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# USE OF BAIT CONTAINING TRICLABENDAZOLE TO TREAT *FASCIOLOIDES MAGNA* INFECTIONS IN FREE RANGING WHITE-TAILED DEER

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ABSTRACT: Triclabendazole-medicated corn bait was given to white-tailed deer (*Odocoileus virginianus*) on the Welder Wildlife Refuge, Sinton, Texas (USA), at a dose of 11 mg/kg body weight per deer per day for seven days, for control of *Fascioloides magna*. Medicated bait was offered for one week each during the winters of 1987, 1988, and 1989. Deer collected from treated areas, from baited control and from unbaited control areas were examined before the start of the study in 1987, and four weeks after the end of the baiting period in each of three years. Prior to the study, prevalence of fluke infection was 68%. After treatment with triclabendazole medicated corn, 13 (56%) of 23 deer collected were infected with flukes of which 15% had live parasites; this was evidence for therapeutic treatment. Of the deer collected in the baited and unbaited control areas, 63% and 80%, respectively, were infected only with live flukes. Prevalence of live flukes in deer was significantly ($P < 0.05$) lower in the treatment pasture than in the baited or unbaited control areas in each of the three years. Efficacy of the baiting system over the three years was 63% when comparing the treatment area and the baited control area.

*Key words:* *Fascioloides magna*, liver fluke, white-tailed deer, *Odocoileus virginianus*, triclabendazole, medicated bait, control.

## INTRODUCTION

*Fascioloides magna* (Bassi, 1875) is a trematode of white-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus hemionus*), elk (*Cervus elaphus*), and woodland caribou (*Rangifer tarandus caribou*) (Davis and Libke, 1971; Foreyt and Todd, 1976; Lankester and Luttich, 1988). Cattle and some other herbivores are infected as dead-end hosts. Deer present on the same pastures as domestic livestock act as reservoirs for the parasite (Bassi, 1875). In the USA liver fluke infections are the third most important parasitism of cattle resulting in substantial losses to the livestock industry (Foreyt, 1975). In Texas (USA), Foreyt and Todd (1972) reported a prevalence of 70% in deer and 38% in cattle from endemic areas. On the Welder Wildlife Refuge, Sinton, Texas, the area of the present study, 67% of male and 47% of female white-tailed deer were found infected with the parasite (Glazner and Knowlton, 1967).

Strategies to control liver flukes include chemotherapy with recently developed anthelmintics such as triclabendazole. This benzimidazole anthelmintic is highly effective against young and adult *Fasciola hepatica* in sheep (Boray et al., 1983), goats (Wolff et al., 1983), and cattle (Eckert et al., 1984). It also is highly effective against mixed infections of *F. hepatica* and *F. magna* in calves (Craig and Huey, 1984), and, against *F. magna* infections in wapiti (*Cervus elaphus nelsoni*) (Pybus et al., 1991) and white-tailed deer (Qureshi et al., 1989).

The transmission of the parasite might be controlled by treating the deer reservoir to prevent contamination of pastures shared with cattle. When done in winter, transmission potential theoretically would be lower because fewer eggs would be passed in feces. Many free-ranging deer can be treated using a suitable bait as a form of self treatment. Baiting does not require immobilization and handling of animals; thus it is less stressful for both animals and handlers. Corn is consumed readily by deer in winter, a time of nutritional stress. Thus, corn provides a suitable bait in which triclabendazole can be incorporated. Our objective was to determine whether a delivery system consisting of corn containing a calculated dose of triclabendazole would reduce the prevalence of live *F. magna* in free-ranging white-tailed deer.

## MATERIALS AND METHODS

The study was conducted on the Rob and Bessie Welder Wildlife Refuge, San Patricio County, Texas (28°6′N, 97°25′W) where white-tailed deer are abundant. Flat topography, heavy rainfall (except during a drought), soils prone to water logging and suitable temperatures of this area (Sellards et al., 1932) provide a suitable habitat for the intermediate snail host of *F. magna*, *Lymnae bulimoides*.

