Evaluation of the VetCap® Treatment Method for Horn Fly Control on Cattle*

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ABSTRACT

A field study was conducted to evaluate the efficacy of the VetCap® treatment method for the control of horn flies on cattle. The VetCap® delivery system consists of a pressure (liquid CO_2) driven launcher, and an encapsulated insecticide (CyLence®) formulation (10 ml CyLence® gel capsules). Three groups of cattle on three adjacent pastures were used, including: 1. Animals treated with 10 ml CyLence® pour-on formulation, 2. Animals treated with VetCap® treatment method (10 ml CyLence® gel capsule), and 3.The untreated animals.

Fly counts were conducted at 2 days prior to treatment, and at 4, 11, 18, 25, 32, and 39 days post-treatment. Mean fly numbers per side of the animal for all three groups at each sampling date were obtained, and percent control of each treatment method was generated by comparing them to: 1. The untreated control group, and 2. Tthe pre-treatment fly count within the treatment group. Both treatment methods provided significant control of horn flies for about 3 weeks. A higher level of control was achieved with the Pour-on treatment, which was largely due to smaller animal size and lower pre-treatment fly load on animals. The potential benefits and applications of the VetCap® treatment method are discussed.

INTRODUCTION

The horn fly, *Haematobia irritans irritans* (L.), is an economically damaging parasite of cattle in several parts of the world. Annual economic losses ascribed to horn fly parasitism in the U.S. and Brazil are estimated to be at $876 and $150 million dollars, respectively.[1,2] Despite the evolution of resistance, insecticide use remains an important part of integrated horn fly control programs.[3] Efficiency-enhancing agricultural technologies are expected to serve as the engine to deliver the additional food supply required to meet the growing world food demand, which is forecasted to increase two- to threefold by 2050.[4,5] Various approaches have been taken to apply insecticides to cattle topically and systemically for horn fly control since the late 1940s. Ease of use, safety, cost-effectiveness, and reduced frequency of application, thereby minimizing cattle handling and distress, are desirable traits for novel horn fly control products. Insecticides have been commercialized to treat cattle against horn fly infestations using various formulations and delivery systems including sprays, dust bags, backrubbers, ear tags, boluses, injectables, feed-throughs, and pour-ons. [6-10]

The VetCap® treatment method was developed and patented by SmartVet Pty Ltd (SmartVet) as a way of remotely delivering a metered dosage of pour-on insecticide formulations to free ranging livestock and wildlife.[11] It represents a new generation of remote treatment systems offering the opportunity to administer parasite control to grazing cattle with minimal stress and no interruption of normal herd behavior and feeding patterns. Here, the efficacy of the VetCap® treatment method was evaluated using a commercially available insecticide formulation (CyLence® pour-on) against horn flies infesting cattle under field conditions. Additionally, we compared the VetCap® treatment method to the traditional pour-on treatment method using this same commercially available formulation.

MATERIALS AND METHODS

This field trial was conducted at a ranch in Mason County, Texas, between May 20 and June 30 2009. The three experimental treatments were: 1. A commercially available pour-on insecticide formulation applied using the VetCap® treatment method, 2. The same insecticide formulation applied by the traditional pour-on method, and 3. Untreated control. The experimental groups were located in three adjacent pastures. Because of constraints associated with the field nature of this study, we were unable to randomly assign animals into similar experimental cattle groups based on estimated body weights and pretreatment horn fly counts. The VetCap® group included 56 cows and two bulls in a 1,000 acre pasture. The pour-on group consisted of 46 cows in a 200-acre pasture, and the untreated group had 15 cows and one bull in a 400 acre pasture. Both Hereford and Angus cattle were present in all the groups, but most animals were *Bos taurus* crossbred cattle. The estimated weight of cows in the VetCap® and the untreated control groups was between 1,000 and 1,100 pounds respectively, and in the pour-on treatment group was between 600-700 pounds. Each animal received an ID tag in one of the ears to facilitate identification.

