FALL BURNING OF GRASSLAND TO CONTROL

DERMACENTOR ALBIPICTUS

(PACKARD) LARVAE

By

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Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1992

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 2000

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Thesis Approved:

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PREFACE

I sincerely appreciate my major advisor, Dr. Robert W. Barker, for his supervision, guidance, and friendship. This appreciation extends to my other committee members: Dr. David M. Engle, Dr. Mark E. Payton, and Dr. Russell E. Wright, whose guidance, assistance, and friendship are also invaluable.

I am grateful to those who provided suggestions and assistance for this study: Mr. Jerry Bowman, Ms. Lisa Coburn, Mr. Don Arnold, Mr. Darryl Forest, Mr. Richard Grantham, and others who contributed to this project and deserve my appreciation.

Moreover, I especially appreciate my son, J. Paul, for his love and inspiration, my parents for their love, support, encouragement, and instruction throughout the years, and God, who makes all things possible.

Finally, I thank the Department of Entomology and Plant Pathology for the generous financial support during this study.

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INTRODUCTION

The human species is thought to have once lived in balance with nature while living in small nomadic bands of hunters and gatherers until the introduction of agricultural practices in Mesopotamia around 10,000 BC (Smith, 1995). The selection and domestication of plant and animal species valued for food, fiber, and labor provided an abundance for mankind while requiring fundamental changes in the plants and animals, the environment, and mankind's lifestyle. Modification of the environment for monoculture cropping, intensive animal production, and the concentration of human population centers shifted the natural balance of many ecosystems and provided ideal conditions for many arthropod species. The shift to agriculture resulted in a population explosion for the arthropod species adapting to thrive in the new man made ecosystem. Efforts to limit the loss of food and fiber to these arthropods continue to drive the search for control strategies (Ordish, 1976; Tauber, et al., 1986).

The use of fire to promote and protect agricultural practices predates agriculture and is one of the first tools used by early man (Sauer, 1952). Fire is recognized today as an important influence on the natural ecosystem by its involvement in the evolution of many plant and animal species. The impact fire has on the environment did not escape aboriginal man who first used it for warmth, for hunting, and for warfare. Fire quickly became an important means to increase the abundance of desirable food and forage plants, to improve animal habitat, and to control insect pests (Stewart, 1951; Barret, 1980).

The importance of fire to the environment was poorly understood and largely forgotten until recent times. The occurrence of fire in the past, both naturally and prescribed, gave way to a modern ecosystem almost free from the influence of burning. Prescribed burning was unheard of for many years while naturally occurring fires were quickly extinguished to prevent environmental destruction. Fire suppression practices have left much of Oklahoma's native lands ecologically unbalanced (Engle, et al., 1985).

The natural role of fire in many ecosystems is clearly seen in Oklahoma where indigenous plants and animals have adapted to periodic fire. Many native plant and animal species of Oklahoma depend on fire to create and maintain suitable habitat while others require fire to complete their lifecycle. Research has shown periodic fire essential to habitat maintenance for the black-capped vireo (*Vireo atricapillus* L.), red cockaded woodpecker (*Picoides borealis*), and the eastern (*Platanthera leucophaea* Nuttal) and western prairie fringed orchid (*P. praeclara* Sheviak & Bowles). All are currently endangered or threatened species in Oklahoma (Engle, et al., 1985).

Prescribed burning is an inexpensive and natural process that can restore ecosystems and landscapes to their historic diversity and productivity, while improving forage production, quality, composition, and palatability for livestock and wildlife. Fire can also be used to control non-native or undesirable plant species, plant diseases, and possibly control some animal parasites through habitat modification (Engle, et al., 1985).

Warren, et al. (1987) theorize prescribed burning can systematically manipulate certain arthropod populations on range lands much as fire is applied to meet other specific goals of range land vegetation management. To this end, the scientists proposed a cyclic prescribed burn model based on the phases of fuel development, combustion, shock, and ecosystem recovery.

Fuel development is the central phase of the prescribed burn model occurring when the ecosystem is at equilibrium having recovered from previous acute and chronic fire effects. The acute phases involve fire and the destruction it causes. The combustion phase is when the environment is burning, while the shock phase begins when the burn ends and lasts until vegetative regrowth begins. The chronic impacts of burning are felt in the final phase of ecosystem recovery. Ecosystem recovery begins with vegetative regrowth and lasts until the environment reaches equilibrium. Burning applications to control arthropod populations may be developed when arthropod responses during each phase of this model are studied (Warren, et al., 1987).

LITERATURE REVIEW

Tick Control

Overview. Prescribed burning for tick control has been studied as an alternative to the more costly chemical and biological methods which do not always provide effective control (Komerek, 1971; Hewitt, et al., 1974; Hardison, 1976). Previous burn studies produced mixed results possibly due to variations in fire intensity, season of burn, and the size of experimental plots (Warren, et al., 1987). Plant community characteristics and environmental conditions at the time of prescribed burning interact to determine the net effect to tick populations. Heat during the burn must reach an intensity and duration sufficient to kill the tick population and/or remove the vegetative cover which could protect surviving ticks from the post-burn microclimatic temperature increase and humidity decrease (Heady, 1960; Van Amburg, et al., 1981). Burn studies in south Texas found the heat generated from grass fires burning 2500-3000 kg $hectare^{-1}$ of continuous fine fuel sufficient to kill ticks (Oldham, 1983).

Area Control. Prescribed burning for area tick control reduced populations of *Amblyomma americanum* (L.) and *Ixodes scapularis* (Say) in grassland habitats (Jacobson and Hurst, 1979; Wright, 1974) of central Texas. The total reduction in tick numbers was related to the percentage of vegetation burned. Areas more totally burned had the greatest reduction of tick populations. Prescribed burning of South African grassland habitats significantly reduced the population of paralysis ticks, *Ixodes rubicundis* (Neumann), when the litter layer was consumed (Trollip, 1980). Another study resulted in fewer ticks attached to cattle from burned versus unburned grassland habitat (Phillips, 1965). It is important to note that even the most effective fires fail to entirely control ticks because some may escape the burn while still attached to a host animal. These ticks may be reintroduced through host immigration during the shock and recovery phases (Stoddard, 1946). Despite frequent host species immigration to freshly burned areas, Gulf Coast tick (*Amblyomma maculatum* Koch) populations were generally reduced for the entire growing season following burns of Texas Coastal Prairie habitats (Oldham, 1983). Population reductions were attributed to post-burn drying of the habitat due to litter layer destruction. Inactive ticks are particularly vulnerable to desiccation since they depend on the litter for moisture while sheltered near plant bases or the litter layer. Ticks remain here until stimulated to crawl to leaf tips for host questing. When questing is unsuccessful, some tick species descend to the litter layer to hydrate (Hair, et al., 1975). Ticks also use the under story of woody plants for protection against desiccation (Stacey, 1977; Fleetwood and Teel, 1983). Loss of wood cover in south Texas savanna reduced Cayenne tick (*Amblyomma cajennense* Fabricius) numbers 75% during early summer recovery following a winter burn (Oldham, 1983).

Habitat Destruction. The season of prescribed burning in relation to tick biology, the use of burned areas by hosts, and the total time the burned area is unsuitable for ticks combine to determine the long-term effects of fire. Alteration of the habitat through burning has little effect and no control value when ticks are already on a host. However, habitat burning before the larvae contact a host or in conjunction with an off-host developmental phase could reduce tick populations through habitat destruction (Daubenmire, 1968). These indirect burning effects during the shock and recovery phases are less obvious but equally important to the survival of resident tick populations. Vegetation and mulch removal causes soil temperatures, organic matter content, and air movement increases while soil water content decreases leading to a change in the soil chemistry (Daubenmire, 1968). These habitat alterations are potentially more important to tick population reduction over time than the fire itself as potential hosts seek habitat not impacted by burning. Surviving ticks would suffer from not only a disruption of their microhabitat, but also from reduced access to hosts when animals migrate from burned areas to more suitable habitat.

Benefits of Controlled Burning. Prescribed burning has the potential to manipulate arthropod populations when arthropod biology and behavior are known. Controlled burning is a beneficial management tool due to its low cost, the unlikely development of genetic resistance and positive environmental impacts. Benefits to the environment include: no pesticide residue; fossil fuels are conserved while renewable plant material is used; burning enhances range management by suppressing woody plants; and burning recycles dead and senescent plant material (Hardison, 1976). These advantages justify further study of controlled burning as an arthropod management tool. *Dermacentor albipictus* (Packard), the winter tick, is a prime candidate for controlled burn studies because its biology and behavior are well studied (Barker, pers. comm.) and because its habitat in Oklahoma benefits ecologically from periodic controlled burning.

Dermacentor albipictus Biology

Overview. In 1869, A. S. Packard described *D. albipictus* on moose (*Alces alces* L.) shipped from Nova Scotia to New York where the animals were examined in transit to Europe (Hays, 1868; Cooley, 1938). *Dermacentor albipictus* adults are dull brown in color with the females having a distinctive slick, angular shield and the males having streaks of darker brown along the back. *Dermacentor* mouthparts are short making this one-host tick easier to brush off during host animal grooming. Winter ticks typically take three separate blood meals from a single host, developing from larvae to replete females in approximately 27 days to 2 months on cattle (Howell, 1939; Bishopp and Trembley, 1945). The winter tick larvae become active in late autumn (Jacobson and Hurst, 1979) but are usually not noticed until they develop into nymphs or nymphs develop into adults due to the host animal's thick winter hair coat.

The parasitic lifecycle of this one-host tick begins with the larvae ascending vegetation and positioning on the edges of leaf blades to make contact with a host. Clusters of up to 300 larvae may gather on the ends of grasses and twigs. Larvae are remarkably tolerant of snow and cold and may remain in position until spring unless they are dislodged by windy conditions or make contact with a host (Gregson, 1956). Upon host contact, larvae attach to the host and ingest blood. Blood meal digestion and molting to the nymph stage follow engorgement while the mouthparts of the shed exoskeleton are still attached to the host. Nymphs reattach their mouthparts without leaving the host to ingest the blood meal necessary to molt to the adult stage. Females will reattach to the host and take a partial blood meal prior to fertilization by a male. Adult males require only a small blood meal to become sexually viable before seeking out and mating as many partially engorged females as possible. The fertilized females will feed to engorgement and drop to the ground to lay eggs. The eggs will hatch in the spring with the larval ticks remaining inactive until the cooler temperatures of the fall. In Oklahoma, oviposition may occur in November and December if the average ambient temperatures remain greater than 10 °C (Barker, Pers. Comm.).

