

## EFFICACY OF 1 % GERANIOL (FULLTEC®) AS A TICK REPELLENT

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### Summary:

A field trial on the efficacy of 1 % geraniol (Fulltec®) spray against ticks has been carried out in two farms near Rabat (Morocco). Results clearly revealed that 1 % geraniol has a preventive effect against *Hyalomma* ticks. Comparison of geraniol sprayed cows with control herd showed a reduction of mean number of ticks per animal of 98.4 %, 97.3 % and 91.3 % at respectively day 7, 14 and 21 post-spraying. These data give evidence that the geraniol, natural product extracted from plants, could be an alternative to limit use of chemical acaricides, which efficacy is compromised by development of resistance.

**KEY WORDS :** geraniol, tick, control, prevention, resistance.

### Résumé :

EFFICACITÉ DU GÉRANIOL À 1 % (FULLTEC®) CONTRE LES TIQUES DU GENRE *HYALOMMA*  
*Un essai de pulvérisation d'un lot de bovins avec du géraniol (Fulltec®) à 1 %, en comparaison avec un lot similaire dans deux fermes de la région de Rabat au Maroc, a montré que le géraniol à 1 % avait un effet préventif important contre les tiques du genre Hyalomma. Des réductions du nombre moyen de tiques par animal de 98,4 %, 97,3 % et 91,3 % par rapport au lot témoin ont été observées à J7, J14 et J21 respectivement après la pulvérisation. Ces données indiquent que le géraniol à 1 %, produit naturel d'origine végétal, pourrait représenter une alternative pour limiter l'usage des acaricides habituels dont l'efficacité est parfois compromise du fait du développement de chimiorésistances.*

**MOTS CLÉS :** géraniol, tique, contrôle, prévention, résistance.

Ticks and tick-borne diseases cause considerable economic loss to cattle breeding (McLeod, 1995; Willadsen, 2006). Over the past ten years, global changes, especially anthropic impacts on the environment, have contributed to the development of tick populations in many parts of the world (Eisen, 2008). In most countries, tick control is based exclusively upon the regular and frequent use of synthetic acaricides. Inappropriate and abusive use of these molecules often leads to the development of chemoresistance. As a result, many Ixodidae have developed resistance to common acaricides, which has made control difficult in some breeding areas (George *et al.*, 2004; Kunz & Kemp, 1994; Li *et al.*, 2004; Fragoso-Sanchez *et al.*, 2008). Furthermore, beside their potential toxic effects on the animals, these products can generate residues in animal products and have serious impact on the consumer's health and the functioning of ecosystems (Laffont *et al.*, 2001; Graf *et al.*, 2004).

To alleviate this constraint, an increasing interest is now oriented toward the development of non-toxic environmentally safe repellents. Geraniol is reported to be a potential repellent against insects, and especially a key component in commercial mosquito repellents (Xue *et al.*, 2003). It is a main product of essential oil extracts of different plants (*Pelargonium* sp., *Eucalyptus* sp., *Cymbopogon* sp., etc.), which can be used as mosquito repellents (Matsuda *et al.*, 1996).

Up to now, there has been no previous report on use of geraniol for preventing tick infestation in cattle. The purpose of this study is to evaluate the efficiency of a spray solution of 1 % geraniol as a preventative measure in cattle naturally infested with ticks.

## MATERIALS AND METHODS

Over a month, a dozen of cattle farms in the vicinity of Rabat, Morocco, were visited to identify animals infested with ticks. Ticks were searched on parts of the animals' bodies most susceptible to ticks, such as utters and the anal-genital fold. Two relatively similar farms were selected on the basis of their number of cattle, breed and level of tick infestation. Both farms are located in Tiflet, at approximately 50 km Northeast of Rabat, and distant of 5 km apart.

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During this survey, a total of 234 ticks were collected for species identification. All examined ticks were *Hyalomma*; among them 84.2 % were *H. marginatum*, 11.5 % *H. dromedarii* and 4.3 % *H. detritum*, and 4.3 % of those ticks were female.