Components of this version of the VetCap® treatment method included frangible soft gel capsules containing a commercial insecticide formulation and a specially designed launcher powered by a compressed CO_2 cylinder. The insecticide used in this study was CyLence® pour-on (active ingredient-1% cyfluthrin) that is commercialized by Bayer Animal Health (Shawnee, KS, USA) for use as a pour-on in cattle. The VetCap® launcher and the insecticide gel capsules were provided by SmartVet (Brisbane, Australia). Each insecticide gel capsule contained 10 ml of CyLence.® The VetCap®-treated group received one gel capsule per cow applied on one side of the body by shooting from 10 to 15 yards away. Bulls received two insecticide gel capsules, one on each side. All cattle in the pour-on group were treated on the same day. Each animal received 10 ml of CyLence® on the back along the midline as per label instructions.

Fly counts were based on random sampling of cattle in the experimental groups due to difficulty in finding all the animals in the large pastures. Flies were counted on approximately 50% of the animals in both the VetCap- and pour-on-treated groups and nearly 100% of the cattle in the control group. A two-person team conducted baseline fly counts on both sides of the animals two days prior to treatment and at 4, 11, 18, 25, 32, and 39 days post-treatment by adapting the digital photography method of Pruett et al.[12]

The mean fly numbers in the experimental groups were determined for each sampling date. JMP statistical software was used to statistically compare the mean fly counts among the three treatment groups for each of the sampling dates using the Tukey-Kramer test.[13] The efficacy of the two treatment methods was determined for each of the two treatment methods at each of the post-treatment sampling dates in two different ways: 1. By comparing the mean fly count on a particular post-treatment sampling date with the mean pre-treatment fly count within the same treatment group using Abbott's formula,[14] and 2. Using the Henderson and Tilton formula that takes account the mean pre-treatment and post-treatment fly counts in both the treatment groups and untreated control group.[15]

Percent control due to insecticide treatment

$$= [1 - (Ta \times Cb)/(Tb \times Ca)]*100$$

where *Tb* is the mean number of horn flies on the treated group before treatment, *Ta* is the mean number of horn flies on the treated group after treatment, *Cb* is the mean number of horn flies on the untreated control group before treatment, and *Ca* is the mean number of horn flies on the untreated control group after treatment. This formula was used because it may be more appropriate than the Abbott's formula when pretreatment fly infestations are not uniform between treatment groups.

RESULTS

Mean fly counts per animal side for the experimental groups before and after treatment are illustrated in Figure 1. The pretreatment mean number of horn flies infesting cattle comprising the group treated with the VetCap® method (510 ± 53) was significantly higher ($P<0.05$) than in the untreated group (190 ± 26), whereas the mean pretreatment fly count (372 ± 62) for the CyLence® pour-on group was not statistically different from the other two groups (Figure 1). Both insecticide treatments significantly reduced horn fly counts by day 4 post-treatment compared to untreated controls (Figure 1). Mean fly counts in the VetCap® group remained significantly lower ($P< 0.05$) than in the untreated group through day 18 post-treatment despite a spike in horn fly numbers observed in this treatment group 11 days following treatment. Cattle treated with CyLence® pour-on had the lowest fly counts between days 11 and 25 post-treatment. By day 4 post-treatment the mean fly count in the untreated group increased to 364 ± 74 then decreased steadily through the remainder of the study. On days 25 – 39, mean fly numbers in the untreated control group were equivalent to the VetCap® group,

The VetCap® treatment method afforded a level (95%) of horn fly control comparable to treatment with traditional CyLence® pour-on method (96%) at 4 days post-treatment (Figure 2A). Thereafter, efficacy was 79% by 18 days following treatment. The decline in the number of horn flies infesting the untreated group observed 25 days after treatment precluded further efficacy comparisons of the VetCap® method. Horn fly control with CyLence® pour-on was >80% for

***Figure 1**. Means and standard errors of fly numbers (per side of animal) in each of the three treatment groups (CyLence® Pour-on, VetCap® System, and untreated control) at two days prior to treatments and different days after treatments. Different letters above means at the same sampling date indicate significant difference (Tukey-Kramer test, P = 0.05)*

