# AN ESTIMATE OF SEASONALITY AND INTENSITY OF INFECTION WITH GASTROINTESTINAL NEMATODES IN SHEEP AND GOATS IN WEST JAVA

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## ABSTRAK

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*Tracer* domba ekor tipis dan kambing kacang digunakan untuk mengukur perubahan musim infeksi cacing nematoda saluran percernaan pada kondisi pedesaan di Jawa Barat. Setiap 3 bulan selama setahun, domba dan kambing jantan muda yang bebas cacing dibagikan, seekor setiap peternak dan dipelihara seperti ternak yang lain selama 2 bulan. Ternak kemudian dikembalikan ke laboratorium dan dipelihara pada kondisi yang bebas cacing di kandang panggung selama 3 minggu sebelum dipotong. Dari semua percobaan, domba mempunyai jumlah telur cacing yang lebih tinggi dibandingkan dengan kambing. Jumlah telur cacing secara nyata lebih rendah selama akhir musim kemarau dan permulaan musim hujan karena terutama rendahnya cacing *Oesophagostomum* spp. dibandingkan dengan waktu musim yang lain. Genus cacing yang paling banyak ditemukan dalam biakan tinja adalah *Haemonchus* dan *Trichostrongylus*. Pada waktu pascamati, lebih dari 94 persen ternak diinfeksi oleh *T. colubriformis*, *T. axei*, *H. contortus*, *O. columbianum* dan *Strongyloides papillosus*. Spesies lain yang ditemukan secara berurutan dari yang paling banyak adalah *Cooperia curticei*, *Trichuris ovis*, *Bunostomum trigonocephalum*, *O. asperum*, *Capillaria bovis* dan *Gaigeria pachycelis*. Dari penelitian ini dapat disimpulkan bahwa intensitas infeksi domba dan kambing oleh *H. contortus*, *T. axei* dan *C. curticei* adalah sama sepanjang tahun, tetapi keberadaan larva infektif cacing *T. colubriformis* adalah lebih tinggi pada musim kemarau dibandingkan dengan musim hujan, hal ini kebalikannya untuk larva cacing *O. columbianum*. Domba mempunyai jumlah cacing *T. colubriformis* yang lebih banyak dibandingkan dengan kambing, tetapi mempunyai jumlah yang sama untuk spesies yang lain.

**Kata kunci:** Domba ekor tipis, kambing kacang, *tracer*, cacing nematoda saluran pencernaan

## ABSTRACT

BERIAJAYA and D.B. COPEMAN. 1997. An estimate of seasonality and intensity of infection with gastrointestinal nematodes in sheep and goats in West Java. *Jurnal Ilmu Ternak dan Veteriner* 2 (4): 270-276.

Tracer Indonesian thin-tail sheep and Kacang goats were used to measure the seasonal changes in gastrointestinal nematodes parasitism under village conditions in West Java. Each 3 months for 12 months worm-free male sheep (5) and goats (5) about 5 months of age were distributed, one per farmer, and managed as part of their flock for 2 months. Animals were then returned to the laboratory and maintained on worm-free diet in elevated slatted pens for 3 weeks prior to slaughter. In all trials sheep had higher faecal egg counts than goats. Egg counts were significantly lower during the late dry-early wet season due mainly to lower burdens of *Oesophagostomum* spp. than at other times of the year. The predominant genera recovered from faecal larval cultures were *Haemonchus* and *Trichostrongylus*. At post mortem more than 94 percent of animals were infected with *Trichostrongylus colubriformis*, *T. axei*, *Haemonchus contortus*, *Oesophagostomum columbianum* and *Strongyloides papillosus*. Other species found, in descending order of occurrence, were *Cooperia curticei*, *Trichuris ovis*, *Bunostomum trigonocephalum*, *Oesophagostomum asperum*, *Capillaria bovis* and *Gaigeria pachycelis*. It was concluded that intensity of exposure of both sheep and goats to *H contortus*, *T. axei* and *C. curticei* was similar throughout the year, but that availability of infective larvae of *T. colubriformis* was higher during the dry than the wet season and *vise versa* for *O. columbianum*. Sheep had higher burdens of *T. colubriformis* than goats but similar numbers of other species.

