

N. Barré¹G. Garris²R. Aprelon¹

Acaricides for eradication of the tick *Amblyomma variegatum* in the Caribbean

BARRÉ (N.), GARRIS (G.), APRELON (R.). Acaricides pour l'éradication de la tique *Amblyomma variegatum* dans les Antilles. *Revue Elev. Méd. vét. Pays trop.*, 1993, 46 (1-2) : 349-354

Le succès d'une campagne d'éradication de la tique *Amblyomma variegatum* dans les Caraïbes impose l'utilisation d'acaricides efficaces, si possible rémanents, faciles d'emploi, ne nécessitant pas le recours à de l'eau pour la préparation de liquides dilués, ni à des équipements coûteux pour le transport et l'application. Des tests de sensibilité *in vitro* conduits sur des souches de Porto Rico et de Guadeloupe ainsi que l'observation de l'impact des campagnes de détiage conduites dans les Caraïbes semblent indiquer qu'il n'y a pas dans la région de problèmes de résistance aux acaricides. Les pyréthroïdes ont l'avantage d'être actifs à très faible concentration et d'être peu toxiques pour l'environnement. Certains sont rémanents. La formulation "pour-on" (application topicale dorsale) permet une application rapide et une diffusion du produit sur tout le corps. Il n'y a pas de délai d'attente. Cependant, des améliorations doivent être apportées pour faciliter l'application chez les bovins qui, aux Antilles, sont en majorité élevés à l'attache. Par exemple, l'application en "spot-on" est plus adaptée qu'en "pour-on". Pour les petits ruminants et les chiens, mais aussi pour les bovins, des dispositifs à diffusion lente imprégnés d'acaricide permettraient de réduire la fréquence d'intervention. Cependant, des essais sur des chèvres avec des colliers à la fluméthrine indiquent une activité de moins de 55 jours, insuffisante pour justifier leur emploi à grande échelle dans une campagne d'éradication.

Mots clés : Tique - *Amblyomma variegatum* - Lutte antiacarien - Acaricide - Pyréthroïde - Antilles - Guadeloupe.

Amblyomma variegatum, the tropical bont tick, was introduced into the Caribbean from West Africa in 1830 (11). This tick species is an efficient vector of *Cowdria ruminantium* and is associated with acute dermatophilosis, two diseases of ruminants which cause considerable economic loss in the Caribbean (10, 22).

This tick is spreading in the Caribbean. For nearly one hundred years, the tick remained distributed only on Guadeloupe, Antigua and Marie-Galante. In 1948, the tick was found in Martinique and in the last 20 to 30 years, the tick has been found on 14 other islands in the Caribbean region (1, 17, 21, 22). Considering the economic losses caused mainly from dermatophilosis when the tick was initially introduced, and the threat of the establishment on the American mainland (1, 4, 7, 21), recommendations were formulated to eradicate this tick from the Caribbean (21, 23). Research on the biology and ecology of the tick were conducted in Puerto Rico (12) and Guadeloupe (3, 6, 8) to develop the knowledge required to eradicate the

tick. Studies to identify effective acaricides for use in eradication programs were also carried out. In this paper, we will summarize the research conducted in Guadeloupe on the efficacy of different acaricides, and on the efficiency of different methods of application for use in eradication programs and suited to particular farming conditions of the Lesser Antilles.

CHOICE OF ACARICIDES

Acaricide susceptibility to commercially available acaricides

In vitro tests of susceptibility of Puerto Rican strains of *A. variegatum* to various organophosphates, amidines and pyrethroids (13) indicate that ticks from Puerto Rico are as susceptible as African *A. variegatum* populations to the acaricides tested (15, 16). In the case of Guadeloupe, larvae and, to a lesser extent nymphs, are even more susceptible than African ticks to the acaricides tested with the exception of ethion. Ticks exposed to ethion showed a high level of tolerance to this acaricide (LC50 from 0,01 to 0,04 depending of the geographical origin of the strain (12).