Dermacentor albipictus infestations occur during the winter months when large ungulate host animals may already be under considerable environmental stress from several aspects. Metabolic stress may result from low nutritional value of winter range vegetation while additional energy is required to remain warm in low winter temperatures. Nutritional balance is further compromised in females that are gestating or lactating. Tick parasitism results in further debilitation of host animal condition. In moose, severe *D. albipictus* infestations can cause anemia (Glines and Samuel, 1984), premature loss of winter hair (Samuel and Barker, 1979), and depletion of pericardial and abdominal fat reserves (McLaughlin and Addison, 1986). Pregnant and lactating Brangus-cross cows wintering in central Texas were found to have reduced body weight and milk yield while suffering winter tick parasitism (Teel, et al., 1990). Cows suffering excessive body weight loss may be unable to breed the following season due to poor physical condition.

History in Oklahoma. *Dermacentor albipictus* is common in Oklahoma where the larvae become active in late September. The K. C. Emerson Entomology Museum collection at Oklahoma State University (OSU), Stillwater, Oklahoma, contains specimens of this tick collected from 21 of Oklahoma's 77 counties as depicted in Table 1. The collection consists primarily of adult females with some larvae, nymphs, and adult males. The principle hosts are large ungulates including cattle, horses, deer, and elk which is consistent with the literature (Table 1) (Howell, 1939; Welch, et al., 1991). Specimens were collected from November through April with the exception of July 1931. Larval activity in July is unusual for this species in Oklahoma and suggests that the larvae can over winter off host and remain viable well into May. *Dermacentor albipictus* larvae ascend to the grass tips in the fall, and remain there throughout the winter if not picked up by a host according to studies in Canada (Wilkinson, 1967). This was confirmed in central Oklahoma through Barker's (Pers. Comm.) observation of *D. albipictus* larvae questing in mid April (Figure 1). The current Oklahoma distributions map shows *D. albipictus* positively identified in 34 counties (Map 1).

Vector Potential. *Dermacentor albipictus* does not produce paralysis, although Wallace, et al., (1933) implicate it as the vector of various pathogenic organisms affecting big game (Gregson, 1956). *Dermacentor albipictus* is a vector of *Anaplasma marginale* (Theiler) and is responsible for a winter outbreak of Anaplasmosis in a Texas cattle herd (Teel, et al., 1990). Winter tick larvae are infected through feeding on infected asymptotic animals. The infected larvae molt into infected nymphs on the host, which in turn, molt into infected adults. The infected males spread the *A. marginale* when feeding on a susceptible host after dislodgment from the original host (Stiller, et al., 1981). *Dermacentor albipictus* is not considered a major vector of this disease due to its one-host lifecycle. However, *D. albipictus* may play a larger role in areas where the disease is endemic or in areas where host animal populations are concentrated in small areas. In addition, *Borrelia burgdorferi*, the causative agent of Lyme disease, has been isolated from *D. albipictus* ticks collected from white tailed deer (*Olocoileus virginianus*

Zimmermann) in Oklahoma (Kocan, et al., 1992). However, *D. albipictus* is not considered a vector of Lyme disease to any host.

Winter Tick Control. Control of tick populations has traditionally centered on pesticide application. Winter tick control is no exception, with several chemical control techniques used. One control method involves thorough herd treatment through dipping or spraying once per year just after the larval ticks have made contact with a host. Properly done, virtually all attached ticks can be eliminated until the following year (Portman, 1949). The draw back, however, is herd spraying does not control larvae failing to make host contact prior to spraying or larvae living on untreated native wild ungulates. Area control is a method that addresses these problems by reducing tick populations through pesticide treatment of the host's environment. Both area and herd treatment control methods are limiting to producers through high pesticide costs, the potential development of resistance to acaracides, and through concerns over environmental pollution.

Prescribed burning for area control has been effective in reducing tick populations. Researchers found engorged *D. albipictus* female survival and productivity reduced through a spring burn of wild habitat in Alberta, Canada on May 12, 1982 (Drew and Samuel, 1985). It was estimated that 97% of the engorged females perished in the burn, based on recovered females and low variable numbers of larvae recovered from six of the eight release sites that autumn from October 4 through November 1, 1982. These data indicate that the burn was effective in reducing tick numbers, but not in eliminating them from the areas. It is important to note that the survival of engorged females was highest in the dense canopy areas where the burn was incomplete (Drew and Samuel, 1985).

The Alberta study objective was to control replete females in wooded habitat and did not target the more vulnerable period in *D. albipictus'* lifecycle which is prior to host contact while the larvae are located on vegetation. A fall season burn, while the larvae are awaiting host contact, would probably be effective in controlling *D. albipictus* populations. Larvae do not voluntarily descend the vegetation once they are positioned on the leaf blades to await contact (Drew and Samuel, 1985). Windy conditions can dislodge larvae from the grass forcing larvae to re-ascend vegetation down wind from the previous questing site (Barker, Pers. Comm.). This behavior should make *D. albipictus* susceptible to a hot, fast fire between early September and early October (Drew, 1984).

Objectives.

First Study:

Primary: Determine if a backfire will control *D. albipictus* larvae in a grassland habitat.

Secondary: Evaluate the oviposition rate under laboratory and field conditions to determine the potential population of *D. albipictus* larvae hatching in the research plots.

Second Study:

Primary: Compare and contrast a headfire and backfire to control *D. albipictus* larvae in a grassland habitat.

Secondary: Determine the average egg counts per gram of egg mass to estimate the potential population of *D. albipictus* larvae introduced into the research plots.

MATERIALS AND METHODS

First Study: Evaluation of a Backfire

Laboratory Colony. *Dermacentor albipictus* females were collected from the Animal Science herd in Pasture #86 near Lake Carl Blackwell, 15 km west of Stillwater from November 28 to December 8, 1994. Mouth part length (Gregson, 1956) was used to identify and confirm the ticks as *Dermacentor* versus Oklahoma's other cool season active tick, *Ixodes scapularis* (Appendix A). The *D. albipictus* ticks were weighed and divided into ten groups based on collection date, mass, and overall appearance. All ticks were housed in a Sherer® growth chamber with 75 to 85% humidity, 24.5 ± 2.5 °C, and 6:18 (L: D). Eggs from these females were used to maintain a laboratory colony throughout this study.

Oviposition Study. Tick specimens collected on December 8, 20, and 21 were divided into treatment and control groups using a random number table. The ticks were collected and maintained in the growth chamber with less than 24 hours variation between each specimen, except for the tick collected on December 8, which was randomly added to make the two groups equal in number. Ticks were individually placed in sleeves constructed from plastic screen wire. Sleeves were approximately 7 cm in length and 2 cm in diameter with Hot Glue® thermal adhesive sealing each end. Sleeves were identified by a distinctive number printed on fluorescent survey ribbon affixed to one end of the sleeve. All ticks were housed in a Sherer® growth chamber with 75 to 85% humidity, 24.5 ± 2.5 °C, and 6:18 (L:D) until the field group was moved to Pasture #15 on December 23. The field group was located in an adjacent research plot to the simultaneous fall season burn study. All sleeves were placed in the soil duff layer for protection within the same 2 m^2 area. Environmental conditions were monitored using a Serdex® Bacharach 7-Day Hydrothermograph Model #22-7078. (Appendix B)

Controlled Burn Study. Twenty-one 0.026 hectare (16 m x 16 m) and two 0.154 hectare (48 m x 32 m) research plots were established in Pasture #15, approximately 6.5 km west of Stillwater, Oklahoma (Figure 2 - 4) during November 1994. Pasture #15 consists of 170 hectares (420 acres) of wooded prairie habitat with grassland suitable for livestock grazing with wildlife cover in the more shrubby areas. Pasture #15 is similar to the study area burned by Engle, et al. (1990) which was dominated by big bluestem (*Andropogon gerardii* Vitman), little bluestem (*Schizachyrium scoparium* Michx.), switchgrass (*Panicum virgatum* L.), and indiangrass [*Sorghastrum nutans* (L.) Nash].

A Caterpillar® D7E bulldozer with a 4 m blade graded all vegetation and soil, resulting in a 16 m fire break around each plot. The two large plots were both fenced with livestock panels and t-posts. A random number table was used to assign each plot to treatment or control (Figure 5). Ticks not used in the oviposition study were divided into twenty 3.0 ± 0.10 g and two 9.0 ± 0.10 g groups. These groups were randomly assigned to treatment or control plots and moved to arenas in each plot (Appendix C). Arenas in the 0.026 h plots were constructed of #10 tin cans cut in half with both end caps removed. Arenas for the 0.154 h plots were constructed of galvanized sheet metal with an inside diameter of 0.33 m and an outside height of 30 cm. Each research plot was divided into 8 m^2 zones using survey stakes with 25 zones in the twenty 0.026 h plots labeled 1-20 (Figure 4) and 150 zones in the two 0.154 h plots labeled 21 and 22 (Figure 3). Environmental conditions were monitored each week using a Yellow Springs Instrument

Company Tele-Thermometer® with a 6-channel probe system for temperature readings at the soil surface and at 1 m above ground. Precipitation measurements were taken with rainfall gauges located within the study area (Appendix B). Environmental data were collected and averaged from four sites within Pasture #15 for comparison to Mesonet data for the same period to validate the reliability of Mesonet data for future research projects in Pasture #15 (Appendix D).