**Keywords:** Thin-tail sheep, kacang goats, tracer, gastrointestinal nematode

## INTRODUCTION

In West Java sheep and goats are housed and fed cut herbage and crop residues at night and on rainy days. The only areas available for grazing are those not under crop such as verges of fields and roads. It is consequently difficult to determine their level of exposure to infection with gastrointestinal parasites using pasture sampling techniques. Furthermore, few studies have been made in Indonesia on worm burden of sheep and goats kept by farmers since the animals are usually not available for post-mortem, sick animals are slaughtered for consumption, and such studies are expensive. Faecal strongyle egg counts have been monitored in village sheep and goats (BERIAJAYA and STEVENSON, 1985, 1986) suggesting the occurrence of

seasonal differences in worm burdens but actual worm burdens have not previously been investigated.

In this study worm burdens in tracer animals have been used as a further measure of the seasonality and intensity of infection with gastrointestinal strongyles to which sheep and goats are subjected under village conditions. Data collected also provide a measure of the correlation between worm burden and faecal egg count and the species of helmiths which infect sheep and goats in the study area of West Java.

## MATERIALS AND METHODS

### Tracer animals

For each of 4 trials, 5 male Javanese thin tail sheep and 5 male Kacang cross Etawah goats, aged 4-6 months, were purchased from a market in Bogor. Prior to being used as tracer animals, these animals were held in an elevated pen with a slatted floor at the Research Institute for Veterinary Science in Bogor, West Java and fed with a pelleted ration consisting of 50% dry young elephant grass and 50% grain and mineral concentrate. Animals were treated with oxfendazole at 4.5 mg/kg each 3 days on 5 occasions. This treatment was sufficient to eliminate all worms.

These animals were distributed to farmers where flocks were being monitored in the village of Batujajar. One tracer animal was given to each farmer who kept it with his own animals. Animals were usually allowed to graze during the day and housed in a pen with a raised slatted floor each night. Observations on faecal egg count and larval differentiation were made each 2 weeks.

After 8 weeks, tracer animals were returned to the laboratory and kept in elevated slatted pens for 3 weeks prior to slaughter. They were fed pellets described previously to avoid further infection with helminths.

This experiment was repeated 4 times, once each 3 months with 5 sheep and 5 goats each time. The first experiment commenced on 18 December 1990, the second on 2 April 1991, the third on 25 June 1991 and the last on 17 September 1991. Rainfall data and number of rainy days per month at the village of Batujajar are presented in Figure 1.

### Procedure for worm counts from the alimentary tract

Immediately after slaughter, the abomasum, small intestine and large intestine were ligated and removed. Each was then processed separately. The abomasum was cut open over a plastic tray and washed thoroughly under a stream of water from a tap taking care to remove any worm adhering to the mucous membrane. The contents of the tray were then poured a little at a

time on to a 100 mesh per inch screen and washed with a jet of water from a tap. The thoroughly washed contents of the screen was then washed into a 300 ml jar. The same procedure was applied to the small and large intestine. All worms were collected separately from the abomasum, small and large intestine. They were identified and counted using a dissecting microscope according to methods described in the MANUAL OF VETERINARY PARASITOLOGICAL LABORATORY TECHNIQUES (1971).
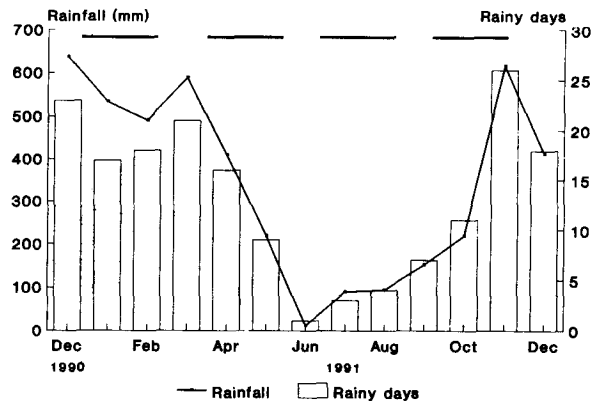


**Figure 1.** Monthly rainfall and number of rainy days per month in the village of Batujajar. Periods when tracer sheep and goats were present are represented by solid lines parallel to the x axis across the top of the graph

### Statistical analysis

During the course of trial 2 conducted from April to May 1991, 1 sheep and 2 goats died two weeks after distribution to farmers. The cause of death was not established. A total of 37 animals from all trials comprising 19 sheep and 18 goats were thus included in the analysis of data.

