Journal of Agriculture, Pure and Applied Science and Technology (JAPAST) ISSN 2073-8749
Printed by Moi University Press

Effectiveness of amitraz in control of *Boophilus decoloratus:* A case study of cattle dips in Sugoi location, Uasin Gishu District, Kenya

Yegon Moses Kiplang'at[a], Paul Chepkwony Kiprono[b*], Wanjala Fredrick Muyoma Ernest[a]

[a] Department of Biological Sciences - Moi University P. O Box 1125, ELDORET, 30100, Kenya. Fax: +254-5320-63257.
[b] Department of Chemistry and Biochemistry - Moi University P. O Box 1125, ELDORET, 30100, Kenya. Fax: +254-5320-63257. E-mail: paulkiprono@yahoo.com

[*]Author for correspondence and reprint requests

J. agric. pure appl. sci. technol. **1**, 1-4 (2009); received January 10/February 20, 2009

Amitraz is widely used, mainly for control of the three-host tick, *Rhipicephalus appendiculatus*, in the dairy lands of Kenya. The weekly dipping regime practiced offers selective pressure for multiplication of resistant populations of the endemic one-host blue tick, *Boophilus decoloratus.*

The study was done to highlight the effectiveness of amitraz for control of *Boophilus decoloratus.* A total of 120 regularly dipped cows, from two farms that used two different amitraz dips, were sampled for the blue ticks in Sugoi location, Uasin Gishu district, Kenya.

A total 439 engorged ticks were found on 60 cows sampled before dipping, and another 118 ticks were recovered from 60 cows sampled after dipping.

The acaricide reduced the tick populations (F= 11.000, p= 0.001), weights, and egg production but not their fertility. Despite the dipping, the ticks produced large masses of eggs, with about 100% hatchability, giving rise to infective larvae high survival rates on *in vitro* exposure to amitraz at the recommended concentration of 0.025%w/v.

Ticks from one herd survived amitraz at a concentration of 0.039%w/v. The study showed presence of resistant populations of *Boophilus decoloratus* in the dairy herds.

Key words: Amitraz, one-host tick, three-host tick, Boophilus decoloratus, Rhipicephalus appendiculatus

Introduction

Amitraz is widely used for tick control in Kenya (Rinkanya, 2003). The blue tick, *Boophilus decoloratus*, which is endemic in the Kenya dairy farms, is frequently found in large numbers on the dairy cattle despite dipping in amitraz. As they feed, the ticks injure their hosts, cause tick worry, anaemia, spread the diseases anaplasmosis and babesiosis, and damage hides and skins.

Policy prescribes weekly dipping for the control of *Riphicephalus appendiculatus*, the vector for *Theilleria parva*, which is associated with losses through the disease East coast fever. Other ticks are expected to be controlled concurrently.

The dipping frequency exposes the one-host blue tick to high selection pressure which favours survival of the resistant populations.

The study was done in two confined dairy herds that used two different dips in Sugoi location, Uasin Gishu district in Kenya.

Materials and Methods

Sample size

Two Friesian herds, randomly chosen on account of their free range grazing within the confines of their farms and being dipped with amitraz weekly, were selected for the study.

From each herd, sixty (60) cows were randomly chosen, identified, and divided into two subgroups of thirty cattle each. Just before dipping, animals in one subgroup (Herd A) per farm were restrained and visible engorged blue ticks hand-picked into individual labeled jars for counting. The remaining subgroups (Herd B) were similarly sampled after twenty four hours from the dipping.

A sample of 300mls dip-wash was collected from each dip for analysis of amitraz concentration.

After counting, the ticks were pooled as per their cattle subgroups, and samples taken and weighed using Sartorius BP 210S balance and then incubated at 27°C and 80% humidity for them to lay eggs.

Controls were picked from the tick pool collected before dipping, immersed in plain water, dried on blotting paper, weighed, and incubated with the experimental ticks.

Incubation was monitored once daily, and ovulation was assumed to be complete when the spent ticks became flat in shape upon dying. The bodies of spent ticks were removed carefully, and egg masses weighed before further incubation until hatching was confirmed to be complete.

Qualitative and quantitative data were used to summarize the collected information and draw conclusion on the effectiveness of amitraz on the ticks.

The *in vitro* tests for larval survival were done through the Modified Larval Packet Test (Miller, *et al*., 2001) while their ability to attach and develop was tested on individually housed calf hosts.

Analysis of variance through the Statistical Packages for Social Scientists (SPSS) 11.0 was used to test the hypotheses at 5% significance level.

Results and Discussion

Despite the weekly dipping, 439 ticks were recovered from 29 cows that were found infested before the dipping. After 24 hours from dipping, 28 cows were still infested and yielded 118 ticks. Both herds had a higher mean number of ticks before dipping, with herd A having a higher incidence of ticks.

Ticks collected from either herd before or after the dipping were actively motile and at various stages of engorgement.

The study showed that the acaricide reduced the infestation, but did not eliminate the ticks completely.

Ticks from the two herds had different weights. Those recovered from the two sub-groups in Herd A had higher mean weights than those from Herd B. The weight of the ticks collected from either herd before dipping was slightly higher than those collected after dipping. More fully-engorged ticks were found on the cows before the dipping.

From all the four cattle subgroups were numerous young adult ticks, in early feeding stages and basically invisible on the animal, were found to have been collected concurrently with the visible ticks. The young ticks were not counted, as they were not part of the visible tick under survey.

Majority of the collected ticks were actively motile, greyish in colour, and visibly similar in body conformations.