## THE ANIMALS

In the two selected farms, all cattle were of "Frisonne pie-noire" breed, aged from two to nine years and had an average weight of 250 to 300 kg. The animals were in good health conditions and had not received any acaricide treatment for more than three months.

At Day-7, each animal was identified by ear-tag, clinically examined and the number of ticks present in each part of the body recorded. The animals remained in their own farms until the end of the study. In both farms, feed was composed primarily of grazing with a supplement of forage and hay. Each farm was considered as a group:

- Group A (11 cows): sprayed with 1 % geraniol.
- Group B (13 cows): placebo.

The sprayed solution of geraniol contains geraniol at 1 % (w/v), polyhexamethylene biguanide hydrochloride at 0,025 % (w/v) and sufficient quantity of purified water for 100 % (w/v).

The placebo sprayed contains polyhexamethylene biguanide hydrochloride at 0,025 % (w/v) and sufficient quantity of purified water for 100 % (w/v).

The polyhexamethylene biguanide hydrochloride (Vantocil IB, Avecia Biologics Ltd) is a preservative compound, used to prevent fungal and bacterial growth in the solution. This compound does not have any insecticide or acaricide propriety.

## GERANIOL

The geraniol was produced by Fulltec® company (Chamerstrasse 14, CH-6301 ZUG, Suisse) and marketed in Morocco by Chimitechnic. This geraniol was prepared by distillation from *Palmarosa* oil produced by Düllberg Konzentra (GmbH & Co, Obenhauptstrasse 3, D-22335 Hamburg, Germany). The *Palmarosa* oil is produced by steam extraction from dried flowering parts of *Cymbopogon martinii* var. *motia*. The crude *Palmarosa* oil containing 60-85 % geraniol is distilled under vacuum. The fractions of the oil from the distillation are continuously checked by gas liquid chromatography, which enables to get pure geraniol. This geraniol is processed by Fulltec AG and proposed as "Fulltec insect killer concentrate 30 % geraniol" with the following composition: dist. water 11.50 w-%; geraniol 30.00 w-%; polyglyceryl-6 oleate 35.00 w-%; polyglyceryl-2 oleate 23.00 w-%; citric acid 0.50 w-% (Fulltec, pers. comm.)

## APPLICATION OF PRODUCT AND EVALUATION OF GENERAL STATE OF THE ANIMALS

The geraniol solution was applied by a 5 litre market sprayer, directly on the entire body of the animal. Each animal received approximately 250 to 300 ml of the solution, corresponding at 2.5 to 3 g of geraniol. The product was applied on all body parts, including utter, inside thighs, anal area, etc. The sprayed animals were kept inside the barn for 24 hours, and let to graze in the afternoon of the following day. After applying the product, the animals were observed for in the next two hours to note any particular clinical sign which might occur. Clinical examinations and tick counts of both groups (geraniol and control) were made at D7, D14 and D21.

## PARAMETERS OF MONITORING

Tick infestation was monitored in each test group at D-7, D0, D7, D14 and D21. Animals were handled in the barn and each part of the body was scrupulously examined for tick. To avoid any bias, search and counting of ticks were done by the same individuals during the trial.

Ticks found after application of geraniol were removed with tweezers, examined with a magnifying glass to check their state and then put in vials for laboratory identification. When female ticks were found alive after application of geraniol, they were incubated at 27 °C with a relative humidity (RH) of 85 % for at least seven days. This procedure made it possible to verify, if need be, their capacity to continue their evolution. The effect of the product sprayed on cattle was evaluated by calculating the reduction in the average number of ticks compared with the control group on D7, D14, and D21.

## STATISTICAL ANALYSIS

Statistical analysis was made with SPSS software. The averages of tick density were compared by ANOVA. The global threshold of signification was set at 5 %.