Prior to statistical analysis, data of nematode egg and worm count were transformed using log (x+1). Analysis of variance was performed using Statistix version 4.0 (Analytical Software, 1992) to determine the significance of differences in egg and worm counts between seasons and between sheep and goats.

In order to determine the relationship between egg and worm counts, data of tracer sheep and goats were analysed separately using linear regression.

## RESULTS

### Egg counts of tracer animals

The mean strongyle egg counts in faeces of tracer sheep and goats from the 4 trials are shown in Figure 2. Counts were similar in the first three trials but significantly lower (P<0.05) both for sheep and goats in

the fourth trial where animals were placed in the village on 17 September. In all trials tracer sheep had higher egg counts than goats (P<0.05).

Larval differentiation from cultured sheep faeces from the 4 trials is presented in Figure 3. The predominant genera of larvae recovered in all trials were *Haemonchus* and *Trichostrongylus*, the former being more numerous than the later in all trials except the last (September-November). The proportion of *H. contortus* larvae was highest in trial 2 which commenced on 2 April. In this trial larvae of *H. contortus* were about 80 percent of the total whereas in other trials they were usually 50 percent or less.
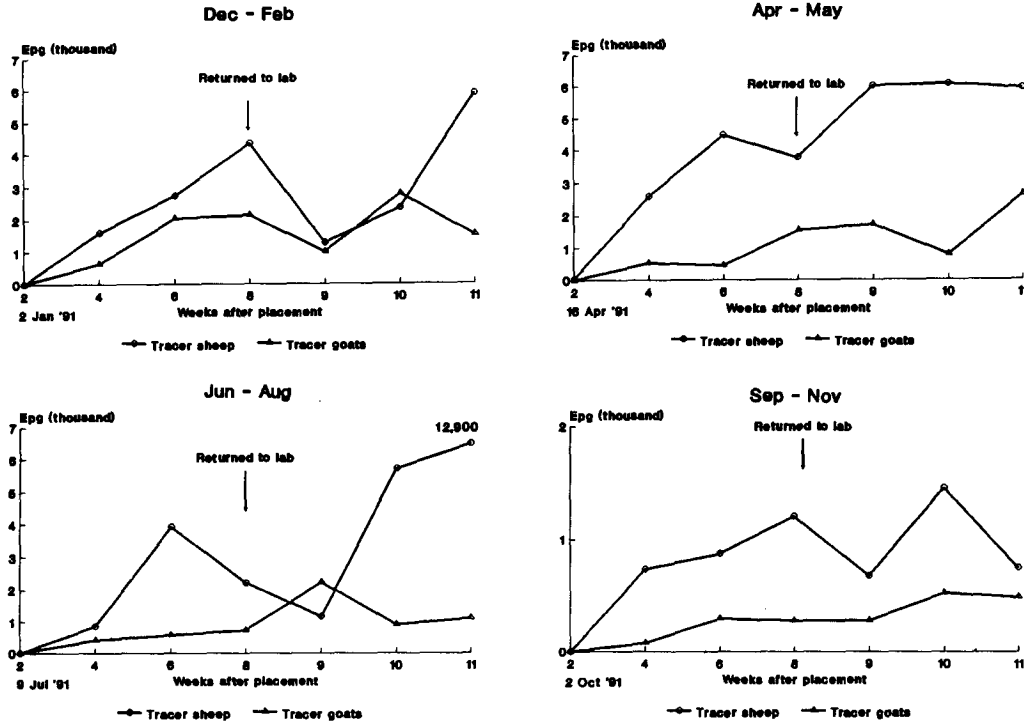