Another approach is to evaluate the efficiency of acaricides in the field. In Guadeloupe, the acaricides most often used are : ethion (Rhodiocide®) which has been used for more than 20 years ; a mixture of chlorpyrifos and toxaphene (Procibam®) which has been used for about 10 years, deltamethrin (Butox®) and amitraz (Taktik®) which both have been in use for about 5 years. They are used in the government control program, alternatively without consideration for management for acaricide resistance. No resistance has been demonstrated to these acaricides in Guadeloupe. However, use of ethion has resulted in animal owner complaints and some concern that resistance may be developing. This observation seems to point to a tolerance of the ticks in the French Antilles to ethion. Only one other report of acaricide resistance in the Caribbean occurs in the literature, that of MOREL (1967) with gamma HCH (Tigal®) on *Boophilus microplus* in Guadeloupe.

To our knowledge, there is no acaricide resistance in populations of the tropical bont tick in Guadeloupe, Martinique, Marie-Galante, La Désirade and St-Martin, to

1. CIRAD-EMVT, BP 1232, 97185 Pointe-à-Pitre, Guadeloupe.

2. FAO, POB 631-c, Bridgetown, Barbade.

N. Barré G. Garris R. Aprelon

coumaphos, amitraz, and the commercially available pyrethroids. Consequently, there is a wide choice of acaricides available for use in an eradication program.

Advantages of the use of synthetic pyrethroids

Low concentration efficiency

In vitro acaricide susceptibility of larvae and nymphs of *A. variegatum* from Guadeloupe has been tested. For larvae, the LC50 of deltamethrin is about 6 times less than for amitraz, 40 times less than for Procibam®, 70 times less than for coumaphos, 540 times less than for toxaphene and as much as 1200 times less than for ethion (12). These ratios are approximately the same for nymphs.

Low toxicity

One advantage of the use of synthetic pyrethroids is that small concentrations of the acaricide are highly effective in controlling populations of ticks. Secondly, these acaricides are theoretically less damaging to the environment because they are used in such small quantities. In addition, these acaricides do not have a withdrawal period before slaughter for meat or a withdrawal period before milking. It is a significant advantage in countries like those in the Caribbean islands where analysis of residues in animal meat and milk products is not carried out.

Also, it seems unlikely that there is a host reaction to use of pyrethroids on different hosts, which would facilitate the organisation of an eradication campaign where the same acaricide could be used on all livestock to be treated.

Length of residual effectiveness

Residual activity of liquid formulations

Different experiments have been conducted in Guadeloupe to determine the length of time of residual activity to adults of *A. variegatum*.

In one experiment (5), flumethrin was used as a pour-on, spray or dip on Friesian cattle ranged on pasture which was naturally infested with ticks. In this study, the first engorged female was observed to detach and was able to lay viable eggs 21 days after acaricide treatment. From this experiment a residual activity of 6-9 days was estimated with dip and 9-18 days with pour-on and spray formulations of flumethrin (fig. 1).

In a second test, flumethrin and deltamethrin pour-on and spray formulations were used. In this study, 4 goats in each test were infested with adults ticks by placing the

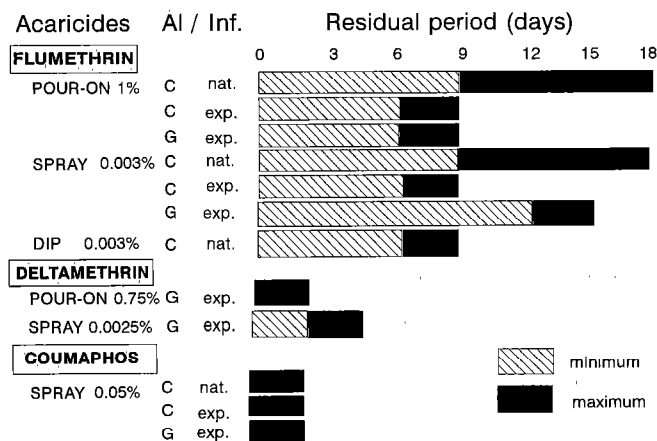


Figure 1 : Residual period of three acaricides after experimental (exp.) or natural (nat.) infestation of cattle (C) and goats (G). (Unpublished, BARRÉ et al., 1987, BARRÉ and GARRIS, 1992).

