Evaluation of infestation level of cattle by the tick *Rhipicephalus microplus* in New-Caledonia : Test of a new assessment grid

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Summary

The cattle ticks represent a particularly important danger for ruminant production, because of the losses they directly cause, or because of the infectious diseases they are associatedwith. In New Caledonia, as in other tropical regions, the tick *Rhipicephalus microplus* represents a real plague, leading to very important losses in cattle herds. Moreover, since a few years, the efficiency of acaricide treatments classically used mark time and resistance of the parasites becomes widespread. So, the development of alternative methods of control of the infestation by the ticks is nowadays essential. Among these, the identification of more resistant lineages of cattle to the ticks, or the culling of the most sensitive animals, are interesting tools to decrease the impact of the ticks in the herds. The evaluation of the level of individual infestation represents therefore a particularly interesting tool for the herd survey.

An assessment grid of the individual infestation by the ticks was worked out in New Caledonia, and applied periodically, in several herds. This semi quantitative grid allows a relatively fast and precise evaluation of the level of infestation, by taking into account the number of semi- and engorged females and the importance of the infestation by the immature stages. The number of semi- and engorged females on one side of the body is either counted, or estimated according to a classification in 7 classes (from 0 to more than 100 ticks), according to the ease of the observation of the ticks on the animals. For the immature stages, the observations are realized in three physical locations of preferential infestation by the ticks (tie of the tail, perineum, neck), following a classification in 5 classes in each location. Finally, these notes are combined in a score of degree of infestation, which varies in a continuous way from 0 to more than 100. This score follows a Poisson distribution, the most common statistical distribution in parasitism phenomena.

Various applications are in progress on the field in New Caledonia. First of all, the evaluation of the infestation by the breeders to identify the most infested individuals is a useful management tool. It allows, after several counting, to identify animals most regularly infested in order to cull them first. The identification of resistant lineages of cattle to the ticks requires a more important implication of the breeders with the realization of regular counting and the follow-up of the genealogies of animals. Such

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a study started in New Caledonia, on about 300 individuals of known filiation. Finally, this method allows to compare the degree of infestation of the animals of various breeds.

The method tested in New Caledonia is operational. Its application in the herds represents a usable additional tool in alternative strategies of fight against the ticks. It also interests the breeders in the tropical regions who face the danger of the tick *Rhipicephalus microplus*.

Keywords: cattle ticks, susceptibility, resistance, survey.

Introduction

The ticks of the cattle represent a danger particularly important for herbivores, because of the losses which they cause directly, or by the diseases with which they are associated. In New Caledonia, as in other tropical regions, the tick *Rhipicephalus microplus* causes very heavy direct losses in the cattle herds. Since a few years, the efficiency of the current acaricides decreases, and the phenomena of resistance of the parasites to the products become widespread. So, the implementation of alternative methods of control of the infestation by the ticks is today essential. Among these, culling of the most sensitive individuals and the identification of more resistant lineages of cattle are interesting tools to decrease the impact of the ticks. The evaluation of the individual level of infestation is then a tool of particularly useful follow-up. A notation grid of the individual infestation level of the cattle by the ticks was worked out, and is applied for more than three years, in three breeding herds in New Caledonia.

Material and methods

This semi quantitative grid allows a relatively precise evaluation of the infestation, by taking into account the number of engorged females, and the intensity of the infestation by the immature stages. The number of engorged females on one side of the body is either counted exactly, or estimated according to a classification in 7 classes: (0 ;]0 ;10] ;]10; 20] ;]20 ;30] ;]30 ;50] ;]50 ;100] ; >100, according to the ease of the observation of the ticks on the animals. A score of adult stage infestation is then assigned, corresponding to the number of adult ticks counted, or to the median value of the class of infestation. For the immature stages, the observations are realized in three physical locations of preferential infestation by the ticks (tie of the tail, perineum, neck), following a notation in 5 classes in every location (0 ; 1 ; 2 ; 3 ; 4). A score of infestation by the immature stages is assigned, which is the sum of the scores attributed at each of the three locations, multiplied by 10. In the end, average of both scores is calculated to establish an average score of degree of infestation, which varies in a continuous way from 0 to more than 100.

In total, we obtain 1145 scores of infestation, on 469 individuals (from 1 to 8 observations by animal), observed during 38 visits, between August, 2014 and January, 2018. These animals belong mainly to the breed Charolais (621 notations on 201 individuals) and Limousine (368 notations on 169 individuals), but also in other bovine breeds (156 notations on 99 individuals). Besides, we obtain the pedigree of each of Limousin and Charolais cattle.