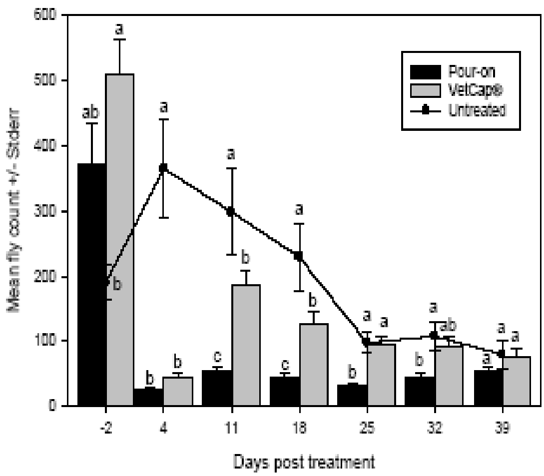
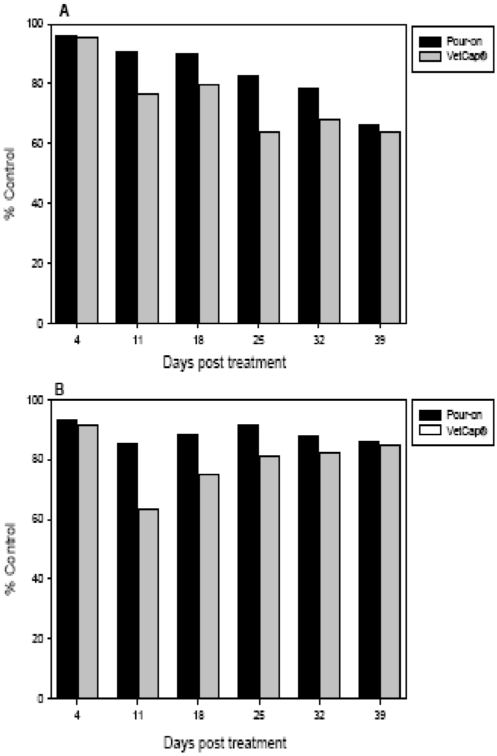


Figure 2. Horn fly control achieved with Cylence® Pour-on and VetCap® System relative to untreated control group (A), and horn fly control achieved with CyLence® Pour-on and VetCap® System relative to pre-treatment fly count in the same treatment group (B).



up to 25 days following treatment. A similar trend in horn fly control was observed when pre- and post-treatment fly counts within the treatment group were used to calculate efficacy for each treatment group (Figure 2B).

No adverse reactions or skin rupture at impact sites were noted in the animals treated with the VetCap® method. Aside from skin twitching at the site of contact with the soft gel capsules, cattle continued with their normal activity immediately after treatment. Animals did not appear to develop a negative behavioral response to repeated treatment with the VetCap® method under field conditions (Grant Weyer, personal observations). No adverse effects were observed in the CyLence® pour-on group either.

DISCUSSION

A method that avoids: 1. Unnecessary stress and danger to cattle and their handlers, 2. The need for animal containment and associated risk of injury, or 3. Direct and indirect lesions with concomitant risk for secondary infection associated with treatment would be a technological advancement in horn fly control.[11,16] The VetCap® treatment method significantly reduced the number of horn flies on cattle for up to 18 days when cows and bulls were treated with one and two of the frangible gel capsules containing CyLence® (a.i.: 1% cyfluthrin), respectively. No apparent stress or overt disruption of normal grazing / feeding behavior was caused by the treatment.

