematocrit tubes (Marienfeld, Germany, or equivalent) were filled with blood per sample and centrifuged (Kubota 3100, N.T. Laboratory Supplies, Johannesburg, or Hermle Z230 HA, Germany) for 7 min at 12 000 rpm. The haematocrits were read for each capillary tube and the average of the 2 readings used in the analyses.

The efficacies of the anthelmintics used in the sheep at Kraaipan were assessed by means of the FECR test according to the method of the World Association for the Advancement of Veterinary Parasitology (WAAVP)[5], which uses the reduction in FECs following anthelmintic treatment as an indication of anthelmintic efficacy. The arithmetic mean of the treatment and control groups at 10–14 days after treatment were used to calculate the percentage reduction of FECs and the upper and lower 95 % confidence intervals. Resistance is considered to be present if the percentage reduction is less than 95 % and the lower confidence interval is less than 90 %. If only 1 of the conditions is met, resistance is only suspected. The faeces remaining after the FECs had been carried out were then pooled separately per group and cultured for L_3 recovery (post-treatment cultures). The proportions of L_3 were applied to the strongyle egg counts to estimate the relative contribution of each genus[5,9]. However, since *Haemonchus* was the predominant strongyle genus in the post-treatment culture of the control animals (82 %, n = 79), the calculations were performed only for the *Haemonchus* egg counts.

Table 3 gives the mean FECs of the animals at the visits immediately prior to the dates on which the anthelmintic treatments for the FECR tests were carried out. The animals were ranked according to these FECs from lowest to highest and divided into groups of 3. Each individual within each group was then assigned to a treatment or control group (Table 3), using a table of random numbers. The treatment and post-treatment dates of the FECR tests and the sizes of the groups included in the tests are also recorded in Table 3.

The body conditions of the sheep were scored on a scale of 1 (emaciated) to 5 (obese) and half-scores were assigned when appropriate[15,18].

Scoring for level of anaemia

At the scheduled visits the 1st author (AFV) or one of the assistants on the project scored each animal for level of anaemia using the FAMACHA© card[13]. AFV ensured that each assistant who recorded scores had been adequately trained in the method. Except for the few visits that AFV could not undertake, the scoring was always performed under his direct supervision. Occasionally monitoring was done in-between scheduled visits by animal health technicians (AHTs) assisting with the project at Kraaipan. However, their scores were not included in any of the analyses. Only the animals considered to be pale, *i.e.* categories 4 and 5, were treated with an anthelmintic. Occasionally, animals scored as category 3 were erroneously treated by AHTs at Kraaipan.

To promote farmer cooperation animals that showed signs indicative of *Oestrus ovis* infection (profuse mucous nasal discharge and difficulty in breathing through the nose) were occasionally also treated with rafoxanide [Nasalcur™, Hoechst Roussel Vet (now Intervet), 7.5 mg/kg]. With respect to the trial animals, 1–2 sheep were treated on 4 occasions at Rust de Winter and 1–8 were treated on 12 occasions at Kraaipan.

RESULTS

Figs 1 and 2 depict the FECs, mean haematocrits and mean BCSs for sheep at the 2 study sites. Third-stage larvae of *Haemonchus* spp., *Teladorsagia/Tricho-*

Table 3: **Faecal egg count reduction** (FECR) **test: details of groups and results.**

Study site	Mean FEC (interval)[a]	Treatment date of FECR test (interval)[b]	Anthelmintic (oral dosage)	Control group Mean post-treatment FEC[c]	*n*	Treatment group Mean post-treatment FEC[c]	*n*	FEC reduction	95% Confidence interval
Kraaipan	8230 (28)	29 Feb 2000 (10)	Levamisole (7.5 mg/kg)	7844	6	0	8	100	Undefined
			Rafoxanide (7.5 mg/kg)	7844	6	0	7	100	Undefined

[a]Mean faecal strongyle egg counts in eggs per gram of faeces at last visit before treatment date of FECR test (interval in days between last visit and FECR test).
[b]Treatment date of FECR test (interval in days between treatment date and date of post-treatment collection of faecal samples).
[c]Mean faecal *Haemonchus* egg counts per gram of faeces.