ticks in attached bags glued to the animal. The goats were infested with adults at increasing intervals. The same experiment was also carried out on cattle treated with flumethrin pour-on and spray and coumaphos spray. Results from these studies are summarized in figure 1. With the spray or pour-on formulations of flumethrin used on goats the period of residual effectiveness ranged from 12 to 15 days and 6 to 9 days, respectively. For cattle, both formulations of flumethrin have a residual period of 6-9 days. The residual period for deltamethrin spray formulation used on goats was 3 to 6 days and for the pour-on formulation less than 3 days.

The residual period of 6 to 9 days for flumethrin pour-on is substantially shorter than the residual period obtained by HAMEL and VAN AMELSFOORT (1985) for *A. hebraeum* which was 12-14 days. Although the residual activity of flumethrin pour-on is less than that found for *A. hebraeum*, it is sufficient to effect eradication, when used at fourteen day intervals in the field in Guadeloupe (9) and in other Caribbean islands (2).

Length of effectiveness of slow - release devices

In a third experiment, collars impregnated with flumethrin at 2,25 % were placed on each of 18 goats. Before infestation with female ticks the goats were allowed to graze on a pasture in a humid zone of Guadeloupe (about 3 000 mm rainfall annually).

One month before placement of the flumethrin treated collars on the goats, each of three goats were artificially infested with 15 males. Six days after the males were placed on each of the three goats, the goats were infested with 15 females. At intervals of 1, 15, 35, 55 and 75 days after the placement of the flumethrin collars, the infestation procedure described above was repeated. When

each goat was infested with either males or females, the goats were held in a large bag for two hours and the ticks were introduced into these bags. This procedure was used to improve the attachment success of the artificially infested goats.

For collection of ticks from the treated goats, each goat was placed in a specially constructed stanchion built over slatted floors which would allow for the ticks to normally detach and be easily collected.

The results from this study are presented in figure 2. A few males and females were able to attach to some of the goats soon after the ticks had been exposed to the flumethrin in the collars. However, the first females were observed to engorge, detach and lay viable eggs only when placed on the goats with males attached 55 days after the placement of collars. Moreover, in another group of 45 goats on which collars were placed and allowed to graze on pastures, 12 (27 %) had lost their collar after 1 month.

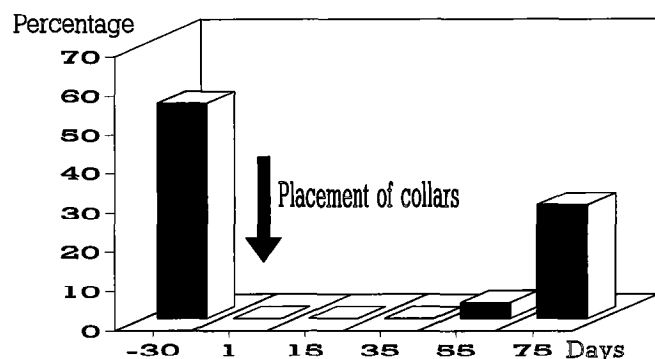


Figure 2 : Percentage of females engorged and detached depending on the delay between collar placement (impregnated with flumethrin 2.25 %) and the release of males on the goats (15 males, then 6 days later 15 females per goats, 3 goats per test).

Because female ticks were observed to engorge and reproduce, and because goats were able to cut off or pull out their collars, the use of the flumethrin collars on stray goats or sheep whose capture for replacement of expired collars would be difficult would not be a reasonable approach in an eradication campaign. In an eradication program, all hosts must be accessible for treatment with an acaricide or these non accessible animals will produce new generations of ticks and thus, prevent a successful eradication.

However, the collars tested were formulated for control of the ticks and fleas on dogs and therefore the concentration of active ingredient may be insufficient for control of *A. variegatum* on goats over a long period of time.

METHOD OF ACARICIDE APPLICATION

Of importance to an eradication program would be the method of application of an acaricide. Dips were constructed in Guadeloupe in the fifties (16 in Grande-Terre, 10 in Basse-Terre, 3 in Marie-Galante) (19). However and due to the dissemination of livestock in the country, dips were never used.