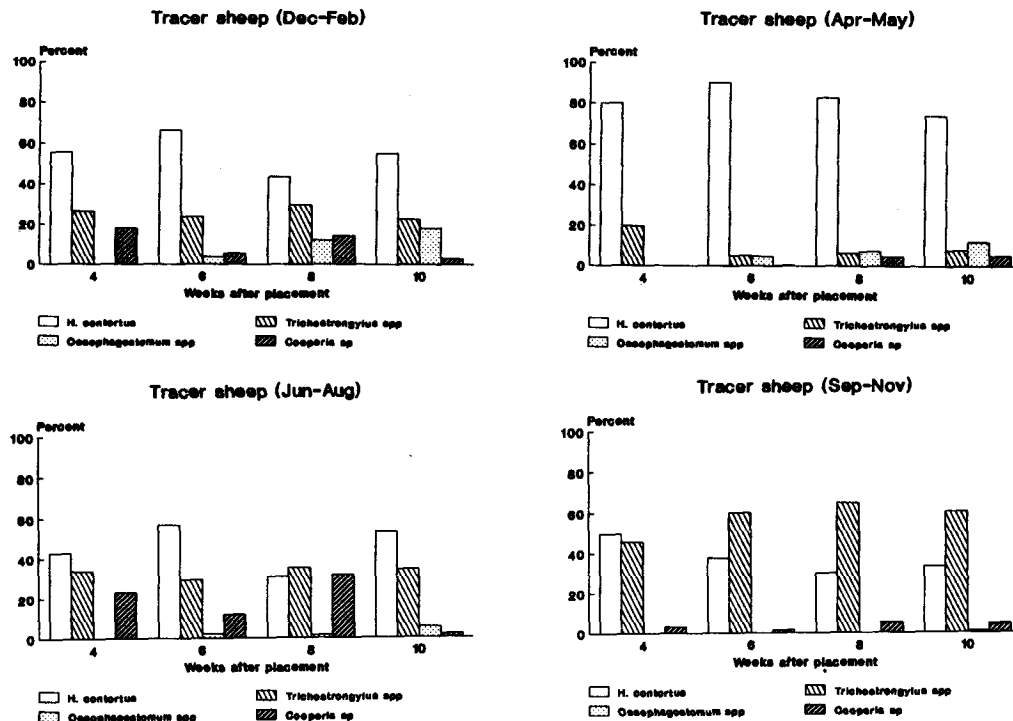**Figure 2.** Mean strongyle egg counts in faeces of tracer sheep and goats at Batujajar



**Figure 3.** Proportions of strongyle larvae of each genus found in cultured faeces from tracer sheep at Batujajar

Larval differentiation from cultured goat faeces also revealed that the genera *Haemonchus* and *Trichostrongylus* predominated (see Figure 4). The proportion of *H. contortus* was also higher than that of *Trichostrongylus* spp. in the first three trials and, as with sheep, there was a trend for a reverse of this situation in trial 4.

Larvae of *Oesophagostomum* spp. were more common in sheep in trials 1 and 2 conducted during the wet season between December 1990 and May 1991 than in the last two trials. Larvae of *Cooperia* sp. (*C. curticei*), in contrast, were more commonly found in the first and third trial than the other two. However, the combined total of these two species was usually less than 30 percent of all larvae and it was less than 10 percent in the fourth trial which commenced 17 September. In goats, on the other hand, larvae of *Oesophagostomum* spp. represented a higher proportion in all trials than in sheep, and the proportion of larvae of *C. curticei* was lower than in sheep. In both sheep and goats there was a general trend in all trials for the proportion of *Oesophagostomum* spp. larvae to increase in successive samples throughout the trial.

## Worm counts of tracer animals

Species of gastrointestinal nematode parasites which were frequently recovered from all tracer sheep and goats were *H. contortus*, *T. axei*, *T. colubriformis*, *O. columbianum*, *C. curticei* and *S. papillosus*. Other species including *B. trigonocephalum*, *O. aspersum*, *Gaigeria pachycelis*, *Capillaria bovis* and *Trichuris*

*ovis* were also found but less frequent or only in low numbers (see Table 1). A few goats and sheep also harboured cestodes, *Moniezia* spp.