Table 4: **Percentage of sheep treated from October to March** (*Haemonchus* season) **and April to September.**

Location	Total examined	F© 4 & 5 treated[a] (%)	F© 3, 4 & 5[b] (%)
Rust de Winter			
Oct 1998 – Mar 1999	74	6.8	21.6
Oct 1999 – Mar 2000	65	1.5	20.0
Apr – Sep 1999	65	0	7.7
Kraaipan			
Oct 1998 – Mar 1999	130	0.8	9.2
Oct 1999 – Mar 2000	86	1.2	17.4
Apr – Sep 1999	110	0	5.5

[a]FAMACHA© values 4 and 5 treated.
[b]FAMACHA© values 3, 4 and 5 treated (theoretical).

strongylus spp., *Oesophagostomum* spp. and *Strongyloides* spp. were identified in the faecal cultures from both trial sites[15]. However, since *Haemonchus* predominated in many of the cultures, the graphs of the FECs were drawn to reflect the mean *Haemonchus* FECs and the mean total FECs for the other strongyle genera. Maximum individual *Strongyloides* FECs never exceeded 200 epg and *Nematodirus* and *Trichuris* eggs were not found. Complete results for the L_3 cultures were not obtained on numerous occasions for the sheep at Rust de Winter mainly because of difficulties in obtaining sufficient faeces from the animals for FEC and culture. L_3 culture results were incomplete for the sheep at Kraaipan during October 1998 owing to problems in the laboratory. In these instances the averages of the proportions for *Haemonchus* spp. and for the other nematode genera for the visit dates immediately prior to and following the dates of missing data were used to estimate the proportional FECs. These results are indicated by dotted lines in the figures.

A period of higher *Haemonchus* egg counts occurred from October to March at Rust de Winter (Fig. 1) and from September/October to February or April at Kraaipan (Fig. 2). The mean haematocrits were lower during the periods of higher egg counts at Rust de Winter and during January and October 1999 and February 2000 at Kraaipan.

The pooled trematode FECs followed a seasonal pattern of amphistome infection in the sheep at Rust de Winter and Kraaipan, with an increase in counts during the summer months of December/January to March/April. However, FECs were low, with a maximum count of 40 epg recorded in February 1999 at Rust de Winter and 54 epg at Kraaipan. A count of 30 epg was recorded during October 1999 at Kraaipan. All samples were negative for *Fasciola* eggs.

Body condition scoring performed by different operators on the same animals at the same time compare poorly[4]. Thus only those scores recorded by AFV are recorded in Figs 1 and 2. The BCSs at Rust de Winter ranged between 1.2 and 2.7. Although no clear seasonal pattern is evident in the BCSs of the sheep at Rust de Winter (Fig. 1), the BCSs were lower during August 1999 to mid-February 2000. The BCSs at Kraaipan were higher during the summer months but lower during July to December 1999 (Fig. 2). Overall the BCSs at Kraaipan remained poor, however, with scores ranging from 1.3 to 2.0.

Very few sheep were treated with an anthelmintic at Rust de Winter or Kraaipan during the trial (Table 4). Hypothetically considering FAMACHA© category 3 as anaemic in addition to categories 4 and 5 did not increase the total scores for anaemic sheep by a substantial degree. Although more animals were scored in FAMACHA© categories 4 and 5 (and 3, 4 and 5) during October to March than during April to September, on most occasions the sheep were scored as non-anaemic, *i.e.* in categories 1 and 2.

Anthelmintic resistance was not detected in the sheep at Kraaipan by the FECR test (Table 3).

DISCUSSION

This study should be considered preliminary. It nevertheless adds to the body of knowledge specifically related to helminthosis in sheep farmed under resource-poor conditions in South Africa.