The final scores underwent a log transformation, with the aim of the realization of variance analyses, by means of the software SAS®. To assess the repeatability of the measure, we used the MIXED procedure, with a model including the group of contemporary (defined by the herd and date of measure), To study the variability

within each main breed (Charolais and Limousin), the statistical models included the direct effects of the herd, the season, the sex, the age and the random effect of the father of the animal.

Main results

This evaluation grid may have various applications in New Caledonia. First of all, the evaluation of the infestation by the breeders themselves is a tool particularly interesting for the management of the herds, because it allows assessing if all or part of the herd has to be treated against the ticks. The realized notations show that the average score of infestation of a herd can vary from 3 to 92 (average 28 +/- 21). Furthermore, 21% of the individuals carry 52% of the total parasitic load (adults and immatures) and 80% of the adult female ticks, while 10% are not infested by any stage, and 32% carry only immature stages (Figure 1).

The application of this grid also allows identifying animals most regularly infested, in order to cull them first. Indeed, on all the measures, the repeatability is about 0.27, what shows that these measures could be a good indicator of the susceptibility of the animals. An Australian study already showed that the reform of the 15% most sensitive animals allowed reducing by 7 the global infestation of the herd in 15 years (Frisch *et al.*, 2000).

Besides, for Limousin and Charolais animals, the analyses intra breed showed that the random effect of the sire is very significant (p=0.018 in Limousin and $P<0.0001$ in Charolais). The average levels of infestation vary, between the extreme “families”, from 3 to 28 in Limousine breed, and from 13 to 49 in Charolais (Figure 2). These first results give encouraging perspectives for the selection of animals onto this criterion.

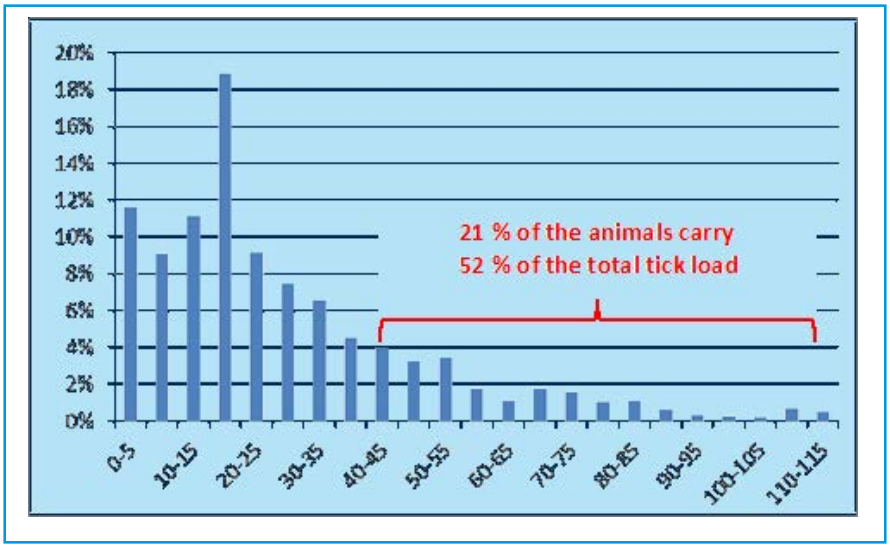

Figure 1. Distribution of tick load between animals.