The tentative burn day was September 30, 1995, with plans to burn eleven treatment plots. However, *D. albipictus* larvae were not observed in the research plots. On November 3, the larvae from 450 engorged females from the laboratory colony were placed in five of the 0.026 h burn plots, five of the 0.026 h control plots, and both of the 0.154 h plots. Twenty-five (25) larval masses were introduced into the 0.026 h plots with 100 larval masses introduced into the 0.154 h plots. Egg masses were placed near the previous randomly assigned zones of the released adult females. Scheduled burning occurred on November 8, 1995, after observing *D. albipictus* larvae in each plot. A backfire technique was used in each plot to provide a slow, hot fire. Rate of spread ($m\ s^{-1}$) was measured with a stopwatch (Britton et al., 1977) to time combustion of the vegetation between two metal rods placed five meters apart aligned with the fire line. Fire line intensity (Byram, 1959) was computed as the product of the fuel low heat of combustion ($kJ\ kg^{-1}$), the weight of the fuel consumed ($kJ\ m^{-2}$), and rate of spread. High heat of combustion was the average value (15,830 kJ kg-1) from Bidwell and Engle (1991) for similar tallgrass prairie fuels, adjusted for moisture content of the fuel. Heat per unit are (kJ kg-2) was calculated from fire line intensity and rate of spread as described by Rothermel and Deeming (1980). Fuel load was estimated by weighing clipped herbaceous material from 4 quadrats (0.5 by 0.5 m) collected from adjacent unburned plots. Fuel moisture, expressed on a dry weight basis, was determined after samples were oven dried at 70 °C for 72 hours. Ambient air temperatures and relative humidity were measured with a sling psychrometer. Wind speed at 2 m above the soil surface was measured with a totalizing anemometer (Engle, et al., 1993; Bidwell and Engle, 1992).

Post-Burn Tick Sampling. Each research plot was visually inspected for the presence of *D. albipictus* larvae. Carbon dioxide (CO_2) traps were set up near known larval release points to attract surviving larvae in the five 0.026 h burn plots on November 10 and 13, 1995. The CO_2 traps were constructed of dry ice wafers (10 cm x 7 cm x 3 cm) placed on 0.25 m^2 foam pads. Visual trapping with masking tape was conducted in the control plots on November 13 and 20.

A weaned steer from the Animal Science Research herd was introduced to each 0.154 h plot on December 1, 1995 for use as sentinel animals. Animal Science personnel who provided the calves did not report seeing any ticks nor were any found by hand. The calves were moved to adjacent individual 5 m^2 pens with wind and rain protection provided on the north west corner using 3 sheets of plywood. Each pen was located on the bare soil within the fire break requiring each calf to be fed an ad libidum ration of hay, range cubes, and water. Engorged females were collected off the ground until January 5, 1996, when ticks were no longer detectable. The animals were subsequently run through a squeeze shoot for a second inspection by hand. No other ticks were found.

Second Study: Comparison of a Backfire and Headfire

Laboratory Colony. The third generation (F3) of larvae from the Lake Carl Blackwell colony collected during the fall of 1994 were used for this study. A 136 kg Hereford heifer was stanchioned in the Medical Veterinary Entomology Laboratory (MVEL) 1 under climate controlled conditions of approximately 25 °C. The calf was fed ad libidum a ration consisting of prairie hay, baby beef ration, and water similar to the ration previously described. Larvae from ten females were released along the back line of this heifer on August 19, 1996. Larvae were not confined to feeding cells and were able to migrate resulting in a total body infestation. Replete females were collected from September 13 through 17 with fewer females observed over the next ten days. One hundred ticks were selected from the September 15 collection for use in the comparison of a headfire and a backfire to control *D. albipictus* larvae and the oviposition study (Appendix E). These ticks were combined, placed in individual plastic cups, and housed in a Sherer® growth chamber with 75 to 85% humidity, 24.5 ± 2.5 °C, and 6:18 (L:D) until oviposition occurred. Surviving ticks were randomly divided into 8 groups, six for the burn study and two for the oviposition study.

The growth and development of these ticks was delayed due to photoperiod system malfunction resulting in 0:24 (L:D) interrupted when the chamber door was opened to examine the ticks. Ticks were subsequently exposed to natural and artificial light and ambient conditions of 72 ± 5 °C with 70 to 75% RH while sitting in the laboratory during the day. Ticks were returned to the growth chamber at night.

Egg Mass Study. Five egg masses were selected for the egg mass study from the ovipositing females. An egg sample from each of the five egg masses was weighed with each egg counted using a vacuum apparatus. These data was used to obtain the average weight of a *D. albipictus* egg for this study.

Controlled Burn Study. A tentative burn date was scheduled for October 8, 1996. Each plot was fenced with livestock panels and t-posts as previously described. Egg masses from 36 females were hatched with the larvae subsequently introduced to the research plots on November 15, 1996. Larvae were randomly dispersed using the previous arena sites in the six plots not burned in 1996 as depicted in Figure 5 (Appendix F). Burning was conducted on November 18, 1996, after observing larvae ascending vegetation in one research plot. Pre-burn and post-burn vegetative samples and fire intensity data were collected as previously described for the 1995 study. Six Hereford Angus crossbred steers were obtained from the Animal Science herd to serve as sentinel animals. Ticks were not found on any of the calves using visual and physical observation techniques. A calf was released in each research plot on November 19, 1996 and allowed to roam freely. Each calf was fed a ration of hay, range cubes, and water ad libidum. Calves were exposed to potential tick populations until they were moved to stanchions on November 22, 1996. Treatment calves were housed in the Medical Veterinary Entomology Laboratory 1 while control calves were housed in the Medical Veterinary Entomology Laboratory 2. Calves were fed ad libidum a ration consisting of baby beef ration, prairie hay, and water as previously described.

Post-Burn Tick Sampling. Sentinel animals were examined daily in conjunction with routine care to include feeding and cleaning of the facility. Visual scouting and trapping was conducted on January 22 and 23, 1997 for *D. albipictus* larvae. Carbon dioxide and visual trapping was conducted on February 4 and 10. The CO_2 traps consisted of dry ice wafers sawed to dimensions (7 cm x 10 cm x 3 cm) and placed on 1 m^2 white 50% cotton and 50% polyester cloth material (Grothaus, et al., 1976). These traps were located at each known larval release point. This was followed by collection of all organic matter within 1 m^2 of the release points on February 12. A flexible 1.2 cm plastic pipe, approximately 3.6 m long, fashioned into a round hoop with an area of 1 m^2 was used to mark the area around each release point for sampling. The control and treatment samples were placed in Berleze funnels until dry to separate live tick larvae from the samples.

Statistics. The response variable was the logarithm of the tick count. The treatments were "burn" and "control". T-test using the SAS (1985) PROC TTEST was performed for each collection day of the study. Since day 4 had an equal representation of carbon dioxide and visual sampling techniques, day 4 data were examined using analysis of variance methods with SAS PROC MIXED with sampling technique as a blocking variable. Another analytical approach was categorizing the count observed as either "ticks present" or "ticks absent". The relationship of this categorical response to treatment was examined with the use of Fisher's Exact Test in SAS PROC FREQ. Finally, the effect of treatment was examined by ignoring "day" and utilizing all data in a t-test.

RESULTS

First Study: Evaluation of a Backfire

Laboratory Colony. Three-hundred-fifty-three (353) replete *D. albipictus* females were collected over an eleven day period from the Animal Science herd with a mean weight of 0.29 ± 0.004 g. Eleven wild *I. scapularis* females were collected from the native population.

Oviposition Study. The goal of the oviposition study in 1995 was to compare the development of *D. albipictus* females in the laboratory with the development of this species under field conditions. The average replete female weight used in the 1995 oviposition study was 0.60 ± 0.01 g. The laboratory group of replete females had a total weight of 14.91 g with an average weight of 0.60 ± 0.017 g. The total number of eggs produced by ticks held in the laboratory was 52,800 averaging 3,542 ± 147 eggs per gram of body weight. The field group of replete females had a total weight of 15.16 g and an average weight of 0.61 ± 0.012 g. Only six field group ticks survived to oviposite with only five of them recovered for an egg count in the laboratory. The total egg production of the five ticks was 6,047 averaging 2,020 ± 169 eggs per gram of replete body weight. Only 1,299 or 21% of the eggs hatched under laboratory conditions. Nineteen of the field group perished or were possibly lost to predators during the study (Appendix G). There were teeth like marks on the empty enclosures suggesting rodent predation. A comparison of the laboratory and field oviposition rates shown in Figure 6. Estimated egg production for the average laboratory tick (0.29 g) is 1,027 eggs. Projections indicate approximately 10,095 larvae were released in each small plot with approximately 30,284 larvae released in each of the large plots.

Controlled Burn Study. The backfire conducted on November 8, 1995 was a slow, hot fire. The average ambient relative humidity was 37.4 ± 1.54 % with an average wet bulb of 44 ± 1.87. The average ambient temperature was 10.11 ± 1.40 °C with winds of 2 to 7 km/h from the northeast. The pre-burn vegetation had an average wet weight of 318.2 ± 25.15 g and an average dry weight of 255.2 ± 19.58 g for an average fuel moisture of 24.4 ± 0.91 %. The average post burn residue was 29.5 ± 3.49 g. Conditions yielded an average rate of spread (ROS) of 0.03 ± 0.006 m/s, an average fire line intensity (I) of 432.8 ± 59.07 kW/m, and an average heat per unit of area (HA) of 13,566.2 ± 1,119.42 kJ/ha (Table 4 and 5).

Post-Burn Sampling. Ticks were not recovered in the small treatment (burn) plots using visual or CO_2 trapping techniques on November 10 and 13, 1995. However, visual trapping in the small control plots on November 13 and 20 yielded 8,990 *D. albipictus* larvae around the release points (Table 2). Carbon dioxide trapping was not conducted in the control plots due to *D. albipictus*' behavior of not descending vegetation upon ascension for questing (Drew and Samuel, 1985; Patrick and Hair, 1975). However, carbon dioxide trapping was conducted in the control plots during the second study. Sentinel detection of replete female *D. albipictus* ticks in the large plots yielded 112 ticks from the burn plot and 366 ticks from the control plot (Figure 9) and (Appendix H).

Second Study: Comparison of a Backfire and Headfire

Laboratory Colony. Approximately 486 replete *D. albipictus* females were collected from the stanchioned heifer during fifteen collection days. One hundred ticks collected on September 15 were selected for the oviposition study and simultaneous comparison of the effectiveness of a headfire versus a backfire to control *D. albipictus* larvae. The average weight of replete females selected for the second phase of this study was 0.43 ± 0.0069 g. Twenty-three of the 100 females died before oviposition. Forty-one oviposited within six weeks, and the remaining 36 oviposited after an additional four weeks.

Egg Mass Study. The total weight of the five egg mass samples was 0.87 g with an average mass of 0.17 ± 0.01 g. The total number of eggs was 8,899 with an average of 10.4 ± 1.24 eggs/mg of egg mass (Table 3). The total weight of replete females selected to provide larvae for the field plots was 15.15 g with an average weight of 0.42 ± 0.014 g. The total mass of the egg masses produced among them was 7.81 g with an average weight of 0.22 ± 0.015 g. The estimated number of eggs produced from the 36 females is 81,273 (Table 3).