Using the dissection microscope at x150 magnification, egg batches were noticed simultaneously in all vials, including the controls. All the eggs laid were ovoid in shape, uniform in size, dark-brown in colour, and had smooth shiny shells. The eggs stuck together into one mass.

Dipping reduced the mean egg weights equally. On dipping, the eggs weights from Herd A had a difference of 0.01351gms while Herd B had 0.01366gms.

The larvae from ticks collected before dipping were more sensitive to amitraz exposure, *in vitro*, at the recommended dipping concentration of 0.025% w/v. Mortalities were lower for the larvae produced by ticks recovered from dipped cattle.

Larvae from all subgroups were able to attach, feed, and develop to adults on calves. Adult ticks were noticeable 23 days post application of larvae along the backlines of the calves.

The amitraz concentration used by Herd A was slightly under-strength at 0.023% w/v which translated to 3 liters amitraz below the optimal requirement. In contrast, Herd B used a concentration of 0.039%w/v, which was 14 liters above the required dosage.

The amitraz dip-wash did not eliminate the tick infestation from the herds. This was contrary to observations made by Seifert (1996) that 90% of the ticks dropped off within eight hours from dipping at the recommended concentrations. Roulston *et al* (1971) also noted that the feeding ticks became hyperactive and detached following exposure to amitraz.

The blue ticks observed in the dairy cattle consisted of populations with different susceptibilities to amitraz. A reduction of 80.3% ($F= 9.042$, $p= 0.004$) of the ticks occurred in Herd A compared to 53.8% ($F= 2.789$, $p= 0.100$) in Herd B.

The length of usage and management of the dip-wash could have contributed to the different response patterns.

Ticks in Herd B may have been exposed to high concentrations frequently hence the occurrence of resistant populations that withstood a dip-wash at 0.039%w/v. This is deduced from observations by Knowles and Roulston (1973) that high concentrations would kill the ticks directly.The exposure had no visible effects on the physical qualities of the ticks.

The reduction on the mean weights of egg batches laid by the ticks was in agreement with the findings by Knowles and Roulston (1973) that ticks surviving an exposure to amitraz would lay a reduced number of eggs. The reduction was 0.0135gms (26.5%) in Farm A and 0.0137gms (20.8%) in Farm B. However, this may need more investigation to know the impact of the reduced mean tick weights, as Bowessidjeou, *et al* (1977) noted that low tick weights were sufficient to account for observed reduction in egg production. The effect on egg fertility was contrary to the observations by Knowles and Roulston (1973) that the hatchability would be reduced. This work showed that the hatchability of the eggs laid by the exposed ticks was virtually unaffected, and gave rise to actively mobile larvae, some of which attached and developed to adult stages.

The *in vitro* exposure of larvae to the standard concentration of 0.025% w/v amitraz did not kill off all the larvae. The larvae from ticks that survived the dipping in both farms were less susceptible to the exposure relative to those from unexposed ticks.

The frequent exposure to amitraz, more so at high concentrations as may have occurred in Herd B, could be responsible for the reduced susceptibility of some ticks in the herds.This concurs with findings by past workers that the rate of resistance development to a chemical depends on intensity of the selection (Nolan, 1985; and Roulston, *et al*, 1981).

The observations were supported by Baxter, *et al*, (1999) who noticed that resistance to an acaricide was bound to increase as reliance on the acaricide increased, as was observed for *B. microplus* in Queensland, Australia in 1980, after a four year usage of amitraz (Reid, 1989). The survival of blue ticks on cattle dipped in amitraz signifies resistance to the acaricide.

Acknowledgement

The authors are grateful to Department of Biological Sciences and Moi University at large for availing research facilities.

References

Baxter G. D., Barker, S. C. **(** 1999), Isolation of a cDNA for an octopamine-like, G-protein coupled receptor from the cattle tick, *Boophilus microplus. Insect Biochemistry and Molecular Biology* **29**, 461-467.

Bowessidjeou J., Brossard, M., and Aeschlimann, A. (1977), Effects and duration of resistance acquired by rabbits on feeding and egg laying in *Ixodes ricinus* L. *Experienta*, **33**, 528-530.

Knowles C.O., and Roulston W.J. (1973), Toxicity to Boophilus microplus of formamidine acaricides and related compounds and modification of toxicity by certain acaricide synergists. *J. Econ. Entomol.* **66**, 1245-1251.

Miller, R., Davey, R., and George, J. (2001). Modification of the Food and Agricultural Organization Larval Packet Test to measure amitraz-susceptibility in the cattle tick, *Boophilus microplus*.
http://www.nps.ars.usda.gov/publications/publications.htm?SEQ_NO_115=125408

Nolan J. (1985), Veterinary Parasitology, **18**, 155-166

Reid T. J. (1989), Acaricide resistance in Queensland. Qld. Dept. Prim. Indust. Info. Series Q189011, pp. 1-7.

Roulston W. J., Wharton R. H., Schnitzerling, H. J., Sutherst, R. W., and Sulivan, N.D. **(**1971), Mixtures of chlorphenamidine with other acaricides for the control of organophosphorous resistant strain of cattle tick *Boophilus microplus*. *Aus. Vet. Journal.* **47**, 521-528.

Roulston W. J., Wharton R. H., Nolan, J., Kerr J. D., Wilson J. T., Thompson, P. G., and Schotz, M. **(**1981), A survey for resistance in cattle ticks to acaricides. *Aus. Vet. Journal.* **57**, 362-371.

Rinkanya (2003), Acaralogist, DVS, Kabete, Kenya (Personal communication)

Seifert Horst S. H. **(**1996), Tropical Animal Health, Kluver Academic Publishers.