**Table 1.** Numbers and percent ( ) of tracer Javanese thin tail sheep and Kacang cross Etawah goats naturally infected with gastrointestinal nematodes at the village of Batujajar

| Species | Sheep, n=19 | Goats, n=18 |
|---|---|---|
| Abomasum | | |
| *Haemonchus contortus* | 17 ( 94.4) | 18 (100.0) |
| *Trichostrongylus axei* | 18 ( 94.7) | 17 ( 94.4) |
| Small intestine | | |
| *Trichostrongylus colubriformis* | 19 (100.0) | 18 (100.0) |
| *Cooperia curticei* | 19 (100.0) | 16 ( 88.9) |
| *Bunostomum trigonocephalum* | 11 ( 57.9) | 6 ( 33.3) |
| *Strongyloides papillosus* | 18 ( 94.7) | 17 ( 94.4) |
| *Gaigeria pachycelis* | 0 ( 0.0) | 4 ( 22.2) |
| *Capillaria bovis* | 4 ( 21.0) | 2 ( 11.1) |
| Large intestine | | |
| *Oesophagostomum columbianum* | 17 ( 94.4) | 17 ( 94.4) |
| *Oesophagostomum aspersum* | 5 ( 26.3) | 16 ( 88.9) |
| *Trichuris ovis* | 11 ( 57.9) | 12 ( 66.7) |

The mean adult worm burdens of tracer sheep and goats from the 4 trials are shown in Figure 5. Sheep carried numerically more worms than goats but the difference was not significant. However, there were significant differences (P<0.05) in worm burdens of different species between trials conducted at different



Tracer goats (Dec-Feb)

Tracer goats (Apr-May)

Tracer goats (Jun-Aug)

Tracer goats (Sep-Nov)
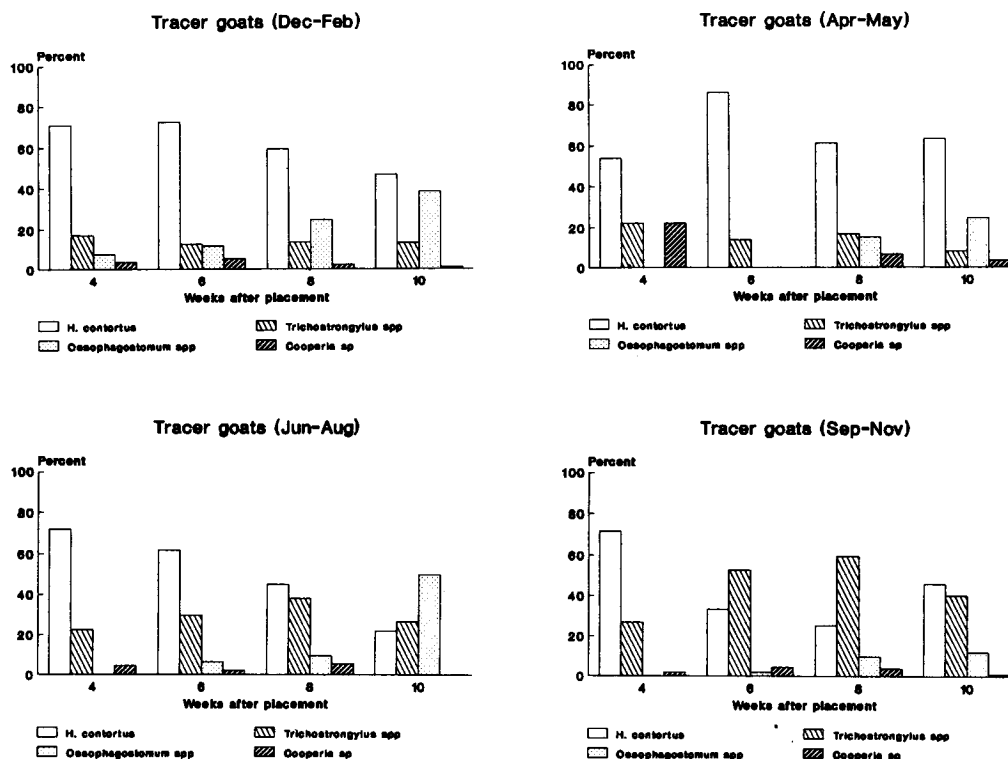
**Figure 4.** Proportions of strongyle larvae of each genus found in cultured faeces from tracer goats at Batujajar