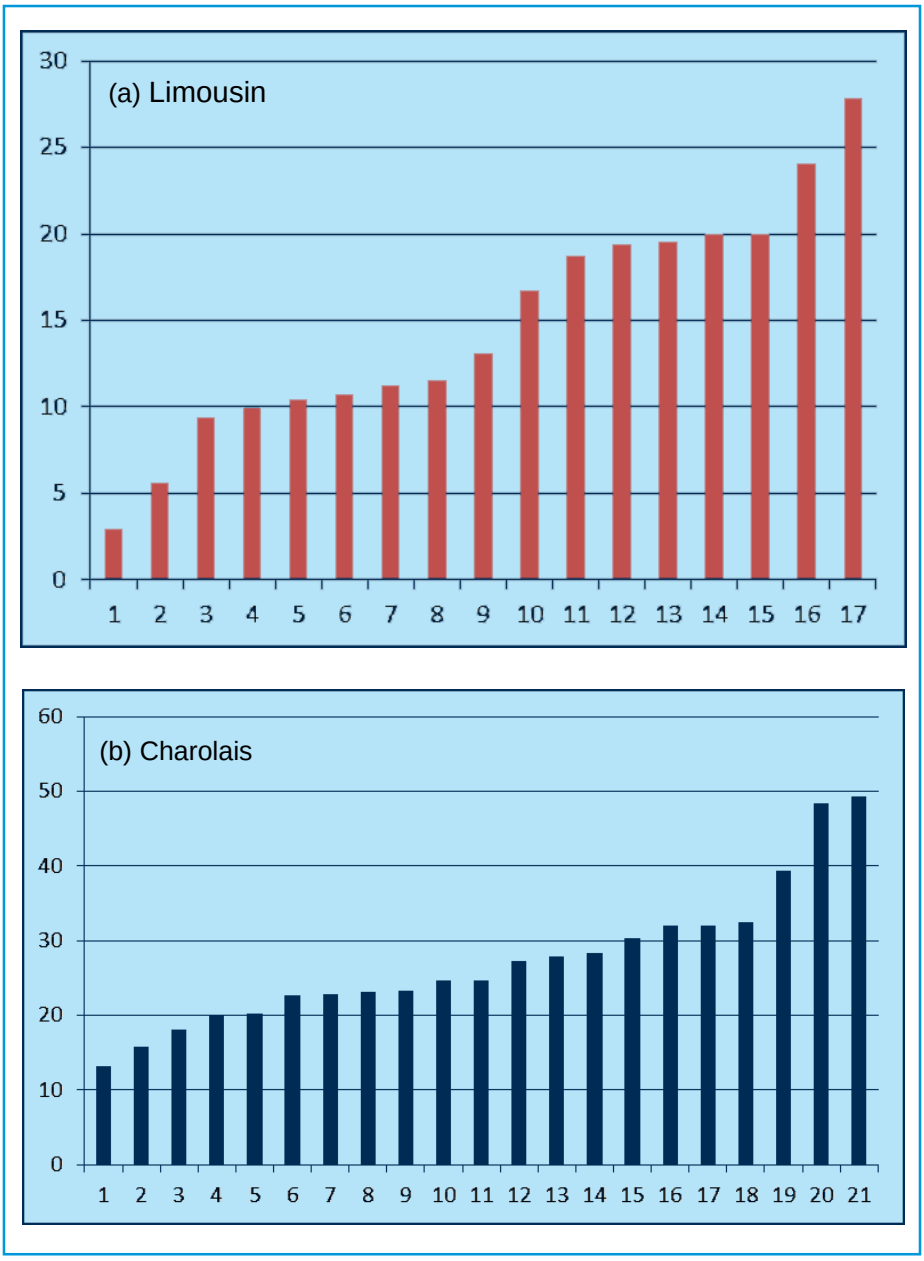

Figure 2. Ranking of the sires according to the infestation level of their offsprings, in Limousin (a) and Charolais (b) breed (for sires with more than 10 observations).

This method also allows to compare the degree of infestation of various breeds and to estimate their level of sensitivity or resistance against the ticks in a given context. On a small studied sample (161 animals of 8 breeds), the breeds Charolais and Limousine appear the most sensitive breeds, with levels of infestation respectively 10.6 times higher and 6.0 times higher than the Brahman breed, which is the most resistant. Droughtmaster, Senepol and Belmont Red breeds, and the crosses of Brahman with Charolais (Charbrais) or Limousin (Bramousin) present intermediate levels of infestations, between 1.4 times and 2.4 higher than Brahman (Table 1).

Table 1. Level of infestation according to the breed.

Breed	Ln(score+1)	Std Err	Score	OR	Diff.[1]
Brahman	1.05	0.22	2.9	1.0	a
Charbrais	1.37	0.45	3.9	1.4	ab
Belmont Red	1.58	0.25	4.9	1.7	b
Brahmousin	1.69	0.33	5.4	1.9	b
Senepol	1.75	0.25	5.7	2.0	b
Droughtmaster	1.93	0.31	6.9	2.4	b
Limousin	2.85	0.18	17.3	6.0	c
Charolais	3.41	0.24	30.3	10.6	d

[1] Different letters indicate a significant difference between breed (P<0.01).

Conclusions and perspectives

The method raised and tested in New Caledonia is operational. Its application must be pursued to validate the first results, in particular to estimate the genetic parameters of this criterion. It represents however an easily usable tool in cattle management, as an alternative strategy for the control of tick infestation, in tropical regions confronted with the tick *Rhipicephalus microplus*.

This rapid assessment grid can now be used to develop new research. The hair length is now recorded during tick counts in order to study a possible correlation between hair length and tick burden in Limousine and Charolais breeds. It can also be used as reference technique for the development of new way of research in tick resistance phenotypes, like skin test or analysis of blood parameters. At last, it will be an unavoidable tool in the search of tick resistance genes especially for these European *Bos taurus* breeds.

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