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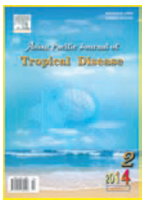

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Economic importance of ticks and their effective control strategies

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ABSTRACT

Role of livestock in improvement of a country's economy is inevitable. Livestock contributes a lion's share in agricultural sector of developing countries. Several developing countries have adopted the use of exotic germplasm to improve the productivity of their native breeds, which has brought down the disease resistance. Among various problems hindering the growth and productivity of livestock, parasite related problem plays a major role. Tick and tick borne diseases are prevalent in 80% of the cattle population around the globe. They cause various worries to the farmers by transmitting major disease causing pathogens and jeopardize animal health leading to poor production. Ticks transmit various pathogenic agents like virus, bacteria, protozoa and other parasites as well. Many of them are dangerous for the livestock health and some are also zoonotic hence, need to be checked at the initial stages. Control of ticks is the major concern in the present situation as the use of anti-parasitic drugs has led to the current trend of resistance development. Search for an effective alternative method has begun; vaccination will be a better alternative and promising tool for protecting livestock from the tick infestations and thereby tick borne diseases.

1. Introduction

Livestock production is an important integral component of the Indian agricultural production system and plays an imperative role in the development of a country's economy as well as for the food and nutritional security. It also plays an important role in the socio-economic development of the small and medium hold farmers. More than one fourth of the total output of the agricultural sector in India is contributed by the livestock alone[1]. In 2010-2011, 3.37% GDP was contributed by animal husbandry proving that it is the major sector in Indian economy[2]. The success of livestock industry depends on the health of livestock, with sustained productivity. Animal breeding plans introduced exotic germplasm to increase productivity of the animal, where the disease resistance/health of the animal was least concerned. Susceptibility to the diseases shattered the hope of livestock sector, and these issues are multifactorial in nature. India stands top in the livestock population throughout the world, even though production of milk and meat is 20%-60% lesser in comparison to the world average[3]. Livestock diseases, decreased resistance to the pathogens and lack of an effective disease control strategy were reasons for the production loss apart from the low productivity of Indian animals. Among the top ten diseases of the livestock, four

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of them are caused by parasites[4]. Parasitic diseases are a major concern worldwide not only to the health issues but also in terms of economic status of the country[5]. Tick and tick borne diseases (TTBDs) rank fourth among the major infections of livestock and latter is regarded as the most important arthropod borne diseases of livestock, humans and companion animals[6]. For the economic development and achieving food security, increasing the livestock population is a constraint because of scarcity of feed, fodder and pressure on natural resources. Therefore, increasing the standard of animal health through controlling TTBD and increasing disease resistance of the animals are one of the few important passive ways to achieve the maximal animal productivity. Various methods are followed throughout the world to control ticks like use of acaricides, vaccines, biological control, physical methods and recent techniques like RNA interference[7].

2. Economic impact of TTBD

TTBD affects 80% of world cattle population, and their prevalence is throughout the world, particularly important in tropical and sub-tropical countries causing loss of production[8]. Vector-borne diseases, directly or indirectly affect the growth of the livestock industry, which is of fundamental importance to rural people in India. They are the source of income to small hold/landless farmers and ensure food supply and income during the quiescent period the agriculture[6]. Ticks are responsible for a variety of losses, and directly attach to the host ('tick-worry') causing injection of toxins, blood loss, general stress, hide damage and irritation, leading to decrease in productivity in terms of milk, meat *etc*. Indirectly it depresses the immune function and transmits several pathogens[8-12].

De Castro estimated that the annual global costs associated with TTBDs in cattle amounted between US$ 13.9 to US$ 18.7 billion[9]. In Australia alone, losses due to cattle tick [*Boophilus* (*Rhipicephalus*) *microplus* (*B. microplus*) (*R. microplus*)] were estimated to be US$ 62 million and in Brazil losses were around US$ 2 billion per year. In Africa, tick-borne diseases are considered to be the most important problems in animal production. In India, the economic losses due to TTBDs in animals were calculated as US$ 498.7 million per annum[11,13].

Accurate estimation of losses due to TTBDs is very difficult, but they significantly affect the farm income. TTBDs severely affect dairy cows and reduce milk yield. When crossbred Holstein-Zebu cows are infested with an average of 105 ticks, a reduction in 23% of milk yield/day was observed. Losing about ¼ of the income through milk has a significant impact on livestock dependent system[7,14]. Further, the direct effect of tick infestation on meat and hide industry is much more significant. Frisch *et al.* reported that animals with an average of 40 ticks/day could lose weight up to 20 kg/year and also diminished hide value by 20%-30%[15,16]. Further, ticks are major contributors for transmission of important disease causing agents to animals (Table 1). Bovine tropical theileriosis caused by the protozoan parasite *Theileria annulata* (*T. annulata*), is transmitted by the tick species of the genus *Hyalomma* worldwide, putting about 250 million cattle at risk to this important protozoan disease[21]. Estimated loss due to *T. annulata* and tick worry worldwide and India was US$ 384.3 million and US$ 57.2 million, respectively[5,12]. In Sweden, over the past 30 years, increase in *Ixodes ricinus* tick population was recorded[22,23]. Recently in 2012, Karnataka, India, outbreak of Kyasanur forest disease (KFD), a *Haemaphysalis* tick borne infection has occurred despite routine vaccination, indicating the need of strategic control of the tick vector[24].

3. Tick control strategies

Tick control demands the attention of researchers because many important livestock diseases are transmitted by ticks and this can be achieved by controlling ticks. To counteract the adverse effects of ticks on animals and humans, various tick control programs were followed in modern livestock practices. The main method among them is the use of acaricides (amidines, benzoyl phenyl ureas, benzene hexachloride/cyclodienes, carbamates, macrocyclic lactones, organophosphates and pyrethroids). Acaricide usage is not sustainable in the long run because the striking ability of ticks becomes resistant. Moreover, acaricide residues in animal food products, undesirable effects on animal health and ecosystem, and the cost involved are other drawbacks of the use of acaricides. So, all these factors warrant the alternate tick control strategies[7].

Effective control of TTBDs is best achieved through a combination of practices like tick control, prevention of disease through vaccination, and treatment of clinical cases. Tick control methods can be grouped into chemical (using acarcides) and non-chemical methods such as, grooming, pasture spelling (*i.e.*, leaving pastures unstocked to break the tick's life-cycle), endosymbiotic approach, biological control, genetic manipulation, use of biopesticides, herbal acaricides and vaccination with tick antigens. Both the methods of tick control are briefly discussed in this review to provide information regarding conventional and upcoming control strategies to control TTBD.

3.1. Grooming

Investigation has been carried out in most mammal species to assess the effect of grooming for the control of ticks. It has direct effect on wellbeing via removal of ectoparasites