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First report of bovine lungworm disease in South-East Asia

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Abstract. This paper presents investigation of lungworm disease outbreaks that is based on retrospective examination of cases recorded between 1994 and 2000 on a government beef cattle breeding centre in the state of Pahang, peninsular Malaysia. The breed of cattle on the centre was Nelore and the mean population over a 7-year period (from 1994 to 2000) was 1612. All animals were allowed to graze on pasture and mixed grazing was practiced on the farm. The routine de-worming programme was performed using levamisole and ivermectin from 1994 to 1998 and abamectin in 1999 and 2000 on 1 to 3-month-old calves and an annual dose given to the adult cattle. Nelore was introduced into the farm in 1991, three years before the first outbreak from Brazil where *Dictyocaulus viviparus* infection had been reported. No lungworm infection had been observed in the farm prior to the animal introduction. Within the 7-year period, 36 fatalities occurred and the annual mortality rate due to lungworm infection was 0.31%. The highest rate was recorded in 1997. Among the total 36 deaths, about 75% of deaths occurred in calves aged between 6 months and 12 months, 67% were males and 33% were female cattle. The highest number of deaths (19%) occurred in the month of November. In conclusion, *D. viviparus* infection may have been introduced into a tropical climate along with consignments of cattle from lungworm endemic areas resulting in fatal disease outbreaks for a few years following the animal's initial introduction.

INTRODUCTION

Lungworm infection in cattle is caused by the nematode parasite *Dictyocaulus viviparus*, and is characterised by bronchitis and pneumonia (Ploeger, 2002). It occurs worldwide but causes problems mainly in moist temperate regions with mild climates and average to high rainfall (Ploeger, 2002). However, outbreaks of dictyocaulosis have also been reported sporadically in the tropical highlands of Tanzania (Thamsborg *et al.*, 1998). In Malaysia, a country with high temperatures (mean: 27ºC), and humidity (±80%, rainfall >2000mm), clinical lungworm infection in cattle is uncommon and has only been reported anecdotally. As it is assumed that this pathogen is of temperate inclination, possible infection could have been under diagnosed or misdiagnosed. Nevertheless, fatal lungworm infection in cattle has been observed by Malaysian state veterinarians and laboratory officers in recent years (Drs. S. Jamaliah, A. Rohaya, and G. Kamaliah, pers. comm.). All those infected animals originated from a government beef cattle breeding centre in Pahang state.

To the authors' knowledge there have not been any other reports of lungworm disease outbreaks in cattle in peninsular Malaysia or in any other regions in the South- East Asia. This paper describes the outbreaks of lungworm disease that occurred in a government beef cattle breeding centre in the state of Pahang (altitude of 22 m above sea level, temperature range: 23ºC-33ºC) on the east-coast of peninsular Malaysia between 1994 and 2000.

MATERIALS AND METHODS

Source of data

Information about the centre and cases of lungworm outbreaks was retrieved from 'Dairy Champ' livestock management database software (ver. 3, University of Minnesota). It included the history and management system of the centre, the number of cattle on the centre, case ID, breed, date of birth, weaning date, dam and sire's ID, age, gender, generation by which the cattle was born at the local centre by imported dam and sire, date of death and necropsy findings. Identification of the adult lungworm found at necropsy for each case was performed at the Regional Veterinary Laboratory, Kuantan, while morphological confirmation was done in the Parasitology Laboratory, Faculty of Veterinary Medicine, Universiti Putra Malaysia, based on the description by Soulsby (1965). The veterinarians working at the centre during the outbreak period were also interviewed.

Data management and analysis

Data from outbreaks between 1994 and 2000 were managed in SPSS (ver. 13 SPSS Inc, Chicago Illinois). Chi-square test was used to test the difference in the proportion of lungworm cases in relation to year. The level of significance was tested at $\alpha = 0.05$.

RESULTS

History of centre

The centre was established in 1973 as a breeding dairy centre. From 1973 to 1982, the breeds were Australian commercial cross, Australian Milking Zebu and Friesian-Sahiwal. However, in 1982, the dairy animals were replaced by beef cattle, Droughtmaster. No lungworm cases were recorded during that period. In 1991, Nelore cattle from Brazil were introduced into the centre to replace the Droughtmaster. Nelore calves were allowed to graze with their dams. The routine deworming programme included the administration of levamisole and ivermectin to 1 to 3-month-old calves and an annual dose to the adult cattle. Those anthelmintics were used continuously from 1994 to 1998 and were replaced by abamectin in 1999.