times of the year both in sheep and goats. Mean counts of adult *H. contortus* in sheep and goats in each trial were statistically similar. In contrast, sheep had significantly higher counts of *T. colubriformis* than goats (P<0.05) except in the first trial when numbers were similar. In sheep, counts of *T. colubriformis* were higher (P<0.05) in trial 4 conducted at the transition of the dry to the wet season than in trial 1 conducted during the wet season; whereas in goats, counts of *T. colubriformis* were similar in all trials.
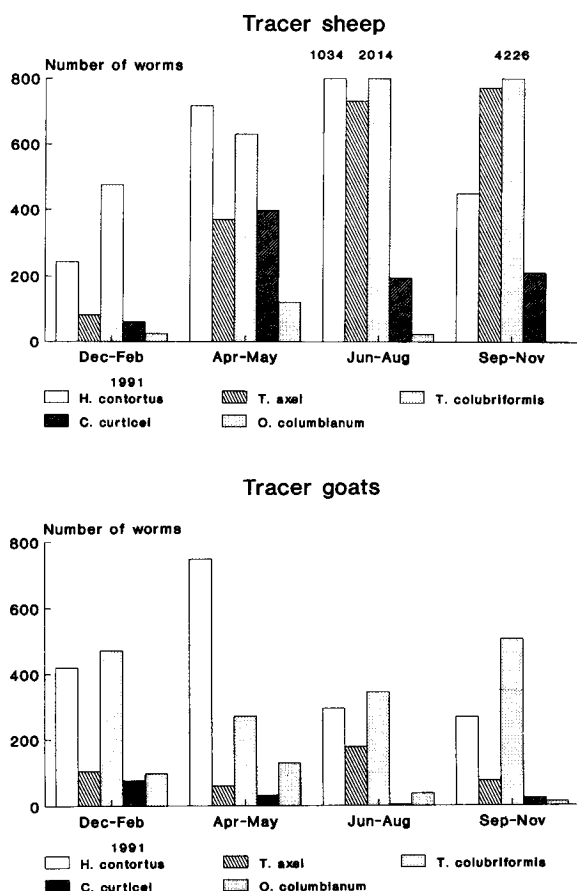


**Figure 5.** Mean adult worm burdens of the most common species found in tracer sheep and goats at Batujajar

Counts of *T. axei* and *C. curticei* were similar in sheep and goats in all trials. Numbers of *O. columbianum* were also similar in trials 1 and 2 in sheep but higher (P<0.05) in trial 2 than in trials 3 and 4. In goats *O. columbianum* was lower (P<0.05) in trial 4 than in the other trials. In both sheep and goats the highest mean counts of *O. columbianum* were in trial 2 but even they were less than 200 worms.

The ratios of female to male worms for *H. contortus*, *Trichostrongylus* spp. and *Oesophagostomum* spp. were 0.59; 0.76 and 0.57 respectively.

## Relationship between egg count and worm burden

Egg counts of *H. contortus*, *Trichostrongylus* spp. and *Oesophagostomum* spp. were calculated from total egg counts using the percentage of each genus in larval differential counts. The correlation coefficients between egg counts at slaughter and worm counts for *H. contortus*, *Trichostrongylus* spp. and *Oesophagostomum* spp. are presented in Table 2.

High correlations (P < 0.05) between egg counts at slaughter and worm counts particularly for *H. contortus* but also *Trichostrongylus* spp. and *Oesophagostomum* spp. and total strongyles with total egg counts, were found in sheep and goats separately and combined.

**Table 2.** Correlation coefficients between egg counts and worm counts of tracer male Javanese thin tail sheep and tracer male Kacang cross Etawah goats aged 7-9 months at slaughter; P<0.05 except where annotated

| Species of worms | Sheep | Goats | Both sheep and goats |
|---|---|---|---|
| Total strongyle | 0.56 | 0.49 | 0.60 |
| *H. contortus* | 0.92 | 0.76 | 0.86 |
| *Trichostrongylus* spp. | 0.73 | 0.43 | 0.63 |
| *Oesophagostomum* spp. | 0.49 | 0.61 | 0.53 |

* P = 0.07

## DISCUSSION

Tracer sheep and goats were used in this study to provide data to support longitudinal studies with village animals because the latter are not readily available for post-mortem examination. By placing tracers, one per farmer, to be managed as part his flock, it was hoped to achieve the same level of exposure to parasites in them as in the farm animals.