Mobile spray equipment has been used in these islands starting in 1963. The use of spray formulations of an acaricide in contrast to pour-on formulations requires expensive equipment and it must be mixed with a carrier, in most cases water. Adequate supplies of water in remote areas in some of the Caribbean countries are limited, making use of the spray formulation impractical.

Also it takes quite a long time to spray one animal (3 min per bovine) and the liquid may not reach ticks hidden in some remote places of the body. It pollutes the environment, for we can estimate that at least 1 liter of solution is wasted, sprayed on the surrounding pasture, for each animal treated.

Since some spray formulations are mixed with water as a carrier, these acaricides are at disadvantage when used in the tropical areas during the rainy season.

Furthermore, access to the remote areas in some of the countries is also limited and in some cases, there is no road. In some remote areas, walking is the only means of getting to the animals which need to be treated.

A pour-on or spot-on formulation comes from the manufacturer as a premixed complete acaricide which could be used in the field without dilution. Not having to dilute the acaricide in the field should reduce the probability, if used over long periods of time, of development of acaricide resistance in the target tick population. In addition, a premixed acaricide already has the level of the active ingredient in the acaricide set by the manufacturer and thus, testing to determine the level of active ingredient in the field is reduced.

Pour-on is also very easily and rapidly applied (a few seconds per bovine) on animals restrained in a corral. Moreover, some pour-ons spread rapidly and completely on the whole body (20), reaching in less than one hour even those ticks attached to hidden sites.

The pour-on or spot-on formulations contain oil-based ingredients that are less miscible in water and therefore, may be used even during rainy periods.

In field studies in Guadeloupe (9), pour-on formulations of flumethrin or deltamethrin applied to cattle completely eliminated all *A. variegatum* ticks on the treated animals three months after treatments began. The pour-on acaricides were applied every 14 days to the test cattle for one year. By the end of the study, it was apparent that the

pour-on formulations of the tested acaricides were highly effective in controlling the ticks and that these acaricides showed promise for use in an eradication program.

However, the pour-on method application requires that the animal being treated be approached to within a meter so that the acaricide can be poured onto the backline of that animal. Because about 90 % of the livestock in the Caribbean region are tethered and are of the zebu breed, many of these animals are difficult to approach. A study was conducted to determine if the pour-on acaricide, flumethrin, would be as effective when applied as a spot-on in controlling the tropical bont tick.

In the study, the acaricide was applied to two groups of 15 tick infested cattle each group every 14 days for a period of 6 months. One group of 15 cattle received the normal pour-on method of application of the acaricide at the manufacturer recommended rate of 1 ml/10 kg body weight. Flumethrin as a pour-on material comes as a 1 % W/v formulation (Bayticol®). To simulate a spot-on method of application using the same acaricide (flumethrin pour-on) at the same concentration, the acaricide was applied to a second group of 15 animals in three jets propelled from a distance of 1.5 to 2 meters onto the upper part of one side of each study animal using a drench gun (Instrument supplies Ltd. Hamilton, New Zealand). As was found in another study (9) all ticks on the pour-on formulation treated group of animals were eliminated by the third month of treatment (table I). No adult ticks were found on the pour-on treated animals three months after the end of the study.

In the spot-on simulation study group (table I) some male and semi-engorged female ticks were found on the treated animals during the months after the start of the treat-

ment. These results suggest that the spot-on method is not as effective as the pour-on technique of acaricide application. However, no fully engorged female ticks were found on the spot-on treated animals after the start of treatment. Further research is needed : site of application, dose, viscosity of the carrier, etc., to reach the efficiency of pour-on.

CONCLUSION

A wide spectrum of acaricides is usable in a campaign of eradication of the tropical bont tick in the Caribbean. Most of them are active against this tick. However, it is obvious that the most appropriate are the pyrethroids : they are efficient at a very low concentration, the toxicity to mammals is low, no withdrawal period is necessary after their administration, some of them have a long residual activity, and most of them come as a pour-on formulation which is ready for use and which does not need expensive equipment or a supply of water for mixing.

