Survival of Strongyle Larvae on Pasture Plots in West Java, Indonesia

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ABSTRACT: Observations on factors affecting survival of ovine nematode larvae on pasture were made in a lowland wet equatorial climate in West Java, Indonesia (latitude 3°S, annual rainfall >3,000 mm). Two shaded and two unshaded pasture plots were used, each plot being subdivided by a lattice of string into 60 subplots of 20 x 20 cm. Ovine feces containing about 2.5 million nematode eggs were uniformly distributed over one shaded and one unshaded plot at the commencement of each trial. The trial was repeated four times, once each 3 months, using a shaded and unshaded pair of plots alternately. Once larvae left the feces their half-life on herbage was about one week. Only a few larvae were still able to be recovered during the wet season six weeks after deposition of the feces and they persisted a few weeks longer during the dry season.

Key words: Larval Survival, Tropics, Pasture, Indonesia

INTRODUCTION

In comparison with information available from temperate regions, little is known of the development and survival of strongyle larvae on pasture in the wet tropics. Reports from tropical countries demonstrated that the number of infective larvae recovered from plots 2 weeks after contamination with infected ovine feces was higher in the wet than the dry season (Ikeme et al., 1986; Kusumamihardja, 1988). In the dry season in the Philippines, larvae of Cooperia spp. and Mecistocirrus digitatus persisted only eight weeks on pasture plots (Tongson and Tong, 1973). Substantial numbers of infective larvae were also recovered on pasture in a wet tropical region of north Queensland for only 2 to 6 weeks after deposition of a fecal pat and larvae persisted generally not longer than 10 to 12 weeks after deposition (Fabiyi et al., 1988). Larvae of Haemonchus contortus and Trichostrongylus colubriformis developed throughout the year in the wet zone but development was more sporadic in the dry zone in Fiji (Banks et al., 1990).

Even though there have been few studies in tropical regions, results have consistently shown that most infective larvae are no longer recoverable from pasture within 4 to 8 weeks of deposition of feces, which is much sooner than occurs in temperate regions (Chiejina et al., 1989; Stromberg et al., 1991; Swarnkar et al., 1997).

However, information about survival of larvae in humid equatorial regions is still scanty. In such regions where seasonal changes are a function of more or less rain rather than of significant changes in temperature or relative humidity, seasonal variation cannot be predicted with confidence from existing studies. The effect of shade on larval survival is also of interest in view of the practice of grazing sheep in plantations of trees, especially rubber and oil palm. The present study, located at Bogor in a high rainfall zone 3° south of the equator was designed to fill some of the gaps in this knowledge.

MATERIALS AND METHODS

Design of plots

Four plots each 1 x 2.4 m were planted with native grass and fenced to exclude livestock, in the grounds of the Research Institute for Veterinary Science, Bogor. The predominant species of grass was Axonopus compressus (Swartz) Beauv. Other species included Eleusine indica (L) Gaertn, Paspalum conjugatum Berg, Cyperus rotundus L and Cynodon dactylon (Z) Pevs. Each plot was subdivided into 60 subplots of 20 x 20 cm by string suspended about 10 cm above the ground, making 5 rows each of 12 subplots. A small ditch was dug around each plot to prevent flooding of plots during heavy rain. The distance between plots was about 2 m. Shade-cloth (330 x 150 cm) designed to exclude 80 percent of sunlight was suspended 0.75 cm above two of the plots. The other two were exposed to full sunlight.

Contamination of plots

Feces with epg of 1500 and 3000 were collected from donor sheep naturally infected with a mixed of gastrointestinal nematodes. Faecal pellets containing about 2.5 million nematode eggs were uniformly distributed over one shaded and also one unshaded plot at the commencement of each experiment.