Controlled Burn Study. The headfire and backfire burns were conducted on November 18, 1996, to compare the two techniques. The average relative humidity was 46.75 ± 1.80 % with an average wet bulb of 48 ± 0.71. The average temperature was 14.44 ± 0.45 °C with strong variable winds from the northeast. The vegetation had an average wet weight of 430.31 ± 41.66 g and an average dry weight of 272.43 ± 21.73 g for an average fuel moisture of 56.32 ± 6.09 %. The average post burn residue was 23.15 ± 3.41 g in the headfire plots and 19.53 ± 1.45 g in the backfire plots. These conditions yielded an average rate of spread of 0.032 ± 0.011 m/s for the headfires and 0.030 ± 0.002 m/s for the backfires; an average fire-line intensity of 1217.5 ± 192.5 kW/ha for the headfire and 854 ± 104 kW/ha for the backfire; and an average heat per unit area of 41,187 ± 7,623 kJ/ha for the headfire and 28,845 ± 2,059 kJ/ha for the backfire.

Post-Burn Sampling. Ticks were not detected visually in any plots immediately after the burn nor were any ticks detected on the sentinel animals after 58 days. A second visual inspection of the control plots on January 22, 1997 yielded ten larvae from the control plots. Subsequent visual trapping on January 23 and February 4 and 10 resulted in another 624 larvae from the control plots and none from the treatment plots. Carbon dioxide traps yielded no ticks in the treatment plots on February 4. Traps were not used in the control plots. Carbon dioxide trapping was repeated on February 10 in each plot with 404 larvae found in the control plots with no ticks found in the treatment plots. All organic matter within 1 m^2 of each known release point was collected on February 12, for separation in a Berleze funnel. This procedure yielded 153 tick larvae from control plot #2 and 31 tick larvae from control plot #5. No larvae were found in the four treatment plots (Table 2).

Statistics. The Satterthwaite t-tests performed on the tick count for each collection day and the sum of all collection days is show below:

Day	DF	t Value	Pr > [t]
1	1	- 3.00	0.2048
2	3	- 2.32	0.1032
3	1	- 8.10	0.0782
4	3	- 6.24	0.0083
5	1	- 5.41	0.1163
Sum	13	- 7.32	< .0001

The t-test analysis performed on environmental and fire behavior data for the two burns is shown below:

Variable	DF	t Value	Pr > [t]
Wet Weight	2	0.49	0.6721
Dry Weight	1	- 0.72	0.6011
Moisture	2	5.17	0.0354
Post-Burn Residue	2	0.83	0.4949
Rate of Spread	2	- 0.10	0.9298
Fireline Intensity	2	- 1.66	0.2740

The contingency table of tick count by treatment is shown below:

Category	Burned	Control	Total
No Ticks	28	1	29
Ticks	0	13	13
Total	28	14	42

The Fisher's Exact Test calculated the probability the difference between "burn" and "control" is not due to the treatment as 5.486×10^{-10}.

DISCUSSION

First Study: Evaluation of a Backfire

Laboratory Colony. The initial collection of replete *Dermacentor albipictus* females from the Animal Science herd shows the potential impact this tick has on cattle production in this area. Collection ended with 353 *D. albipictus* specimens thought to be adequate to support this research project. Further collection over a longer period of time would provide a more complete picture of the total *D. albipictus* population on this herd.

Oviposition Study. The goal of the 1995 oviposition study was to compare the development of *D. albipictus* females in the laboratory with those developing under field conditions. Tick specimens for this study were collected within 24 hours of each other to minimize the amount of handling before beginning the study. A tick collected on December 8 was added to make the two groups equal in number to further minimize variation between treatment and control groups. A need to easily recover female ticks in the field necessitated using containment sleeves previously described in Materials and Methods. Loss rates of the field group were high due in part to sleeve design. Plastic screen wire afforded little protection against gnawing rodents while the design did not afford adequate protection from climactic extremes. Sleeves were positioned in the duff layer with organic matter and vegetation for cover. However, ticks were not able to burrow deeper into the duff layer for shelter against severe temperature changes. These factors may account for the high mortality and lower oviposition and hatch rates among the field group. Sleeves constructed of metal screen wire would reduce rodent predation problems while burying the sleeves approximately 3 cm under the duff layer would help insulate the ticks from the changing environmental conditions.

The average of 3,542 ± 147 eggs/gram of replete body weight is 2 to 3 times less than the average data presented by Drew and Samuel (1986) for eight studies correlating total egg production to engorged female weight. This difference cannot be explained by environmental conditions alone since the temperature and RH settings were average. Photoperiod exposure was variable and could contribute to this difference. The affect of photoperiod on *D. albipictus* oviposition warrants further study.

Controlled Burn Study. The number of eggs produced is strongly correlated to engorged female weight (Wright, 1969a). A low variation in larval numbers between each plot was achieved by introducing 3.0 ± 0.1 g of replete ticks per plot. This technique was unsuccessful due to the high mortality of these ticks. The population perished between the over-wintering adult stage and mid-summer larval period according to pre-burn scouting data. No larvae were observed in any of the research plots. Over-wintering was considered a strong point in the study since it is a vital part of *D. albipictus* biology. However, the arenas are not natural and may have restricted tick migration to suitable shelter from average temperature extremes ranging from winter lows of 2 °C and summer highs of 38 °C. A simplified approach of introducing larvae from the laboratory prior to the burn proved more effective in assessing *D. albipictus* response to burning. However, research including over-wintering is necessary to build a representative model of how *D. albipictus* responds to various environmental stresses.

The backfire, conducted on November 8, 1995, reduced *D. albipictus* larval populations according to sentinel animal sampling. *Dermacentor albipictus* larvae ascend to the tips of native plants, which is natural questing behavior. Larvae were observed having two behavioral responses to approaching fire. Some ticks became excited and hyperactive as heat radiated toward them while the wind subsided, no longer moving the heat away from the ticks. The more common response, however, was simply continued questing with no apparent response to the heat. Backfires burn into the wind with heat blown away from the ticks until they are consumed.

Post-Burn Tick Sampling. Visual and CO_2 trapping of ticks in the burn plots did not yield any larvae with the population thought to be below levels detectable by these two techniques. The recovery of larvae in the burn plot using a sentinel animal validates the assumption that tick numbers were below detectable levels using visual and CO_2 trapping. However, CO_2 trapping was not conducted in the control plots for comparison since *D. albipictus* larval behavior of not descending vegetation after ascension is well documented (Drew and Samuel, 1985; Patrick and Hair, 1975). Larvae ascend the vegetation and remain there until encountering a host or being dislodged and relocated by the wind. Plans to compare a headfire and backfire during 1996 provided an important opportunity to evaluate the efficacy of CO_2 for attracting *D. albipictus* larvae in the treatment and control plots.

The construction of sentinel animal pens similar to those used by Barker, et al. (1990) in the firebreak between the plots proved convenient in terms of a smooth dirt floor, void of vegetation. This convenience was off set somewhat by the difficulties of finding engorged females in the mud. The engorged females sank to the bottom of the mud puddles and were not recoverable until the ground dried up. This is clearly indicated in Figure 9 where no ticks were recovered over two or three days with several to a dozen found on one day. This explains the two peaks in the data plot in Figure 9 that are separated by time and seasonal precipitation.

Second Study: Comparison of a Backfire and Headfire

Laboratory Colony. Rearing *D. albipictus* ticks on a stanchioned heifer calf is similar to the techniques used by Drummond, et al. (1971). The open body release is favored because it allows a total body infestation avoiding the localized irritation associated with feeding cells. Feeding cells require host animal preparation for proper adhesion and are subject to grooming damage from the host. Feeding cells, however, greatly ease tick collection compared to the open body release.

Malfunction of the growth chamber's photoperiod system may have affected the oviposition rate of the ticks in this study. *Dermacentor albipictus* larvae are sensitive to light changes and diapause according to photoperiod (Wright, 1969a) although the affect on oviposition has not been reported. Photoperiod regulates oviposition in the tropical horse tick, *Anocentor nitens* Neumann (Wright, 1969b), and the Gulf Coast tick, *Amblyomma maculatum* Koch (Wright, 1971a) and may play a role in winter tick oviposition (Wright, 1971b).

Egg Mass Study. The correlation between the number of eggs laid by a female tick and her engorged weight is well documented for *D. albipictus* (Drummond, et al., 1969; Addison and Smith, 1981; Glines, 1983; Drew 1984; Drew and Samuel, 1986). The average number of eggs per gram of engorged weight is 7,730.625 ± 423.4077 for these studies (Drew and Samuel, 1986). This number cannot be compared to the 10.4 ± 1.24 eggs/mg of egg mass weight determined through this study. The weight of an individual egg and the number of eggs per gram of engorged female weight were not measured. These data should be collected in future studies if only for comparison with previous studies.

Controlled Burn Study. The headfires and backfires conducted on November 18, 1996 were designed to compare the two techniques while providing minimal replicates to apply statistical analysis techniques. Ticks were not detected visually after the burn nor were they detected on the six sentinel animals housed on concrete. The absence of ticks on treatment and control sentinel animals was due in part to a larval behavioral response to extreme climatological conditions after their release into the plots. Larvae were reared under laboratory temperatures of 24.5 ± 2 °C similar to Drummond, et al. (1969) and were released under similarly mild conditions. However, severe thunderstorms began approximately 12 hours after the release and continued intermittently for approximately 36 hours. The larval questing behavior was delayed at least seven days due to the thunderstorms compared to the 24 to 72 hours from release to questing the previous season. The larvae were not questing while the sentinel animals were in the plots. This theory is supported by larvae recovered during a second visual inspection following sentinel animal sampling.

Controlled burning will normally be conducted in Oklahoma to achieve range management goals with a reduction in *D. albipictus* numbers as a secondary benefit. However, in areas where *D. albipictus* severely impacts wild and domestic animals, burning may be applied as a low cost area control technique. More study is needed to determine if burning throughout the year will reduce *D. albipictus* numbers, and to determine if fire or habitat modification plays the greater role in reducing *D. albipictus* populations.

