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Short communication

High impact and effectiveness of Gavac™ vaccine in the national program for control of bovine ticks *Rhipicephalus microplus* in Venezuela

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ABSTRACT

The 80% of the world's cattle population (approximately 1281 million), 80% are at risk for ticks and tick-borne diseases. Over a decade ago, the estimated global costs of control measures and productivity losses amounted to $7.0 billion USD annually (7 USD/head/years). Tick control in livestock remains, to a large extent, based on chemical acaricides, but their use in combination with anti-tick vaccines and utilization of host resistance to ticks should reduce dependency on chemical tick control. Currently the only effective vaccine in the market to control tick populations is Gavac™. The immunogen Bm86 used to produce Gavac™ had already been tested in controlled experiments and field trials demonstrating its effectiveness. In this study Gavac™ vaccine was used for the first time in a national program, namely the integrated program for bovine tick control, which included more than 1.9 million bovines, spread over 18 states of the Republic of Venezuela. After two years of implementation of the program, 38835 cattle farms were included, and 83.7% of chemical acaricide were reduced. The program had a major impact, saving 81.5% of the estimated cost of the traditional chemical tick control treatments. A reduction of more than 260 t of chemical acaricides was attained. These results strongly support the use of vaccine for tick control in integrated control programs.

1. Introduction

Rhipicephalus (Boophilus) spp. ticks are disseminated mainly in tropical and subtropical regions of the world with sort expansion for some species due to changes in climate (Barker and Murrell, 2004; Estrada-Peña et al., 2006; Olwoch et al., 2007). Cattle tick (*Rhipicephalus microplus*) infestations have an economic impact on cattle production by reducing weight gain and milk production, and by transmitting pathogens that cause babesiosis and anaplasmosis among others (Peter et al., 2005).

Currently, chemical acaricides represent the main line of anti-tick defense. However, increasing concerns regarding development of acaricide resistance, especially in the cattle tick, and environmental safety issues indicate the need for other, less aggressive but equally efficient methods (Jetter and Paine, 2004; Ostfeld et al., 2006; de Morais et al., 2013). These alternative approaches to control tick infestations are based on the use of hosts with natural resistance to ticks, pheromone-impregnated decoys for attracting and killing ticks,

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biological control agents, and vaccines (de la Fuente and Kocan, 2006; Sonenshine et al., 2006; Willadsen, 2006).

In the early 1990 s, vaccines inducing immunological protection on vertebrate hosts against tick infestations were studied. As result, the commercial vaccines Gavac™ and TickGARD contained the recombinant *R. microplus* Bm86 gut antigen were developed (Willadsen et al., 1989; Rand et al., 1989; Rodríguez et al., 1994). These vaccines reduce the number of engorging female ticks, their weight, and reproductive capacity. Thus, the greatest vaccine effect was the reduction of larval infestations in subsequent generations. Currently, the only effective vaccine in the market to control tick populations is Gavac™. Their use by producers in integrated programs in some parts of Cuba, Mexico, and Brazil has demonstrated their ability to control tick infestations (Rodriguez et al., 1995; 2004; de La Fuente et al., 1998; Redondo et al., 1999). Despite the use of Gavac™ has continued for more than a decade after their registration, the results of its commercial field application have been reported only briefly, or their application was local and based on a small number of animals. In this context, the present study evaluated for the first time the outcome of an integrated national program for tick control using Gavac™ vaccine in Venezuela. This integrated program for bovine tick control (IPBTC) was designed as a free-of-charge program, mainly directed to small and medium sized cattle farms in the country. This program included more than 1.9 million bovines spread over 18 states of the Republic of Venezuela. We evaluated the results obtained after the application for 18 months in terms of the reduction of chemical acaricide treatments per year per bovine, immunogenicity after vaccination, reduction on the average weight of engorging female ticks, the average weight of eggs and the efficiency reproduction index of ticks. The overall results demonstrated the high impact and effectiveness of Gavac™ vaccine applied in the IPBTC in Venezuela.

2. Material and methods

2.1. Vaccine

The commercial Gavac™ vaccine (Heber Biotec S.A., Cuba) was used. Vaccination was done intramuscularly in the neck, employing 2 mL containing 100 μg of the Bm86 antigen (produced in the yeast *Pichia pastoris*) in Montanide ISA50Vg (Seppic) oil adjuvant. Three immunizations at 0, 4 and 7 weeks were performed. A re-immunization every 6 months was also applied to maintain the protective antibody titers (Rodríguez et al., 2004).