Although both the VetCap® and the pour-on treatments achieved over 95% control on day 4 post-treatment, the pour-on treatment was significantly more efficacious than the VetCap® treatment between days 11 – 32 (Figures 1 and 2). This difference in efficacy may have been due to the disparity in estimated body weights between the two treatment groups, a situation likely to be encountered by users of the technology under field conditions. The unit dosage for both treatment groups was 10 ml of the CyLence® formulation per head to allow for comparisons between the application technologies, ie, pour-on vs remote treatment. Cows in the CyLence® pour-on group had estimated body weights of 600-700 lbs. Since the CyLence® pour-on label rate for cows in this weight range is 8 ml per head, these animals were overdosed approximately 20%. Conversely, cows in the VetCap® treatment group, with estimated weights of 1,000-1,100 lbs, were under dosed approximately 17% because the label rate for these animals is 12 ml per head.

This issue could be resolved by Smart-Vet's product labeling of the commercial product that recommends a one-capsule dosage on cattle weighing between 400 lbs and 800 lbs and a two-capsule dosage for cattle over 800 lbs. Longer suppression of horn flies on cattle may have been observed with the VetCap® method if fly counts in the untreated group rebounded and the study had been extended. Additionally, results for the VetCap® method were potentially handicapped by the significantly greater pretreatment fly counts in that group, as compared to the untreated group (Figure 1).

Pyrethroid resistance is a trait evolved in horn flies in response to strong selective pressure from the indiscriminate use of products based on compounds in this chemical class.[17] The VetCap® treatment method facilitates the implementation of alternative strategies for horn fly control and resistance management like the partial herd treatment.[11,18] Where it is practically applicable, this approach could be combined with knowledge of the individual variation in infestation levels among cattle in a herd.[12,19] The VetCap® method allows for selective treatment of high horn fly carriers in a herd visually detected during treatment, potentially helping mitigate resistance selection pressure.

The compressed CO_2 launcher delivered the frangible soft gel capsule without breaking the cattle's skin. Following rupture of the gel capsule upon impact with the animal, cyfluthrin spread across the skin surface via a carrier in the CyLence® formulation left an active residue on the skin and hairs. It remains to be determined if coverage (and hence efficacy) of the VetCap® gel capsules applied to the side of an animal is equivalent to that achieved with the same insecticide applied as a pour-on along the animal's backline where horn flies tend to concentrate.

Similar to what we observed in this experiment, a previous study that used a CO_2-operated pellet pistol to remotely apply a high concentration (38%) of permethrin also demonstrated a sharp decline of horn fly population immediately after treatment.[16,20] As the paint pellets they used in their study can hold a small volume (2 ml) of insecticide, high concentration of insecticide was required to achieve substantial control. Given the concerns regarding safety and environmental impact of insecticides, such high concentrations of insecticide are no longer advisable for use on cattle. Previous work highlighted technical challenges with the pellet pistol treatment device for practical use. By comparison, the VetCap® method that SmartVet developed incorporates novel technological features in gelatin gel encapsulation and custom design of the CO_2-powered launcher, which translates into an efficiency-enhancing technology that producers could use to control horn fly infestations in cattle.

Some refinements of the VetCap® treatment method tested in this study include: 1. Balancing frangibility with minimal splattering upon impact of the gel capsules with cattle skin, 2. Reformulating to achieve sustained release, and 3. The addition of a dye to identify animals in the herd needing treatment and to determine if successful gel cap rupture occurred. These refinements are expected to enhance CyLence® gel capsules' efficacy. However, it must be noted the VetCap® method is amenable to other applications in veterinary medicine for the remote treatment of domestic animals and wildlife species. For example, South African studies showed that VetCap® applied as a ballistic bolus containing abamectin achieves 92.7% and 98.6% efficacy against adult and immature *Boophilus* spp. ticks, respectively.11 The is a urgent need to develop and implement new technologies for use by the US Cattle Fever Tick Eradication Program.[21] Testing the VetCap® method's utility to treat cattle, horses, white-tailed deer, and other exotic ungulate wildlife species found to be infested with cattle fever ticks in the US is warranted.

In conclusion, the VetCap® was demonstrated in this study as an effective treatment method for remote delivery of insecticide to control horn flies infesting cattle. Optimization of this versatile technology offers the opportunity to enhance efficiencies through diverse veterinary applications in livestock production systems.

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