It was not possible to obtain helminth-naive tracers for this work. As a consequence, immunity acquired prior to purchase may have affected subsequent level of parasitism. In attempt to minimise this effect, only "recently weaned" animals were purchased. However, this may not always have been achieved as the history of animals purchased at a market cannot be regarded as reliable. On the other hand, the animals purchased were most likely locally reared and, therefore, probably accustomed to the food and management on the farms where they were placed as tracers. They may, therefore, have adapted more quickly and given a truer indication of level of infection to which farm animals were exposed than would have been achieved with tracers custom-reared worm-free in pens.

Sensitivity of comparisons of egg counts and worm numbers between sheep and goats and between

seasons was reduced by large variation within groups and small group size (5). The number per group was constrained by economic and logistical considerations, whereas variation within groups may have been due to different levels of acquired or innate immunity between animals or differences between farms in management or exposure to parasites. Nevertheless, the level of differences between groups was such that it is possible to conclude, with a probability of more than 95%, that the dry season was the period of greatest exposure to parasitism in sheep and sheep were exposed more than goats.

The higher faecal egg counts and worm counts in sheep than goats, especially of *Trichostrongylus* spp. during the second half of the year (dry and early wet season), were probably a result of differences grazing behaviour between sheep and goats and a greater tolerance of free-living larvae of *Trichostrongylus* spp. than of other species to dry conditions.

Since conclusions based on worm counts are all from a single time-point, 11 weeks after placing the tracer animals in Batujajar, it is pertinent to question whether results are a true reflection of the worm burden accumulated over that period. It is reported that Merino sheep develop immunity to *T. colubriformis* about 9 weeks after exposure resulting first in a decrease in faecal egg count, followed by reduced rate of establishment of new infection and consequently reduced worm burden (DOBSON *et al.*, 1990). The strong positive correlation between faecal egg count and worm burden typical of susceptible animals is also lost when immunity develops (ROBERTS and SWAN, 1981).

A number of results support the conclusion that sheep and goats had not become immune to infection when trials were terminated. There was a strong positive correlation between faecal egg count of the most numerous species and number of worms of the respective species recovered at slaughter; furthermore, faecal egg counts, which rose progressively during the 8 weeks animals were in the field, remained high during the subsequent period of 3 weeks in the laboratory prior to slaughter. Nevertheless, there was a suggestion from the low level of significance of the correlation between worm number and faecal egg count for *Trichostrongylus* spp. in goats and *Oesophagostomum* spp. in sheep (Table 2) that this may have been an indication of the imminent development of resistance. It is plausible that resistance was delayed in animals in this trial if it is induced by products liberated by moulting infective larval stages (NEILSON and VAN DE WALLE, 1987), as these were not available after week 8 when animals were returned to a worm-free environment.

The evidence that tracer animals had not developed a significant degree of immunity to their gastrointestinal parasites at slaughter thus supports the conclusion that worm burdens found were an accurate reflection of exposure to infective larvae at Batujajar and, therefore, an indication of the level of exposure of village sheep and goats to these parasites. It also supports a conclusion that exposure of tracers to parasitism prior to purchase did not induce sufficient acquired resistance to compromise their effectiveness as tracer animals.

Caution must be exercised in interpreting results of the proportion of faecal eggs of each species as they are dominated by eggs of *H. contortus* and *Trichostrongylus* spp. during the dry season and eggs of these two plus *Oesophagostomum* spp. during the wet season. A substantial fluctuation in number of eggs of any of these species will therefore affect the proportion of all species even though numbers of eggs of the other species are unchanged. Since the number of *H. contortus* adults was similar in goats and sheep in each trial, the higher proportion of *Haemonchus* eggs in faeces in trial 2 than in other trials should not be taken as an indication that conditions in trial 2 favoured *H. contortus*; they are, instead, a reflection of the relatively low level of infection with *Trichostrongylus* spp. relative to *H. contortus* at that time of year. Similarly, the relatively low proportion of *Haemonchus* in trial 4 is a reflection of the presence of a higher number of *Trichostrongylus* spp. rather than a change in the number of *H. contortus*.