2.2. Personnel and farms to be included in the integrated program for bovine tick control

An integrated program for bovine tick control (IPBTC) in Venezuela was designed directed to small and medium sized cattle farms in the country (farms with less than 70 cattle). In each state

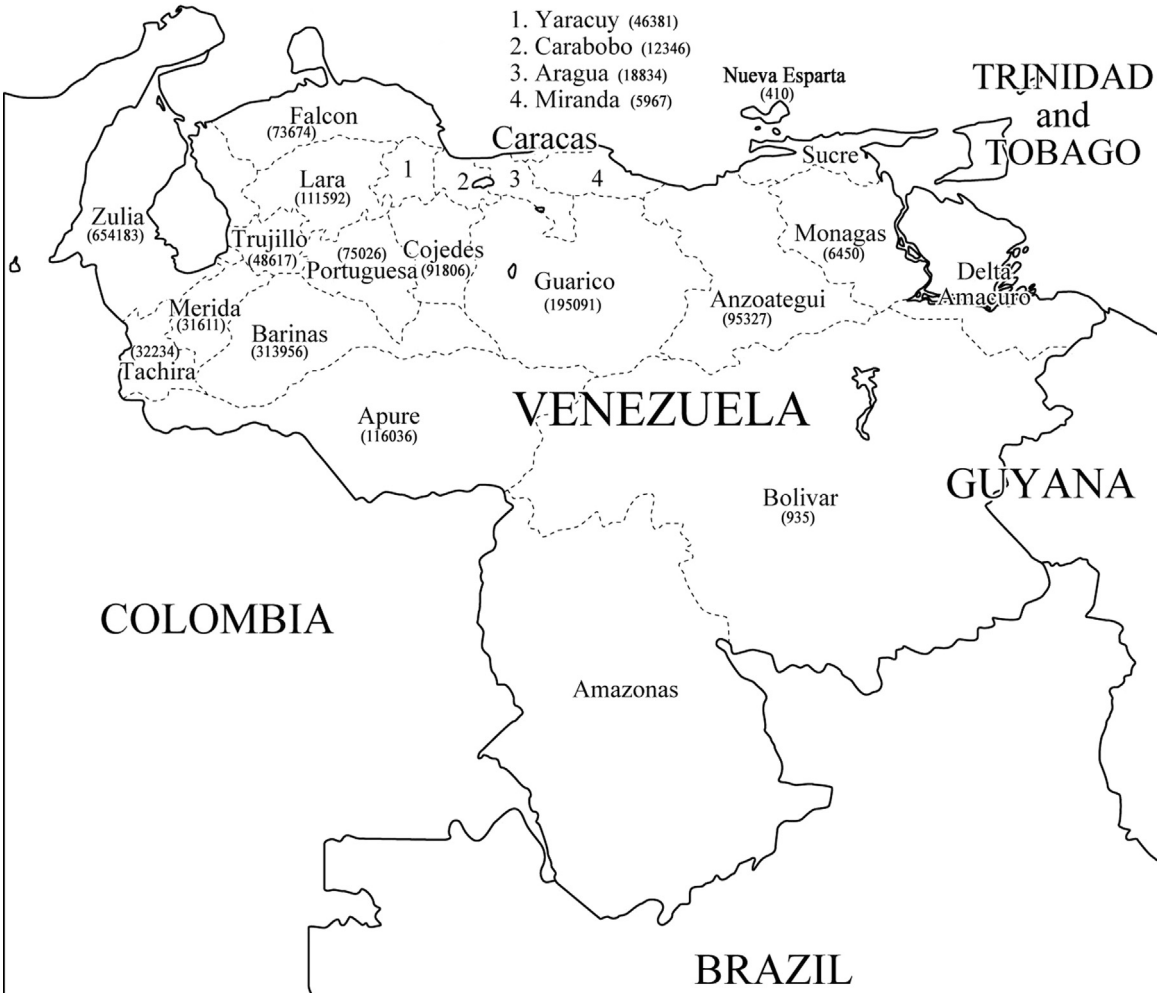

Fig. 1. Political map of Venezuela showing the 18 states included in the IPBTC. The numbers of animals vaccinated and included in the program appear in parentheses below each state name. IPBTC: integrated program for bovine tick control.