Outbreaks of lungworm disease

The first outbreak of lungworm disease occurred in 1994, a few years after the introduction of the Nelore breed. The second outbreak occurred in 1997, followed by outbreaks in 1998, 1999 and 2000. Clinical signs observed by the centre veterinarians during the outbreaks were coughing, general unthriftiness and progressive weight loss in 28% of the cases a few months before the animals were found dead. The significant finding upon necropsy was gross pathological lung lesions including lung oedema and emphysema, and the presence of adult lungworms in the bronchi and bronchioles that were confirmed as the cause of death of the host. No records could be found on the exact numbers of adult lungworms that were found at necropsy. However, according to the veterinarians who attended the cases, the bronchi and bronchioles of the affected animals were filled with lungworms (G. Kamaliah and S. Jamaliah, pers. communication). A total of 36 Nelore cattle deaths were recorded as due to lungworm infections between 1994 and 2000. In the 7-year period, the mean Nelore population of the farm was 1612 (SD = 292.59). The annual lungworm-infection mortality rate within the 7-year period was 0.31% with the highest rate recorded in 1997. However, the differences in rate between year was not statistically significant ($\chi^2 = 8.23$, $p = 0.10$) (Table 1).

Fourteen dead animals (40% of deaths) were first generation calves which were born at the local centre by the imported dam and sire. Although the information on generation of the remaining 22 dead animals could not be retrieved from the recorded data, we assumed that those animals could be first or second generation animals born at the centre. The total number of animals in relation to age,

Table 1. Number of deaths in Nelore cattle due to lungworm disease from 1994 to 2000 in a beef cattle breeding centre in peninsular Malaysia

Year	Total population	No of cases and the lungworm infection death rate (%)	Generation		Age			
			First	Unknown	6-12 months		>12 months	
					Male	Female	Male	Female
1994	1396	5 (0.36)	0	5	2	0	1	2
1997	2002	15 (0.75)	5	10	9	5	0	1
1998	1685	7 (0.42)	6	1	4	2	0	1
1999	1723	8 (0.46)	3	5	4	1	3	0
2000	1257	1 (0.08)	0	1	0	0	1	0
1994-2000	Mean: 1612	36 (0.31%)	14	22	19	8	5	4
					27		9	

gender and month during the outbreak period cannot be retrieved; therefore, age and gender -specific death rates for the disease cannot be computed. However, among the cases, more than half (67%) were male and 33% were females. Seventy-five percent of lungworm infection deaths occurred in calves between the ages of 6 and 12 months, and 25% occurred in cattle aged 12 to 19 months. No cattle more than 19 months-old died during these outbreaks. Most of the deaths (19%) occurred in November and May (17%) (Figure 1).

DISCUSSION

We speculate that the imported adult Nelore cattle might be carriers of the *D. viviparus* since the organism has been reported in Brazilian cattle (Almeida & Taira, 1998; Silva *et al.*, 2005). No deaths occurred in adult cattle in this study. Most of the cases occurred in calves below 12 months of age than cattle older than 12 months. Young calves that died in these outbreaks were mainly first generation and second generation calves born at the farm and were completely naïve of lungworm infection. We assume that all calves were susceptible to lungworm infection and might have succumbed to the infection following grazing on pasture that had been contaminated with parasite larvae shed by the adult carrier animals. According to Taylor (2001), the occurrence of lungworm disease is related to the level of host immunity. Light initial infection favours the development of immunity while deaths due to lungworm infection normally only occur among first season grazers. The highest number of deaths observed in 1997 was possibly due to the increased population of susceptible young calves. In addition, the animals that had survived the 1994 outbreak and the imported carrier animals collectively may have contributed to heavier pasture contamination.

The high number of cases observed in November and May between 1994 and 2000 appeared to be associated with the heavy rainfall during the North-East monsoon season from November to March and South-West monsoon season from June to August on the east-coast of peninsular Malaysia. *Dictyocaulus* larvae are known to flourish in wet conditions more so than in drier conditions (Rose, 1956).