However, the deposit of the acaricide on the back line as a pour-on is almost impossible in the rearing conditions of the Caribbean where more than 90 % of the cattle are tethered and are quite mobile at the end of their chain even if it is shortened at the time of treatment. The administration of the compound by spot jets with a gun from a short distance may considerably simplify the application and minimize the constraints imposed on cattle owners. Research however must be implemented to increase the efficiency of this method.

TABLE 1 Mean numbers and standard deviation (SD) of male (M) and female (F) *A. variegatum* attached to one side of cattle ($n = 15$) treated with flumethrin applied as a pour-on or a spot-on, every 14 days (from T1 the 16 april 1992 to T12 the 17 September 1992) at 1 ml per 10 kg body weight.

Date	Ttmt	FLUMETHRIN POUR-ON					FLUMETHRIN SPOT-ON				
		M	SD	F	SD	%C	M	SD	F	SD	%C
6 Feb		8.6	3.7	6	3.6		10.5	6.7	8.5	6.1	
18 Feb		18.1	7.9	8.8	4.8		7.5	4.6	4.4	2.3	
18 Mar		18.9	11.4	3.1	2		15.4	13.1	4.5	4.8	
16 Apr	T1	22.4	14.8	4.2	3.2		20.5	16.1	1.9	1.5	
14 May	T3	0.6	0.7	0.1	0.4	97	2	1.8	0.1	0.4	90
12 Jun	T5	1.3	1.9	0.3	0.6	94	1.6	1.1	0.6	0.9	90
9 Jul	T7	0.2	0.4	0		99	0.3	0.6	0.3	1	97
6 Aug	T9	0.1	0.3	0		99	0.5	0.6	0		98
3 Sep	T11	0		0		100	0.3	0.6	0		99
2 Oct		0		0		100	0		0		100
29 Oct		0		0		100	0.2	0.4	0.1	0.3	99
25 Nov		0.1	0.4	0		99	0.7	1	0.1	0.4	96
21 Dec		0.1	0.3	0		99	0.7	1.2	0.3	0.5	95
20 Jan		0		0		100	1.2	1.6	0.3	0.6	93

% C = percentage of control.

Also, experiments should be continued with impregnated slow release devices for each animal species in order to obtain the longest possible period of activity and consequently to reduce the frequency of acaricide application on animals by other means.

ACKNOWLEDGEMENTS

The authors thank M. FARGETTON and all the personnel of the experimental farm of INRA at Gardel for their helpful technical assistance.