Three areas of uniform habitat consisting of clay and clay loam soils (Victoria clay soil), mesquite-mixed grassland or chaparral-mixed grassland were selected as treatment areas. The treatment area of 391 ha was flanked by two unbaited control areas consisting of two pastures, 144 ha to the east, and 277 ha to the west. The unbaited control area of 439 ha was located east of the baited area. The treatment area was surrounded by a predator-proof fence 1 m in height, providing a suitable area for treatment. Although a few deer did jump over the fence, most deer groups inside and outside the enclosure were maintained as separate populations.

Deer numbers on the treatment and baited control areas were estimated on the basis of aerial censuses. North-south transects 200 m apart were flown by fixed winged aircraft just before sunset, between 1630 and 1830 hr on clear days with good visibility and temperatures of 20 to 27 C. Three censuses were flown each year during the baiting period.

Observations of the number of deer at or within the vicinity of each baiting site were made by spotlight counts between 2100 and 2300 hr each night. Other animal species at the bait sites also were noted.

Deer on the Welder Refuge have small home ranges (Michael, 1963), high population density (Kie, 1977), morning and evening peaks of activity (Hood, 1971), and a mean weight of 45 kg (Knowlton et al., 1978). Deer were easily baited to corn, especially in winter, when green vegetation was not abundant.

Twenty baiting sites were established throughout the study area in a grid pattern, ten each in the treatment and baited control pastures. Corn was distributed at each bait site for an acclimation period of 3 to 4 wk before corn containing triclabendazole was used in the treatment pasture.

A three-strand barbed wire fence at least 1 m high was constructed around each bait site, enclosing an area of about 20 $m^2$. The fence was designed to keep cattle away from the bait but allowed deer to pass. The bait was placed just before nightfall to avoid use by birds and to take advantage of the evening peak of deer activity. Automated feeders (Model number MFH-1, Moultrie Feeders Inc., Alabaster, Alabama, USA) were placed at sites that were not easily accessible by road. At most sites, deer bait was placed on the ground; in the treatment pasture, bait was placed on a 1 $m^2$ plywood plank. Bait sites regularly visited by non-target species such as cattle, feral hogs (*Sus scrofa*), and raccoons (*Procyon lotor*) were discontinued.

Observations of number of deer at or near each bait site were used to determine the amount of feed needed at that site. We gave 5, 7.5, or 10 kg of corn for 1 to 5, 5 to 10, or >10 deer, respectively.

Bait containing triclabendazole (Fasinex 5%, Ciba-Geigy Corporation, Greensboro, North Carolina, USA) was prepared by mixing 500 ml of the 5% suspension (w/v) of triclabendazole with 23 kg of corn in a concrete mixer (500 mg triclabendazole in 0.5 kg of corn, the amount of corn assumed to be eaten per visit). The feed provided triclabendazole at an estimated dose of about 11 mg/kg body weight for seven consecutive days to each deer, assuming a mean deer weight of 45 kg. Medicated feed was placed at each site for a period of 1 wk to help ensure that all deer visiting the bait site ate at least 0.5 kg of corn.

Thirteen fawns and 12 adults were shot in January 1987, before the start of the baiting study. Later, six to 15 adult deer were shot from each study pasture 4 wk after the end of the baiting period. Deer were hunted from blinds and observation towers in the study area; from a vehicle driven through the study area; or, as deer became more wary, from a vehicle using a spotlight. Deer were killed by a single rifle shot in the neck.

The livers from each deer were sliced in 1 cm thick sections, placed in phosphate-buffered saline solution, and incubated at 37 C for 4 to 6 hr to stimulate the migration of young parasites. The slices were washed in tap water and the wash filtered through an 80-mesh screen to recover immature parasites.

Baiting study and post-baiting collection of adult deer was repeated in 1988 and 1989. The data were compared using a chi-square test with significance assumed at $P < 0.05$ (Ott, 1984).

## RESULTS

Populations of deer estimated during the baiting trial in 1988 and 1989 were 69 and 63, respectively, in the treatment area and 93 and 51, respectively, in the baited control area.