As a result of the continuous use of both anthelmintics; levamisole and ivermectin, from 1994 to 1998, we speculate that the worms might have

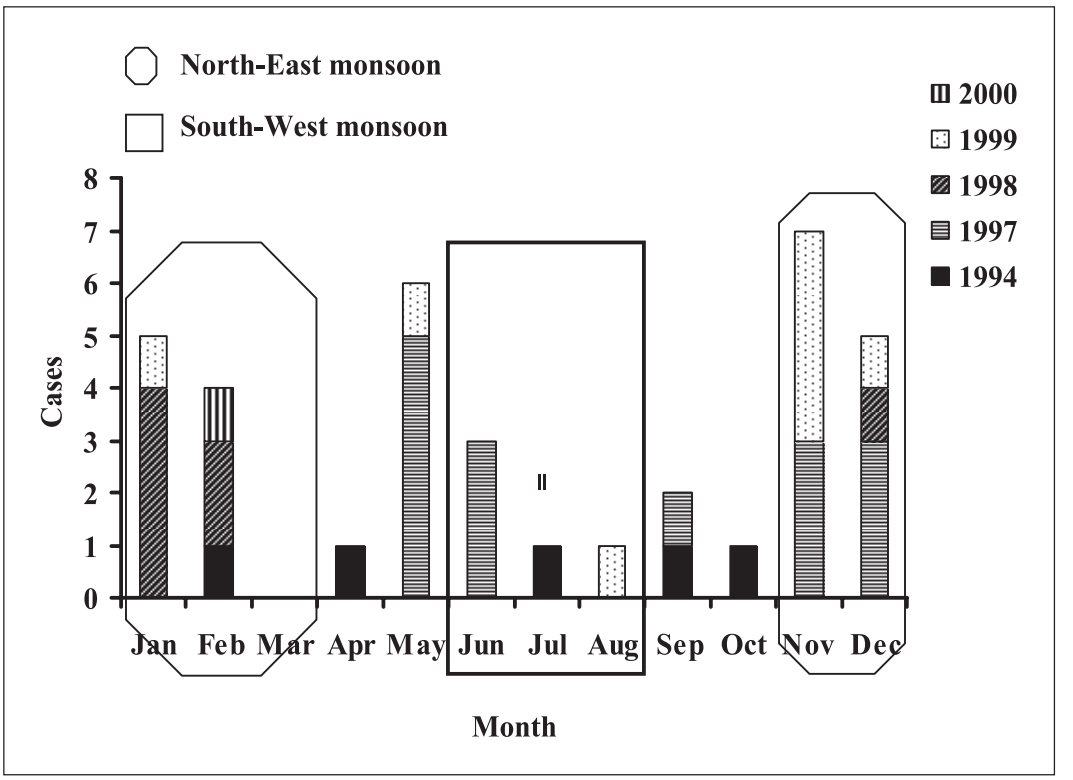

Figure 1. The number of monthly Nelore cattle deaths due to lungworm infection between 1994 and 2000 in a beef cattle breeding centre in peninsular Malaysia.

become resistant to the drugs and distributed drug-resistant larvae to the pasture. The disease could have developed after a heavy larval intake by the susceptible cattle.

Lungworm fatalities propagated from 1994 to 1997, 1998, 1999 then declined rapidly in 2000 and became completely absent thereafter even though Nelore remained as the only breed on the centre. This might be due to the absence of carrier animals as a result of the use of alternative anthelmintics, changes in the centre management system, transfer, culling, or deaths of animals due to other reasons.

A major limitation of the study is that the number of animals with the actual clinical signs for lungworm infection was not recorded; therefore, the total number of animals that were affected by *D. viviparus* during the period is unknown. Consequently, the morbidity and case-fatality rate cannot be computed. All recorded cases were of animals that were found dead, and confirmation of the disease was based on post-mortem examination of those animals. To the researchers' knowledge, there was no follow-up investigation on the animal population during the outbreak period to either monitor the larvae in animal faeces or the antibody levels in blood.

In conclusion, this study illustrates that *Dictyocaulus* lungworm infection may have been introduced into a tropical climate along with consignments of cattle from *D. viviparus* endemic regions and caused a series of fatal disease outbreaks for a few years following the animals' initial introduction.

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