REFERENCES

1. ALDERINK (F.J.), McCAULEY (E.H.). The probability of the spread of *Amblyomma variegatum* in the Caribbean. *Prev. vet. Med.*, 1988, **6** : 285-298.
2. ALEXANDER (F.C.). Attempts at eradication of the tropical bont tick in St Lucia and Dominica. In : CTA Seminar Proceedings. Cowdriosis and dermatophilosis of livestock in the Caribbean region, CARDI, CTA, St John, Antigua, 12-14 Nov. 1990. 1991. Pp. 113-118.
3. BARRÉ (N.). Biologie et écologie de la tique *Amblyomma variegatum* (Acarina : Ixodina) en Guadeloupe (Antilles françaises). Thèse Doc. Univ. Paris Sud, 1989. 268 p.
4. BARRÉ (N.), UILENBERG (G.), MOREL (P.C.), CAMUS (E.). Danger of introducing heartwater onto the american mainland : Potential role of indigenous and exotic *Amblyomma* ticks. *Onderstepoort J. vet. Res.*, 1987, **54** : 405-417.
5. BARRÉ (N.), CAMUS (E.), DELAPORTE (J.). Essai de la fluméthrine pour le contrôle de la tique *Amblyomma variegatum* dans un élevage bovin en Guadeloupe. *Revue Élev. Méd. vét. Pays Trop.*, 1987, **40** (2) : 127-131.
6. BARRÉ (N.), GARRIS (G.), BOREL (G.), CAMUS (E.). Hosts and population dynamics of *Amblyomma variegatum* (Acari : Ixodidae) on Guadeloupe, French West Indies. *J. Med. Entomol.*, 1988, **25** (2) : 111-115.
7. BARRÉ (N.), GARRIS (G.). Biology, ecology and management of the tick *Amblyomma variegatum* in the Caribbean. In : CTA Seminar Proceeding. Cowdriosis and dermatophilosis of livestock in the Caribbean region, CARDI, CTA, St John, Antigua, 12-14 Nov. 1990. 1991. Pp. 63-84.
8. BARRÉ (N.), GARRIS (G.). Biology and ecology of *Amblyomma variegatum* (Acari : Ixodidae) in the Caribbean : implications for a regional eradication programme. *J. Agric. Entomol.*, 1990, **7** (1) : 1-9.
9. BARRÉ (N.), GARRIS (G.). Efficacy of three pour-on acaricides and one spray formulation for eradication of *Amblyomma variegatum* (Acari : Ixodidae) on cattle in Guadeloupe, F.W.I. 1993 (in press).
10. BURRIDGE (M.), BARRÉ (N.), BIRNIE (E.), CAMUS (E.), UILENBERG (G.). Epidemiological studies on heartwater in the Caribbean, with observations on tick associated bovine dermatophilosis. Proceedings of the XIIIth World Congress on Diseases of cattle. Durban, South Africa, **1**, 542-546.
11. CURASSON (G.). *Trypanosoma vivax* et variétés. Traité de Protozoologie humaine et comparée. Paris, Vigot, 1943.
12. GARRIS (G.). Colonization and life cycle of *Amblyomma variegatum* (Acari : Ixodidae) in the laboratory in Puerto-Rico. *J. Med. Entomol.*, 1984, **21** : 86-90.
13. GARRIS (G.), BARRÉ (N.). Acaricide susceptibility of *Amblyomma variegatum* (Acari : Ixodidae) from Puerto-Rico and Guadeloupe. *Exp. Appl. Acarol.*, 1991, **12** : 171-179.
14. HAMEL (H.D.), Van AMELSFORT (A.). Tick control with flumethrin 1 % m/v pour-on under south African field conditions. *Vet. Med. Rec.*, 1985, **2** : 132-145.
15. LOURENS (J.H.M.). Genetic basis for organochlorine resistance in *Amblyomma variegatum* and information on the susceptibility of *A. lepidum* to organochlorine acaricides. *J. Econ. Entomol.*, 1979, **72** : 790-793.
16. LOURENS (J.H.M.). Susceptibility to cholinesterase-inhibiting acaricides of organochlorine-resistant and susceptible strains of *Amblyomma variegatum* (Acari : Ixodidae) and an organochlorine-susceptible strains of *A. lepidum*. *J. Med. Entomol.*, 1980, **17** : 375-379.
17. MOREL (P.C.). Etude sur les tiques du bétail en Guadeloupe et Martinique. I. Les tiques et leur distribution (Acariens, Ixodoidea). *Revue Élev. Méd. vét. Pays trop.* 1966, **19** (3) : 307-321.
18. MOREL (P.C.). Etude sur les tiques du bétail en Guadeloupe et Martinique. III. Résistance de la tique *Boophilus microplus* contre le gammaxane aux Antilles françaises. *Revue Élev. Méd. vét. Pays trop.*, 1967, **20** (3) : 451-456.
19. ROCHETTE (I.). Etude critique de la campagne de lutte contre les tiques en Guadeloupe. L'éradication est-elle possible ? Thèse Doc. vét. Lyon, 1984. 158 p.
20. STENDEL (W.), HAMEL (H.D.), SIEVEKING (H.U.), BRUHNE (D.). Analytical determination of the distribution of flumethrin on the body surface of cattle following tropical pour-on application. *Vet. Parasitol.*, 1992, **42** : 137-143.
21. UILENBERG (G.). Extension de la tique *Amblyomma variegatum* dans les Antilles : Comment expliquer cette grave menace et que faire ? *Revue Élev. Méd. vét. Pays trop.*, 1990, **43** : 297-299.
22. UILENBERG (G.), BARRÉ (N.), CAMUS (E.), BURRIDGE (E.), GARRIS (G.I.). Heartwater in the Caribbean. *Prev. vet. Med.*, 1984, **2** : 255-267.
23. USAID, USDA, IICA, FAO. Management of the tropical bont tick (*Amblyomma variegatum*) and associated diseases in the Caribbean. A feasibility proposal. Report. Nov. 1986. 20 p.