Sampling of plots and meteorological data

Each week for 12 weeks all vegetation down to ground level was collected from 5 subplots, one from each row of both the shaded and unshaded plot being sampled. Subplots in each row were allocated at random for weekly collection prior to the commencement of sampling, with each subplot being sampled only once. Sample collections were made in the morning usually between 8.00 and 9.00 am. This experiment was repeated 4 times, once each 3 months, using a shaded and unshaded pair of plots alternately. Rainfall was recorded in a rain gauge adjacent to the plots. Daily rainfall (mm) for the first 3 weeks after deposition of feces on plots from week 0 to 21 was as follows in trial 1: 7; 0; 0; 0; 4; 4; 69; 3; 1; 8; 35; 72; 8; 10; 55; 61; 2; 56; 4; 0; 1; 3; 45; in trial 2: 2; 1; 18; 2; 2; 10; 15; 5; 2; 29; 4; 3; 10; 5; 21; 0; 3; 21; 4; 31; 1; 12; 13; in trial 3: 25; 0; 0; 27; 0; 0; 0; 0; 0; 0; 0; 0; 40; 0,
0; 0; 0; 0; 0; 0; 0; and in trial 4: 0; 0; 4; 0; 0; 0; 0; 0; 0; 13; 0; 0; 0; 0; 51; 29; 34; 0; 0.

**Procedure of larval recovery from herbage**

The method used was a modification of methods described by Heath and Major (1968) and Lancaster (1970). Efficacy of larval recovery was 60 to 80 percent, determined by recovery of a known number of larvae added to herbage. Infective larvae were identified to genus based on the characteristics described in the Manual of Veterinary Parasitological Laboratory Techniques (1971).

**Statistical analysis**

The number of larvae recovered from each subplot was transformed (log (x+1)) prior to statistical analysis. Analysis of variance was performed using Statistix version 4.0 (Analytical Software, 1992) to determine the significance of observed differences between trials, and plots in the number of larvae recovered.

**RESULTS**

More larvae were recovered from shaded plots than from unshaded plots (P<0.05) in all trials except trial 1 (Figure 1). The number of larvae recovered declined progressively (P<0.05) over time in all trials. The number of larvae recovered in trials 1 and 4 were similar and higher (P<0.05) than numbers recovered in trials 2 and 3. In the first two trials, no larvae were detected after week 8 and week 10 respectively. However, in the last two trials, a few larvae were still recovered until the end of observations at week 12. The pattern of progressive decline of larvae recovered from the first two trials was similar, but more larvae were counted in the first trial than in the second (P<0.05). In the third trial, a sudden drop in number of larvae recovered occurred on week 3 and recoveries remained low throughout the remainder of the experiment. In contrast, in the fourth trial, the number of larvae recovered was low at the first week of collection, and progressively increased to week 3, followed by a sudden drop in week 5 which persisted thereafter. Fewer larvae were recovered during trial 3 (dry season) than in any of the other trials (P<0.05).

Linear regression analysis showed that there was a weak correlation between the number of larvae recovered and weight of dry herbage from which larvae were recovered in the first 3 weeks of collections (r=0.40, P<0.01) and (r=0.15, P<0.01) for unshaded and shaded plots respectively.

**DISCUSSION**

These studies demonstrated substantial differences in total number of larval recovery between trials. Rainfall is likely to have been the most important factor (Aguye, 1997) as it varied considerably between trials, whereas temperature and humidity varied only a little throughout the year within parameters optimum for larval development (Crofton, 1963; Banks et al., 1990).

A number of workers have recognised the importance of rain in translation of larvae from dung to herbage in temperate areas but no information has been found on minimum falls necessary or their frequency to promote optimum translation under tropical conditions. Gordon (1953) and Levine and Anderson (1973) regarded a total monthly rainfall of 50 mm or more as effective for larval translation from ovine feces, in work carried out in temperate regions. Although not designed specifically for this purpose, trials carried out in the present study provide data from which information on rainfall and its relation to larval translation in a tropical environment may be deduced.