Post-Burn Tick Sampling. Carbon dioxide trapping was conducted in each plot with no larvae recovered in the burn plots with some larvae recovered from the control plots. Larvae collected in the control plots may have been wind displaced since they were recovered from the bottom of the ground cloth. Larvae were primarily on the bottom side of the white fabric sheets with few collected from the top. This supports the literature description of *D. albipictus* behavior of not descending the vegetation upon questing (Drew and Samuel, 1985; Patrick and Hair, 1975). The collection of vegetative matter within 1 m^2 of the larval release sights for Berleze funnel separation yielded larvae from the control plots with none detected in the treatment plots. Specimens may have perished in the treatment plots due to habitat modification by the burning.

Statistics. The differences between study data are not statistically significant but do exist. Differences would be significant with larger sampling size similar to the sum of all ticks collected over all collection days being significant while the ticks collected on the individual collection days were not.

Fisher's Exact Test is an appropriate method for contingency tables where the assumptions needed to do a Chi-square test are violated. If this test is significant, then the presence or absence of ticks in the plots is related to the application of burning. The result of Fisher's Exact Test was 5.486×10^{-10}, which is highly significant.

Raw data from the sentinel animal sampling indicates burning reduces larval numbers. The control sentinel animal yielded 366 replete females compared to the 112 replete females on the treatment calf. These numbers suggest a 70% decrease from this single control and treatment observation.

Future studies should focus on burning large tracts of grassland with larval ticks dispersed throughout the study area. The use of Berleze sampling will allow a greater number of observations than the more laborious and time sensitive visual, carbon dioxide, or sentinel techniques. Insuring the same sampling techniques are used in each treatment over multiple years will provide more data for statistical analysis.

Percent moisture was significant (Pr > [t] = 0.0354) with no other significant differences in the environmental and fire behavior data. The similar environmental conditions during the two burns as well as the small research plot size possibly minimized the difference between these variables.

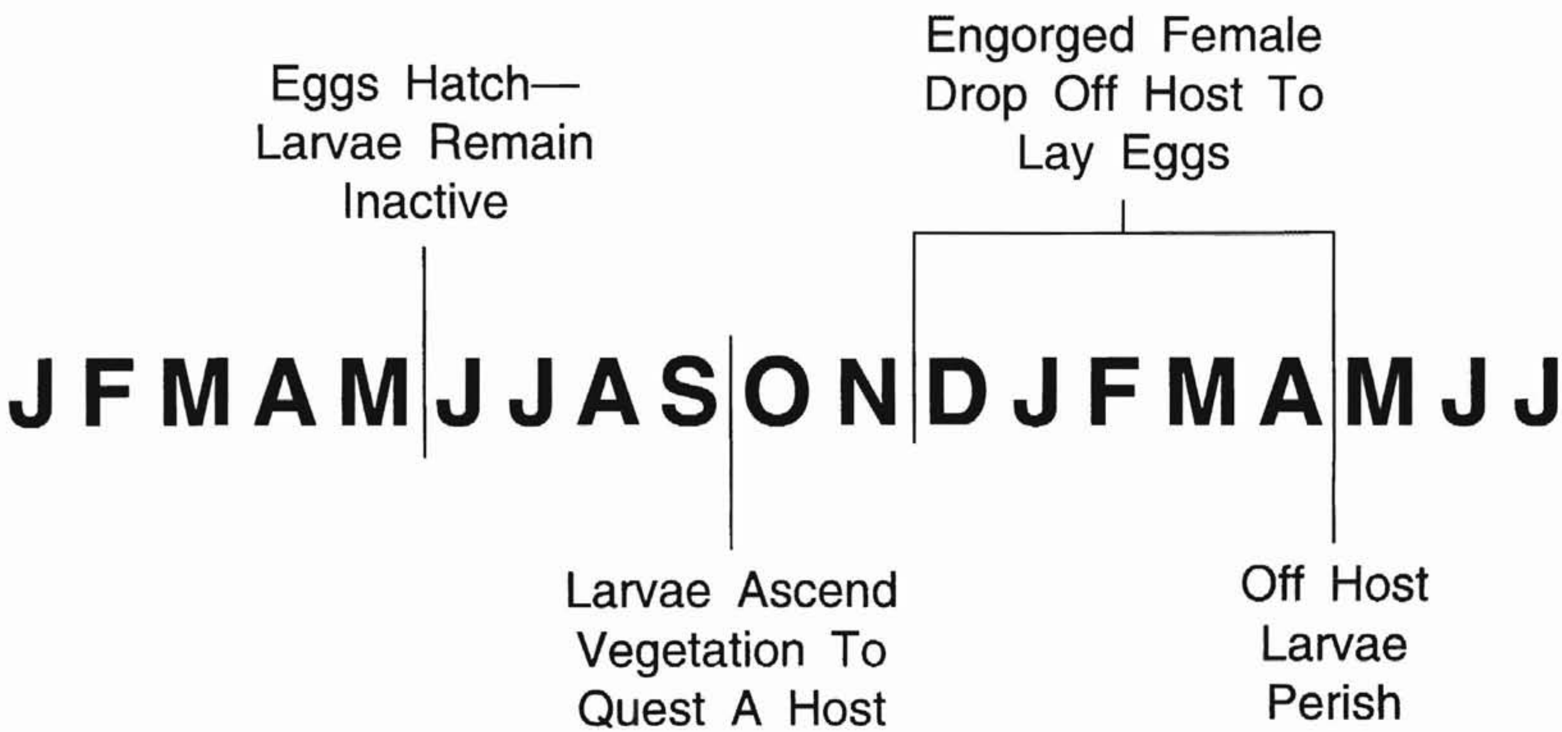


FIGURE 1. Seasonal Activity of *Dermacentor albipictus* in Oklahoma. The first letter of each calendar month depicts the timeline.

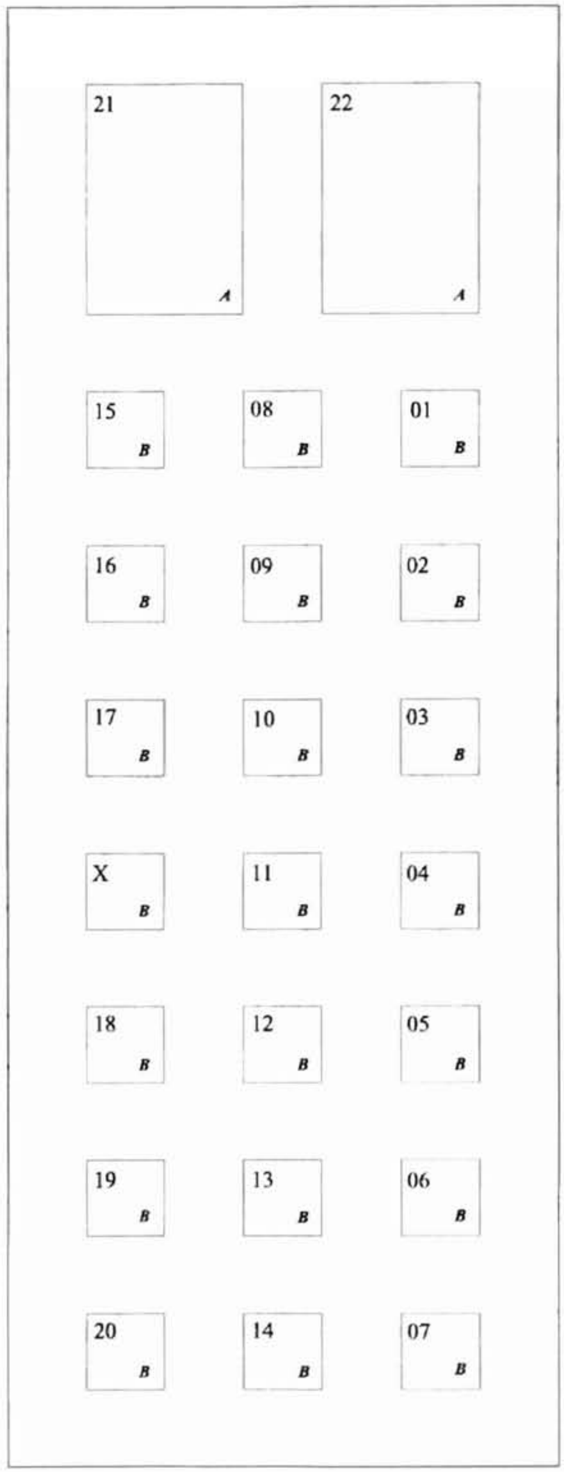


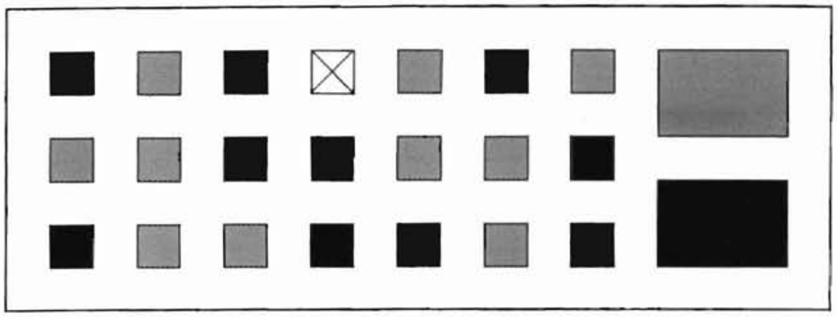
FIGURE 2. General Plot Layout, Pasture #15, Payne County, Oklahoma, 1994-1997 depicting twenty-one 0.026 hectare (h) plots and two 0.154 h plots. The "x" denotes the simultaneous oviposition study plot. The "A" denotes an exploded view in Figure 2. The "B" denotes an exploded view in Figure 3.