The pattern of higher *Haemonchus* egg counts during the warmer months of the year agrees with studies in sheep raised under commercial farming conditions in the summer rainfall region of South Africa[7,8]. The high *Haemonchus* FECs during the summers account for the declines in haematocrit and the increased incidence of anaemic conjunctival mucous membrane colour-scores seen during these months. Trematodes do

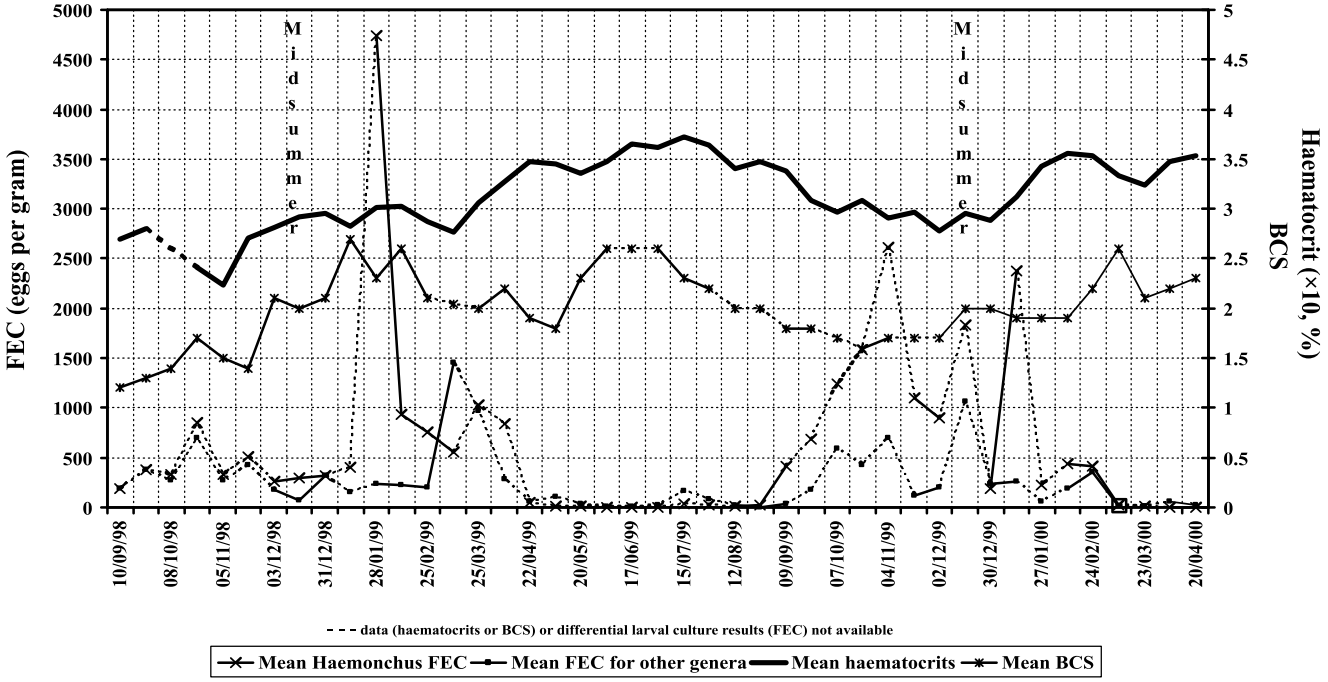

Fig. 1: **Strongyle faecal egg counts** (FEC), **haematocrits and body condition scores** (BCS) **of sheep at Rust de Winter.**

not appear to be important parasites in the sheep studied, although confinement of the sheep at Rust de Winter to the enclosed paddock of fallow land from May 1999 onwards would in any event have limited their exposure to trematode infection.

No clear relationship between the faecal egg counts and the body condition scores was evident. The body condition is probably more closely related to the nutrition of the sheep, which was poorer during the periods of little rainfall (June to November).

The FAMACHA© system was developed to provide a solution to the problem of anthelmintic resistance in sheep in South Africa by reducing the number of anthelmintic drenches administered. It has been shown to achieve this within the context of an integrated worm control approach on commercial farms[2]. Although wider application of the FAMACHA© system under resource-poor conditions in sheep should be further investigated, the present study shows that the method may also be used under these conditions. It may prove to be especially applicable to these farmers who are unlikely to treat all their animals for worms at any one time because of the cost of anthelmintics. The system allows the farmer to identify affected animals and treat those, thus preventing mortalities. Furthermore, although no anthelmintic resistance was detected in the present study, resistance was detected in sheep in Lebowa, a communal grazing area in the Mpumalanga and Limpopo provinces of South Africa[14]. Every effort should be made to reduce the selection pressure for anthelmintic resistance through, amongst other methods, the judicious and sparing use of anthelmintics.