N. Barré G. Garris R. Aprelon

BARRE (N.), GARRIS (G.), APRELON (R.). Acaricides for eradication on the tick *Amblyomma variegatum* in the Caribbean. *Revue Elev. Méd. vét. Pays trop.*, 1993, **46** (1-2) : 349-354

The success of an eradication campaign against the tropical bont tick in the Caribbean imposes the use of active acaricide compounds, if possible with residual activity, easy to apply and requiring few or no accessible water supplies and expensive application equipment. Tests of *in vitro* susceptibility of tick strains from Puerto Rico and Guadeloupe as well as observations of the impact of the current tick control campaigns conducted in some Caribbean islands, seem to indicate that there is no problem of resistance to acaricides. Pyrethroid acaricides have an advantage since they are active at very low concentration levels and have a low toxicity for mammals and to the environment. Some of them are in a pour-on formulation which allows for rapid application and complete coverage of the whole body of the animal. A withdrawal period is not necessary. However, improvements must be found to facilitate the application onto the back of cattle that, for the majority in the Caribbean, are tethered and not perfectly restrained. A spot-on application method with a drench gun seems more adapted to tethered animals than the pour-on. For small ruminants and dogs but also for cattle, slow release devices impregnated with acaricides may be useful in reducing the frequency of animal treatments. However, experiments on goats with collars impregnated with flumethrin indicate an efficiency of less than 55 days, insufficient to justify their use on a large scale in an eradication program.

Key words : Tick - *Amblyomma variegatum* - Tick control - Acaricid - Pyrethroid - West Indies - Guadeloupe.

BARRÉ (N.), GARRIS (G.), APRELON (R.). Acaricidas utilizados para la erradicación de *Amblyomma variegatum* en el Caribe. *Revue Elev. Méd. vét. Pays trop.*, 1993, **46** (1-2) : 349-354

El éxito de las campañas de erradicación contra la garrapata tropical en el Caribe, exige el uso de compuestos activos de acaricidas, que de preferencia no provoquen residuos, de fácil aplicación y que requieran poca o ninguna utilización de agua o equipo sofisticado. Los tests de susceptibilidad *in vitro* de las cepas de garrapatas originarias de Puerto Rico y Guadalupe, así como las observaciones sobre el impacto de las campañas de control de garrapatas llevadas a cabo en algunas islas del Caribe, no parecen indicar la existencia de problemas de resistencia a los acaricidas. Los piretroides son recomendables, debido a que actúan a concentraciones muy bajas y presentan un grado mínimo de toxicidad para los mamíferos y para el medio ambiente. Algunos de ellos se presentan en forma de "depósito" (*pour-on*), lo que permite una aplicación rápida, con buena cobertura del cuerpo del animal. Además, el período de ensayo no es necesario. Sin embargo, debe mejorarse el sistema de aplicación sobre el dorso del ganado, ya que por lo general, en las islas del Caribe éste se encuentra atado y no estabulado. La administración por *spot*, con una pistola de aplicación, parece más adaptada a los animales atados que el sistema de depósito. Para pequeños rumiantes, perros e incluso bovinos, los métodos de liberación lenta impregnados con acaricidas, pueden ser útiles en la reducción de la frecuencia de los tratamientos. Sin embargo, los experimentos realizados en cabras con collares impregnados de flumetrina, indican una eficiencia en la duración menor a 55 días, lo cual no justifica el uso de éstos a gran escala en los programas de erradicación.

Palabras claves : Garrapata - *Amblyomma variegatum* - Control de garrapatas - Acaricida - Piretroide - Antillas - Guadalupe.