## RESULTS

This study shows that 1 % geraniol was very well tolerated by all sprayed cattle. No notable signs of unusual reaction were noticed in groups A or B, and three weeks after application of the product the animals remained healthy and did not show any abnormal clinical signs. Table I summarises the results of tick counts in both groups made at D-7, D0, D7, D14 and D21. It also shows the percentages of reduction in the average number of ticks. Figure 1 shows the

Days	Group A: geraniol	Group B: placebo	% reduction	Statistical significance
D - 7	21.5 ± 12.5	22.4 ± 10.0	–	–
D0	21.3 ± 12.5	22.2 ± 9.8	–	–
D7	0.4 ± 1.2	22.8 ± 10.2	98.4	P < 0.0001
D14	0.6 ± 1.3	23,2 ± 10,1	97.3	P < 0.0001
D21	1.9 ± 2.2	21.9 ± 9.9	91.3	P < 0.0001

Table I. – Activity of 1 % geraniol in cattle, determined by the reduction in average number of ticks (average number of ticks per animal: n ± standard deviation).

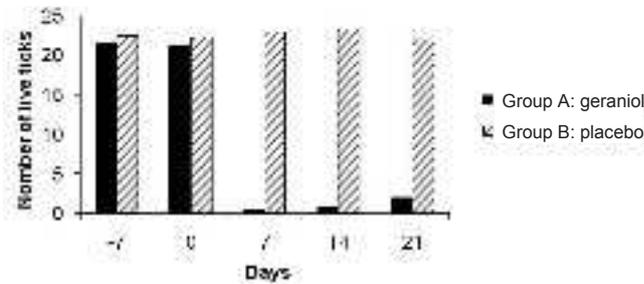


Fig. 1. – Evolution of tick infestations in sprayed and control groups, shown by number of ticks per animal. Only live ticks found on animals are reported on the figure.

evolution of tick infestations in sprayed group in comparison with the control group.

Clinical examination on the seventh day (D7) showed that only one cattle was infested with four ticks (Table I). Examination of these ticks after removing them revealed that they were male and very active. It was supposed that these ticks come from a recent infestation, which probably occurred on the same day or one day prior to the visit.

On the fourteenth day (D14), three of the eleven cows from group A were infested, and hosted respectively one, two and four ticks. These ticks were alive, and found in the utter area. At this time, the ticks were not removed from the animals in order to monitor the kinetics of tick infestations.

At three weeks (D21) post-spraying, six of the eleven cows from group A were infested, and each one had between two and six ticks. All ticks were alive and attached to the skin of the utter area.

## DISCUSSION

A variety of organophosphates and synthetic pyrethroids have been used as acaricides worldwide. These chemicals may be highly toxic to non-target organisms and chemoresistance has also been developed in some tick populations. Botanically active compounds against ticks and other pest arthropods have been tested by several authors and are considered to be an alternative to synthetic pesticides

(Panella *et al.*, 2005). Recently, Cetin *et al.* (2009) reported the acaricidal effects of the essential oil of *Origanum minutiflorum* (Lamiaceae) against *Rhipicephalus turanicus*.

We have tested in this study the effect of geraniol extracted from *Palmarosa* essential oil by Fulltec® laboratory against *Hyalomma* sp. ticks in Morocco. The product was used as a 1 % spray on cattle.

In conclusion, it can be noticed that at 1 % dilution, geraniol was well tolerated by cattle, which did not show any adverse events. As repellent, geraniol reduced tick infestation in grazing cattle in comparison to control animals. Following application of the product, a significant reduction in tick number of 98.4 %, 97.3 % and 91.3 % was observed respectively on D7, D14, and D21 compared to the placebo group (p < 0.0001).

In grazing cattle, application of 1 % geraniol maintained tick infestation at a significantly low level in comparison to the control group (1.9 vs 21.9) for a period of three weeks. It is suggested that 1 % geraniol could be effective product for preventing tick infestation in cattle, and represent an alternative of choice to avoid development of chemoresistance of ticks.

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