136	121	106	91	76	61	46	31	16	01
137	122	107	92	77	62	47	32	17	02
138	123	108	93	78	63	48	33	18	03
139	124	109	94	79	64	49	34	19	04
140	125	110	95	80	65	50	35	20	05
141	126	111	96	81	66	51	36	21	06
142	127	112	97	82	67	52	37	22	07
143	128	113	98	83	68	53	38	23	08
144	129	114	99	84	69	54	39	24	09
145	130	115	100	85	70	55	40	25	10
146	131	116	101	86	71	56	41	26	11
147	132	117	102	87	72	57	42	27	12
148	133	118	103	88	73	58	43	28	13
149	134	119	104	89	74	59	44	29	14
150	135	120	105	90	75	60	45	30	15

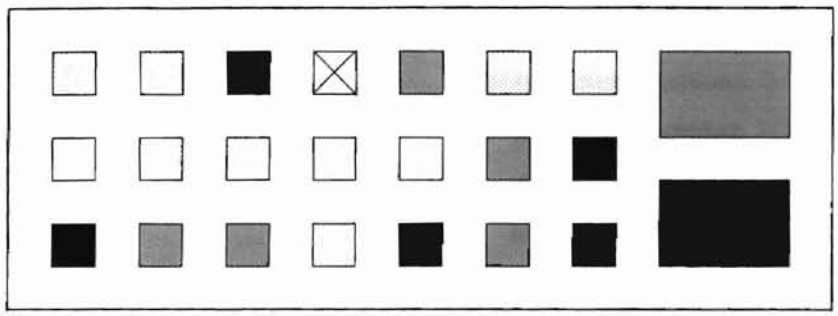
FIGURE 3. Exploded view of Plots 21 and 22 Depicting the Zone Layout Used to Randomly Place Tick Containment Arenas

21	16	11	06	01
22	17	12	07	02
23	18	13	08	03
24	19	14	09	04
25	20	15	10	05

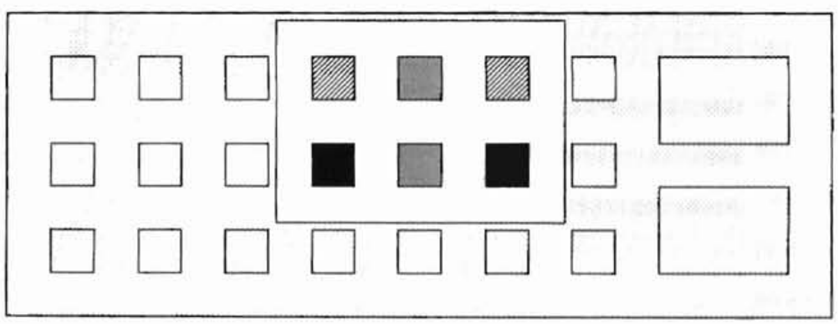
FIGURE 4. Exploded view of Plots 1 - 20 Depicting the Zone Layout Used to Randomly Place Tick Containment Arenas



First Study Treatments 1995: Planned



First Study Treatments 1995: Implemented



Second Study Treatments 1996

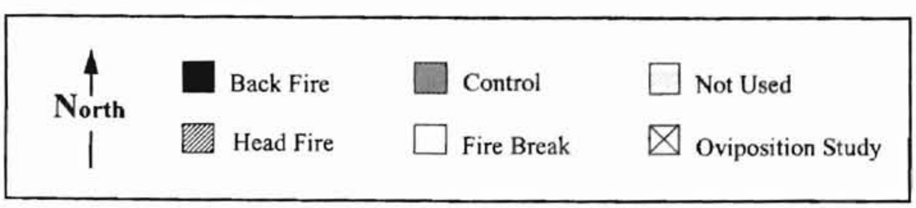


FIGURE 5. Plot Assignment and Utilization, Pasture #15, Payne County, Oklahoma, 1995 and 1996 to Evaluate the Effectiveness of Fall Burning to Control *Dermacentor albipictus* Larvae in Grassland Habitat

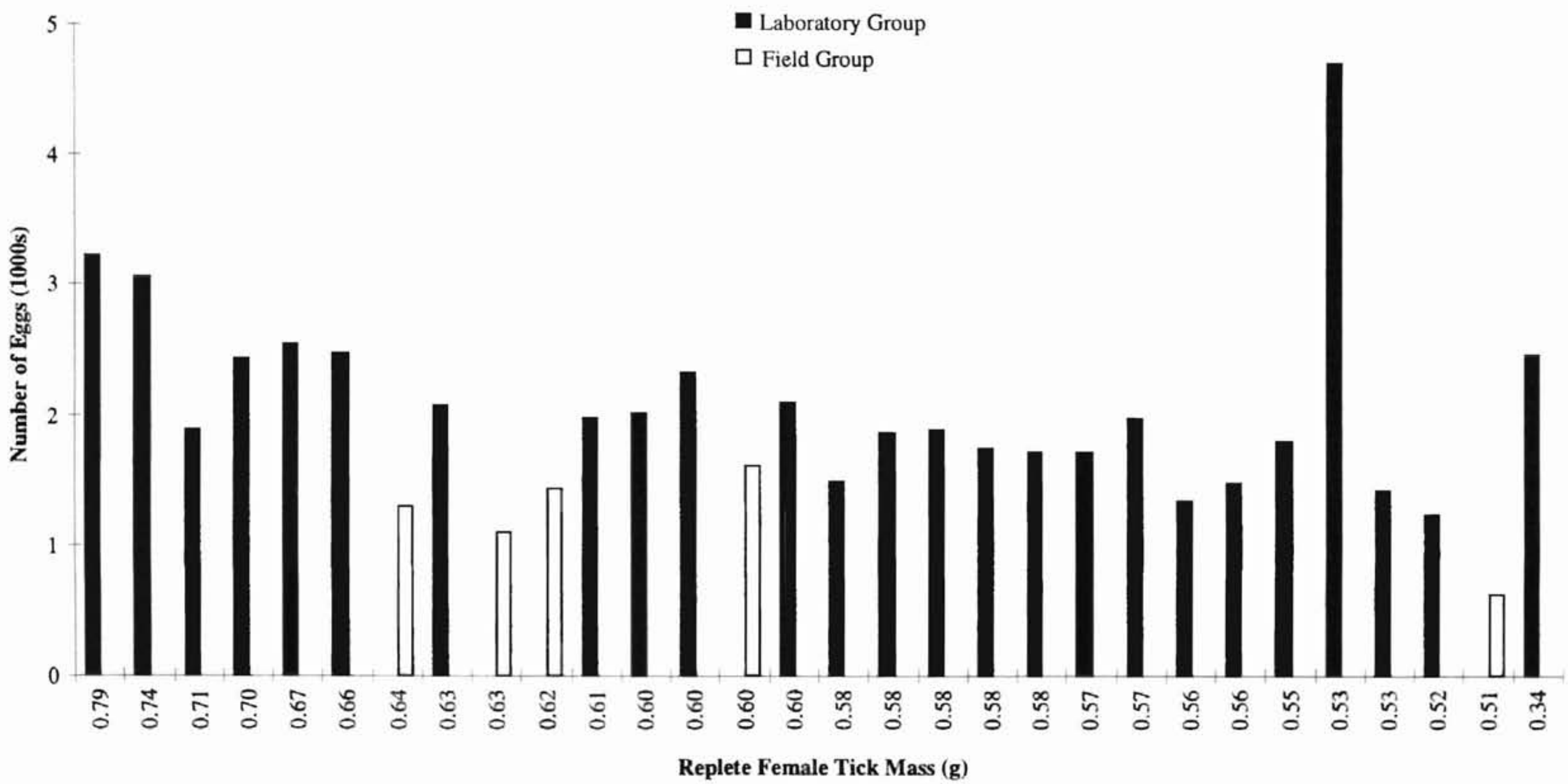


FIGURE 6. Variation in *Dermacentor albipictus* Oviposition Rates Among 50 Female Ticks Divided Between Laboratory and Field Environments, Payne County, Oklahoma, 1995.

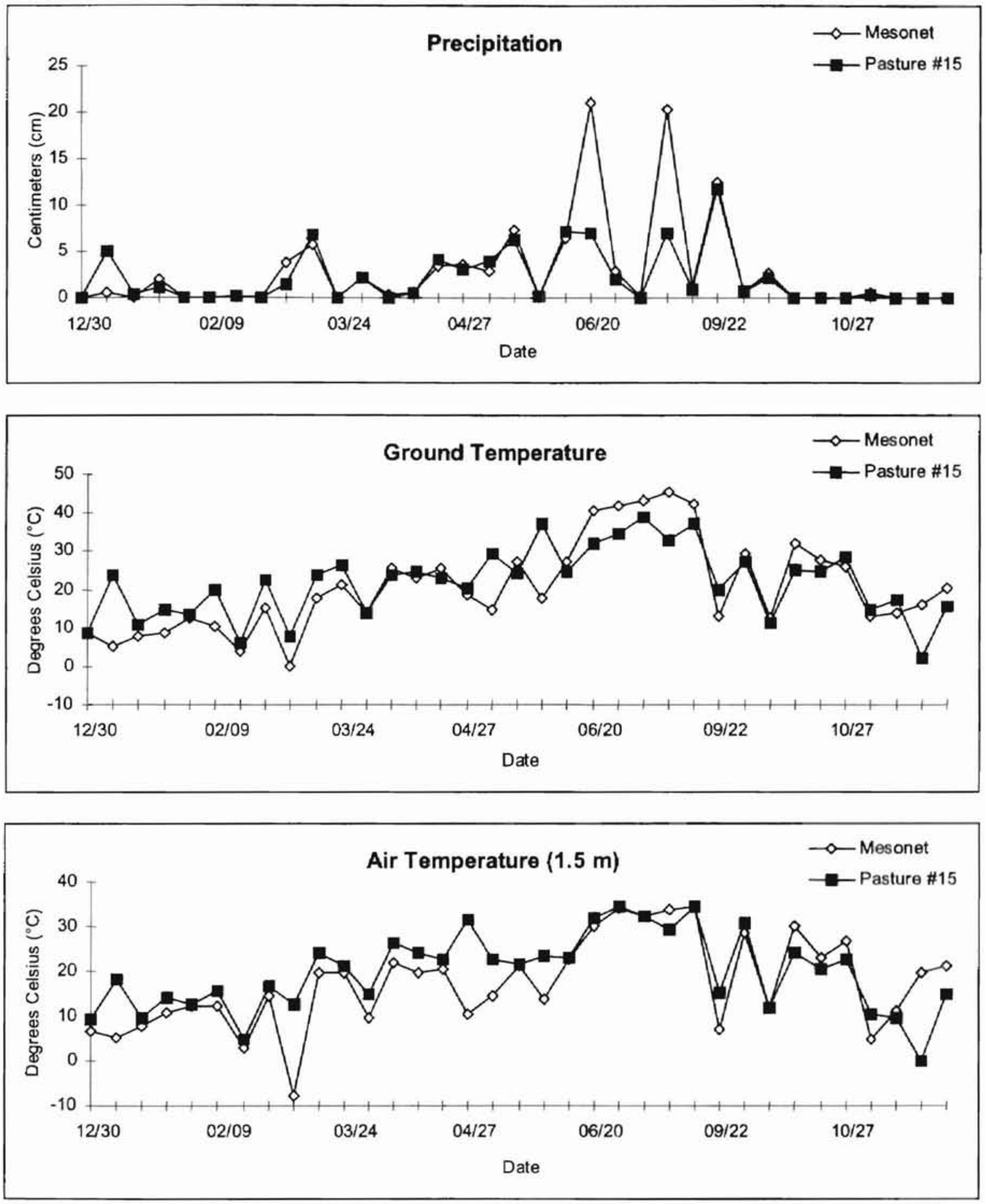


FIGURE 7. Pasture #15 and Marena Station Climatological Data Comparison Validating the Use of Mesonet Data to Supplement Environmental Observations Within Pasture #15, Payne County, Oklahoma, 1994 –1995