Larvae recovered in trials 1 and 2 were highest from samples collected 1 week after deposition of feces. Since most larvae would have developed in fecal pellets to the infective stage by the fourth day after deposition of feces on the plots (Banks et al., 1990), it follows that rain received on the fourth, fifth and sixth days provided sufficient moisture for optimum translation of larvae in these trials. From Table 1 it may be calculated that this occurred with falls of 72.4 mm and 27 mm respectively during this period in trials 1 and 2, with some rain falling each day. On the other hand, in trial 3 a single fall of 27 mm on day 3 followed by a series of dry days was not sufficient for optimum release of larvae from fecal pellets. This conclusion is justified because the anticipated pattern of progressive decline in number of larvae recovered over time after the first week observed in trials 1 and 2 (and reported by Banks et al., 1990) did not occur. Thus, it may be presumed in trial 3 that another group of larvae escaped from pellets with moisture from a fall of 40 mm the day before the second sampling on day 14, maintaining the level of larvae recovered similar to that of the first sampling. Similarly, in trial 4 it is apparent from the progressive increase in larval numbers recovered over the first 3 samplings, that falls of 4 mm and 13 mm on days 3 and 11 respectively did not release most larvae from fecal pellets. This was achieved with falls totalling 114 mm in the week preceding the third sampling.

From these results it may be concluded that both amount and frequency of rainfall contribute to create the continuous film of moisture necessary for larvae to move from dung pellets to the pasture. The more rain (up to the point of full hydration of dung pellets) and the longer favorable (moist) conditions for translation persist, the higher will be the proportion of larvae which escape. In these trials optimum conditions for larval translation were provided by falls totalling 27 mm over 3 days whereas a single fall of 27 mm was measurably less favourable. It was not possible, however, to establish what minimum falls were necessary for optimum translation but they were lower than the 50 mm over 1 month proposed by Gordon (1953) and others. Moreover, because of the higher rate of evaporation and shorter larval survival in tropical than in temperate regions, monthly rainfall is likely to be much less relevant than single falls or falls over a
few days for describing conditions that promote larval translation in the tropics.

The pattern and duration of persistence of larvae on pasture was generally similar to that described by others in tropical regions (Banks et al., 1990). Nevertheless, results varied considerably between trials, thus giving insights into circumstances responsible. The rapid decline in number of larvae recovered after an initial peak in trials 1 and 3 demonstrated that the half-life of larvae that have translated to the pasture is less than 1 week both with daily falls of rain (trial 1) and without rain (trial 3). This interpretation can be made because results of larval recovery can be compared between weeks 1 and 2 in the case of trial 1, and weeks 2 and 3 in trial two, without the complication of significant further translation of larvae; due to heavy rain in the former during the first week which allowed the bulk of larvae to translate, and absence of rain in the latter during the third week inhibiting larval migration.

The shorter persistence of larvae on pasture in trial 1 than in other trials was probably due to heavier early rainfall and consequent earlier translation of all larvae to the pasture resulting in their more rapid demise in this trial than in the others. On the other hand the infrequent rainfall in trial 3 and resultant retention of larvae in dung pellets may also explain the more protracted period of recovery of larvae from pasture observed in this trial than in the others. The more favorable environment for larval survival provided by dung pellets in comparison with that experienced on pasture may also have been helped by the observed tendency of dung pellets to remain intact in trial 3 whereas they broke down due to effects of more frequent rain in the other trials.

Results of these trials have thus confirmed observations by others in tropical regions (Tongson and Tong, 1973; Fabiyi et al., 1988; Banks et al., 1990) that during the wet season, most (>95 percent) infective larvae have gone from unshaded pasture 6 weeks after deposition of feces. Larvae persisted in low numbers a few weeks longer during the dry season probably because they were retained longer in fecal pellets (Chiejina and Fakae, 1989).

Unfortunately, conditions under which village sheep are managed in Indonesia are not readily adaptable to take advantage of the possibility of worm control through pasture spelling. However, where flocks are grazed in plantations of rubber or oil palm such a means of control may be realistic. If introduced, the period of spelling would need to be increased to 8 weeks as more larvae translate to shaded than unshaded pasture, and persist in larger numbers for longer even though the period of greatest survival is unchanged.

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REFERENCES


Figure 1. Mean number of strongyle larva