Higher faecal egg counts and higher worm counts especially during the dry and early wet seasons in sheep than in goats, probably reflect differences in their grazing behaviour. Goats have a greater tendency than sheep to browse on plants well above ground level. Since such herbage is unlikely to be infested with infective nematode larvae, it may be anticipated that sheep are at greater risk of exposure to infection than goats. Furthermore, this risk is likely to be exaggerated during the dry season when pasture is short, as larvae will be concentrated on the available pasture which sheep must eat because supply is limited. In contrast, during the wet season, pasture is abundently available, allowing animals greater selection and possibly a lower level of contamination with nematode larvae. They are also usually hold in pens during rainy weather and fed "cut and carry". As this may consist of crop residues and herbage from shrubs and pasture, the latter collected from areas such as adjacent to crops where animals don't normally graze, it is likely to contain few infective larvae. Thus, the risk of infection with nematode larvae is likely to be lower during the wet than the dry season and lower in goats than in sheep.

Sheep acquired heavier burdens of *Trichostrongylus* spp. during the dry and early wet seasons, possibly because larvae of this genus on pasture tolerate dry conditions better than larvae of other genera.

The pattern of seasonal acquisition of infection suggests that strategic treatment of sheep with anthelmintic towards the end of the wet season, perhaps

February-March might reduce the contamination of pasture with larvae which occurs towards the end of the wet and early dry seasons and thus reduce the high level of infection with *Trichostrongylus* species that otherwise occurs at this time.

In Indonesia, 14 species of gastrointestinal nematodes have been reported in sheep and goats (ADIWINATA, 1955) comprising *H. contortus, Haemonchus sheatheri, T. axei, T. colubriformis, Trichostrongylus* sp., *O. columbianum, Oesophagostomum venulosum, O. aspersum, Gaigeria smiti, Cooperia oncophora, B. trigonocephalum, S. papillosus, Trichuris ovis* and *Nematodirus filicollis*. The list was revised to 13 species without *N. filicollis* by MUCHLIS (1971). All but 4 of these; *O. venulosum, H. sheatheri, G. smiti* and *C. oncophora* were found in the present study. Moreover, their inclusion in the list of parasites of sheep and goats in Indonesia warrants reconsideration in the light of current conventions of classification.

The genus *Gaigeria* was first reported in Indonesia by NOTO-SOEDIRO (1928). He described a specimen from goats as a new species, *G. smiti* because, even though it resembled *G. pachyscelis*, it was considerably larger. However, size is not a strong taxonomic character and, alone, does not justify separation of a new species. Worms of this genus have, therefore, been identified as *G. pachyscelis*. In India, GUPTA *et al.* (1987) also found this species in a flock of sheep. Its absence from sheep in this trial is probably a chance event resulting from a low rate of infection as there is no published evidence that goats are more susceptible to infection than sheep.

The species of *Cooperia* found in these studies was identified as *C. curticei* as it had morphological features described for *C. curticei* in the MANUAL OF VETERINARY PARASITOLOGICAL LABORATORY TECHNIQUES (1971). Furthermore, specimens from sheep and goats from Java sent to the Commonwealth Institute of Parasitology, St Albans, UK in 1984 were confirmed as being *C. curticei*. No specimens of *C. oncophora* were found. Moreover, since *C. oncophora* is primarily a parasite of cattle in temperate climates it is likely that the original identification of *C. oncophora*, reviewed by ADIWINATA (1955), was in error.

The name *H. sheatheri* should be synomysed with *H. contortus* in accordence with the recommendation of GIBBONS (1979) as she considered the morphological characters used to describe regional varieties of *H. contortus* were unreliable.

The finding of *C. bovis* in this study is the first recognition of this species in Indonesia. Its identity was confirmed with specimens sent to the Commonwealth Institute of Parasitology, St Albans, UK.

The list of gastrointestinal nematodes of goats and sheep for Indonesia should thus be revised from that of MUCHLIS (1971) to the eleven species listed in Table 1.

## ACKNOWLEDGEMENTS

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