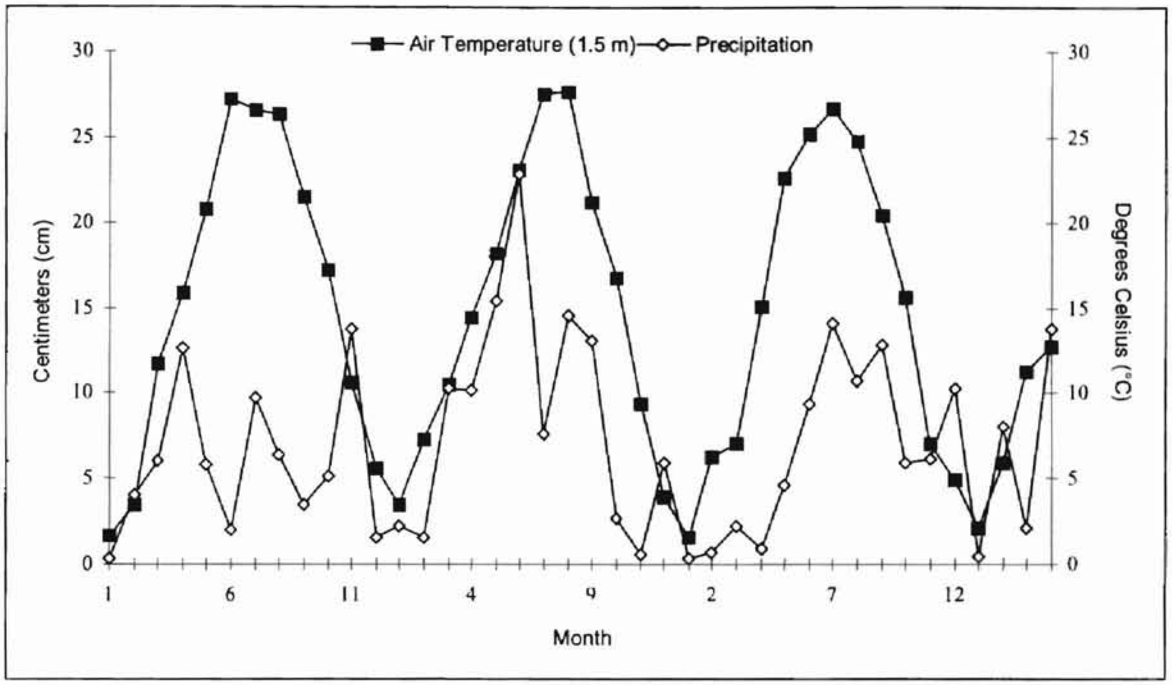


FIGURE 8. Marena Mesonet Station Climatological Data, Depicting the Temperature and Precipitation Trends Impacting a Three Year Evaluation of Burning to Control *Dermacentor albipictus* Larvae in a Grassland Habitat, Payne County, Oklahoma, 1994-1997.

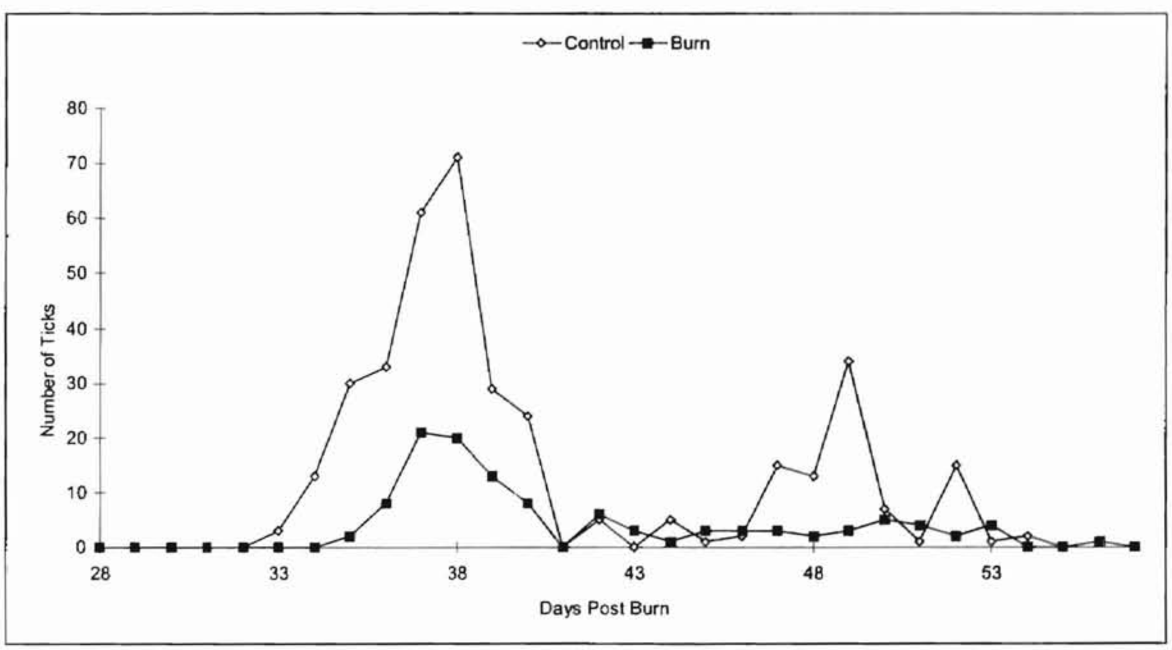


FIGURE 9. Ticks Collected From Sentinel Animals From a Treatment (Backfire) and Control Plot, Pasture #15, Payne County, Oklahoma, 1995

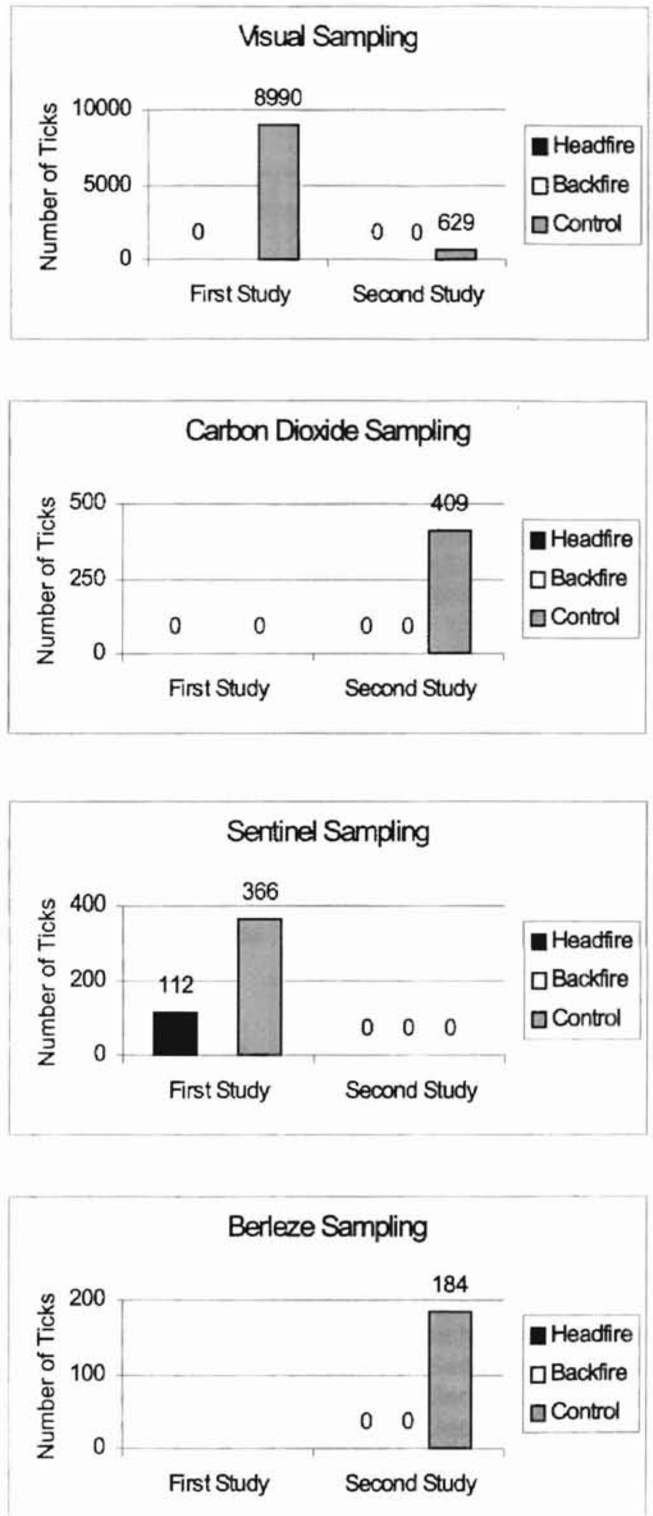


FIGURE 10. Comparison of Post-Burn Tick Sampling Techniques, Pasture #15, Payne County, Oklahoma, 1995 and 1997

TABLE 1

Dermacentor albipictus Ticks In the K. C. Emerson Entomology Museum, Oklahoma State University, Stillwater, Oklahoma, 1997