ACKNOWLEDGEMENTS

The project was funded by the Food and Agriculture Organization of the United Nations Technical Co-operation Project TCP/SAF/8821 and through the financial,

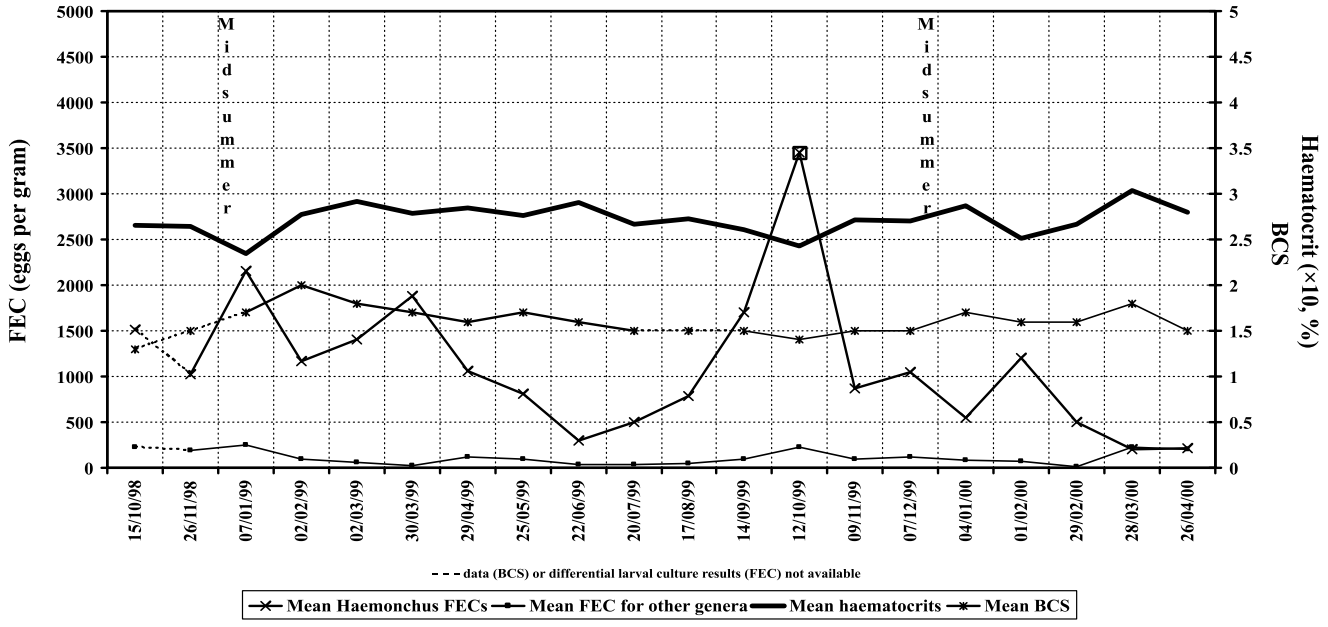

Fig. 2: **Strongyle faecal egg counts** (FEC), **haematocrits and body condition scores** (BCS) **of sheep at Kraaipan.**

technical and/or administrative assistance of Gauteng Veterinary Services, Hoechst Roussel Vet (now Intervet), the National Research Foundation (formerly Foundation for Research Development), North West Province Veterinary Services, Onderstepoort Veterinary Institute, THRIP and the University of Pretoria. We gratefully acknowledge the participation of the farmers, Messrs Mthombeni and Segwe, and field and/or laboratory assistance by Mr D Chipana, Mr F Masubelle, Ms O Nepholovhodwe, and Messrs W Shima and L Tshikhudo.

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