Baiting attracted one to 25 deer at each successful site. Unsuccessful sites consisted of two in 1987, four in 1988, and eight in 1989. Baiting was discontinued at the unsuccessful sites which were in areas of minimal deer activity. Fences were successful at keeping cattle away from the bait at all except two sites in the baited control pasture.

At the start of the study in January 1987, five of 13 fawns and all 12 adults collected had *F. magna*. After baiting in 1987, seven of eight adult deer collected from the treatment pasture were infected and six of these seven deer had dead and disintegrated flukes; this is evidence that they had been treated effectively. Thirty-six whole parasites (35 adults and one non-encapsulated parasite) were recovered from the infected deer. In the baited control pastures seven of nine deer were infected with live flukes (69 adult and six migrating). In the unbaited control pastures 11 of 15 deer were infected with live flukes (76 adults and six migrating parasites). These prevalences of live flukes between the treated area and the baited control area were significantly different ($P < 0.05$).

In 1988, four of nine deer in the treatment pasture were infected with *F. magna;* all parasites were dead and disintegrated. In the baited control area, seven of nine deer were infected; all had live parasites (including 28 adults; five migrating parasites). In the unbaited control area, eight of nine deer were infected with live parasites (90 adults; three migrating parasites). The prevalences of live flukes between the treated area and the baited control area were significantly different ($P < 0.05$).

In 1989, only eight of 18 deer were infected. In the treatment pasture, two of six deer were infected; one had live parasites (eight adults; one immature), while the other had a small cyst containing disintegrated parts of a parasite. In the baited control pasture, one of six deer collected was infected (four adults; one immature parasite). In the unbaited control five of six deer were infected (91 adults; two migrating parasites). The parasite prevalences of live flukes between the treated and baited control groups were significantly different ($P < 0.05$) for each year. There was a significant difference ($P < 0.05$) in the numbers of live flukes between the treated group and the two controls using data pooled over the three years (Table 1). Efficacy of the baiting system over the three years was 63% when comparing the treatment area and the baited control area. No difference was observed between the baited and the unbaited control groups ($P > 0.05$).

## DISCUSSION

We provide further evidence that anthelmintics may be delivered to free-ranging deer using medicated bait as demonstrated by Balbo et al. (1989) and Garris et al. (1991).

Prebaiting deer to bait sites was considered the most important prerequisite for successful delivery of medicated bait to free-ranging deer. Prebaiting attracted deer and accustomed them to consuming the corn, such that the bait was eaten within a short time after being placed at each site. This limited bait consumption by nontarget species. Placing bait over several days ensured that most deer were exposed to the bait. It is likely that dominant deer consumed more than the estimated amount of bait at each visit or through several visits to the site; however, adverse effects from the drug were not observed.

Based on the post-baiting deer collections in 1987, there was a high prevalence of the parasite in deer collected from the study site. In 1988, parasite prevalence in the treatment pasture was much lower than 1987, while prevalence in the control pastures was not different in the two years.

TABLE 1. Pre-baiting and post-baiting prevalence of *Fascioloides magna* in white-tailed deer (*Odocoileus virginianus*) collected on the Rob and Bessie Welder Wildlife Refuge, Texas, 1987 to 1989.

| Pasture | Treatment | Baited control | Unbaited control |
|---|---|---|---|
| Pre-baiting | | | |
| Number of deer sampled | 9 | 8 | 8 |
| Number of deer infected | 8 | 4 | 5 |
| Post-baiting over three years | | | |
| Number of deer sampled | 23 | 24 | 30 |
| Number of deer infected | 13 | 15 | 24 |
| Number of deer with live flukes | 2 | 15 | 24 |
| Number of flukes recovered | 45 | 108 | 262 |

In 1989, a severe drought affected the refuge, and overall parasite prevalence in both the treated and untreated deer was much lower than previous years, obscuring treatment effects. Nevertheless, chi-square analysis indicated a significant effect in the treatment area over the two control areas after the three years ($P < 0.05$). Efficacy of the treatment also was significant. We conclude that baiting deer with corn containing triclabendazole was an effective means of administering a therapeutic dose to free-ranging deer. Winter treatment would remove new and old infections preventing contamination of the pastures in spring, the peak of fluke transmission (Craig and Bell, 1978).

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