Date	County	Host	Stage	Date	County	Host	Stage
01/04/74	Adair	Cow	F	02/03/30	LeFlore	Mule	F
11/19/66	Atoka	Deer	F	11/19/66	LeFlore	Deer	F
11/22/66	Atoka	Deer	F	11/19/66	Love	Deer	F
11/24/66	Atoka	Deer	F	12/04/30	McCurtain	Cow	F/M
88	Carter	Deer	F/M	12/04/30	McCurtain	Horse	F/M
11/19/66	Cherokee	Deer	F/M	03/16/31	McCurtain	Cow	M
11/20/66	Cherokee	Deer	F	03/14/31	McCurtain	Mule	F
11/21/66	Cherokee	Deer	F/M	03/26/32	McCurtain	Cow	F
88	Cherokee	Deer	F	11/10/37	McCurtain	Deer	F
12/01/28	Comanche	Cow	F	11/23/62	McCurtain	Deer	F/M
12/01/28	Comanche	Elk	F	11/19/66	McCurtain	Deer	F
12/01/28	Comanche	Horse	F	11/20/66	McCurtain	Deer	F
03/03/30	Comanche	Antelope	F	11/21/66	McCurtain	Deer	M
03/27/30	Comanche	Antelope	F	11/24/66	Osage	Deer	F
03/26/30	Comanche	Buffalo	F	11/27/66	Osage	Deer	F
03/03/30	Comanche	Mt. Sheep	F	11/24/66	Pawnee	Deer	F
03/19/30	Comanche	Mt. Sheep	F	03/14/31	Payne	Cow	F
04/07/30	Comanche	Mt. Sheep	F	04/02/31	Payne	Cow	F
03/27/30	Comanche	Elk	F/M	04/06/31	Payne	Cow	F
05/09/30	Comanche	Elk	F	04/28/31	Payne	Cow	F/M
05/23/30	Comanche	Elk	F	07/24/31	Payne	Cow	F
02/26/40	Comanche	Antelope	F/M	07/25/31	Payne	Cow	F
02/14/40	Comanche	Elk	F	07/27/31	Payne		L
11/24/62	Comanche	Deer	N/F/M	05/09/36	Payne	Cow	F
03/18/31	Delaware	Cow	F	05/10/36	Payne	Cow	F/M
03/24/31	Delaware	Cow	L	05/14/36	Payne	Cow	F
03/23/31	Delaware	Horse	F	11/17/70	Payne	Cow	F
11/19/66	Delaware	Deer	F/M	11/19/66	Pittsburgh	Deer	F/M
11/20/66	Delaware	Deer	F	11/24/66	Pittsburgh	Deer	F
11/24/66	Delaware	Deer	F/M	11/19/40	Pontotoc	Horse	F
12/29/76	Garfield	Calf	F	11/19/66	Pontotoc	Deer	F
95	Harper	Cattle	F	03/18/29	Pushmataha	Cow	F
11/19/66	Hughes	Deer	F	03/19/29	Pushmataha	Goat	F
11/21/60	Johnston	Cattle	F/M	03/17/29	Pushmataha	Horse	M
03/16/29	Latimer	Horse	F	03/19/29	Pushmataha	Hound	F
01/06/31	Latimer	Cow	F	03/18/29	Pushmataha	Sow	F
01/06/31	Latimer	Horse	F	11/23/66	Pushmataha	Deer	F
11/22/29	LeFlore	Horse	F	04/03/41	Sequoyah	Cattle	F/M
11/22/29	LeFlore	Mule	F	11/24/62	Sequoyah	Deer	F/M
02/03/30	LeFlore	Cow	F	11/19/66	Sequoyah	Deer	F
02/03/30	LeFlore	Horse	F	11/20/66	Sequoyah	Deer	F

L = Larvae N = Nymph F = Female M = Male

TABLE 2

Post Burn Sampling of *Dermacentor albipictus* Larvae, Pasture #15, Payne County, Oklahoma, Using Visual (V), Carbon Dioxide (CO_2), and Berleze Funnel (B) Collection Techniques in Headfire (H), Backfire (B) and Control (C) Plots

First Study – 1995					Second Study - 1997				
Date	**Larvae**	**Trtmt**	**Techn**	**Plot**	**Date**	**Larvae**	**Trtmt**	**Techn**	**Plot**
11/10/95	0	B	CO_2	08	01/22/97	0	B	V	1
11/10/95	0	B	CO_2	01	01/22/97	8	C	V	2
11/10/95	0	B	CO_2	03	01/22/97	0	B	V	3
11/10/95	0	B	CO_2	18	01/22/97	0	H	V	4
11/10/95	0	B	CO_2	07	01/22/97	2	C	V	5
11/13/95	0	B	CO_2	07	01/22/97	0	H	V	6
11/13/95	0	B	CO_2	18	01/22/97	0	B	V	1
11/13/95	0	B	CO_2	03	01/23/97	15	C	V	2
11/13/95	0	B	CO_2	01	01/23/97	0	B	V	3
11/13/95	0	B	CO_2	08	01/23/97	0	H	V	4
11/10/95	0	B	V	08	01/23/97	132	C	V	5
11/10/95	0	B	V	01	01/23/97	0	H	V	6
11/10/95	0	B	V	03	01/23/97	0	B	V	1
11/10/95	0	B	V	18	01/23/97	0	C	CO_2	2
11/10/95	0	B	V	07	01/23/97	0	B	V	3
11/13/95	0	B	V	07	01/23/97	0	H	V	4
11/13/95	0	B	V	18	01/23/97	5	C	CO_2	5
11/13/95	0	B	V	03	01/23/97	0	H	V	6
11/13/95	0	B	V	01	02/04/97	0	B	CO_2	1
11/13/95	0	B	V	08	02/04/97	56	C	V	2
11/13/95	464	C	V	02	02/04/97	0	B	CO_2	3
11/13/95	45	C	V	06	02/04/97	0	H	CO_2	4
11/13/95	149	C	V	09	02/04/97	177	C	V	5
11/13/95	549	C	V	17	02/04/97	0	H	CO_2	6
11/13/95	290	C	V	05	02/10/97	0	B	CO_2	1
11/20/95	2257	C	V	17	02/10/97	0	B	V	1
11/20/95	1245	C	V	09	02/10/97	390	C	CO_2	2
11/20/95	1277	C	V	02	02/10/97	53	C	V	2
11/20/95	1759	C	V	05	02/10/97	0	B	CO_2	3
11/20/95	955	C	V	06	02/10/97	0	B	V	3
-----	-----	-----	-----	-----	02/10/97	0	H	CO_2	4
-----	-----	-----	-----	-----	02/10/97	0	H	V	4
-----	-----	-----	-----	-----	02/10/97	14	C	CO_2	5
-----	-----	-----	-----	-----	02/10/97	186	C	V	5
-----	-----	-----	-----	-----	02/10/97	0	H	CO_2	6
-----	-----	-----	-----	-----	02/10/97	0	H	V	6
-----	-----	-----	-----	-----	02/12/97	0	B	B	1
-----	-----	-----	-----	-----	02/12/97	153	C	B	2
-----	-----	-----	-----	-----	02/12/97	0	B	B	3
-----	-----	-----	-----	-----	02/12/97	0	H	B	4
-----	-----	-----	-----	-----	02/12/97	31	C	B	5
-----	-----	-----	-----	-----	02/12/97	0	H	B	6

TABLE 3

Laboratory Egg Mass Study, Oklahoma State University, Stillwater, Oklahoma, 1996 to Estimate the Potential Larval Population Introduced to Pasture #15 Based Upon the Weight of the Larval Egg Mass

Weight (g)	Col. Date	EMW (g)	Ovip. Date	Group	Plot	Zone	Larvae*
0.6094	09/15/96	0.3230	09/25/96	H	3	24	3359
0.5386	09/15/96	0.3249	09/27/96	H	3	13	3379
0.5272	09/15/96	0.1455	09/26/96	B	6	9	1513
0.5231	09/15/96	0.0623	09/30/96	B	4	11	648
0.5214	09/15/96	0.2901	09/30/96	C	2	11	3017
0.5156	09/15/96	0.3231	09/23/96	C	2	7	3360
0.4919	09/15/96	0.2579	10/02/96	H	1	7	2682
0.4771	09/15/96	0.2640	09/23/96	B	4	22	2746
0.4738	09/15/96	0.2652	09/25/96	H	1	9	2758
0.4647	09/15/96	0.2806	09/30/96	C	5	24	2918
0.4591	09/15/96	0.2817	09/25/96	H	3	5	2930
0.4499	09/15/96	0.2814	09/23/96	H	3	17	2927
0.4435	09/15/96	0.2822	09/25/96	C	5	10	2935
0.4425	09/15/96	0.2855	10/02/96	B	6	1	2969
0.4381	09/15/96	0.2814	09/30/96	H	1	22	2927
0.4309	09/15/96	0.2616	09/26/96	C	2	14	2721
0.4309	09/15/96	0.3783	09/25/96	B	4	7	3934
0.4304	09/15/96	0.1323	09/27/96	C	5	3	1376
0.4125	09/15/96	0.0310	09/27/96	C	5	22	322
0.4120	09/15/96	0.2497	09/27/96	B	6	3	2597
0.4099	09/15/96	0.0363	09/30/96	C	2	24	378
0.4089	09/15/96	0.2510	09/27/96	B	6	13	2610
0.4081	09/15/96	0.2648	09/25/96	B	4	3	2754
0.4068	09/15/96	0.2351	09/25/96	B	6	18	2445
0.3947	09/15/96	0.2527	09/26/96	C	2	4	2628
0.3934	09/15/96	0.2172	09/25/96	H	1	5	2259
0.3806	09/15/96	0.2340	09/25/96	B	4	9	2434
0.3785	09/15/96	0.1905	09/25/96	H	3	3	1981
0.3780	09/15/96	0.2247	09/23/96	C	2	8	2337
0.3715	09/15/96	0.2236	09/23/96	C	5	9	2325
0.3566	09/15/96	0.0654	09/25/96	H	1	18	680
0.3495	09/15/96	0.2035	09/23/96	B	6	20	2116
0.3231	09/15/96	0.1841	09/30/96	C	5	7	1915
0.2929	09/15/96	0.0279	09/26/96	B	4	21	290
0.2049	09/15/96	0.0989	09/27/96	H	1	12	1029
0.1966	09/15/96	0.1033	09/27/96	H	3	11	1074

The estimated number of larvae is based upon 10.40 ± 1.24 eggs/mg of egg mass.

H = Headfire B = Backfire C = Control

TABLE 4

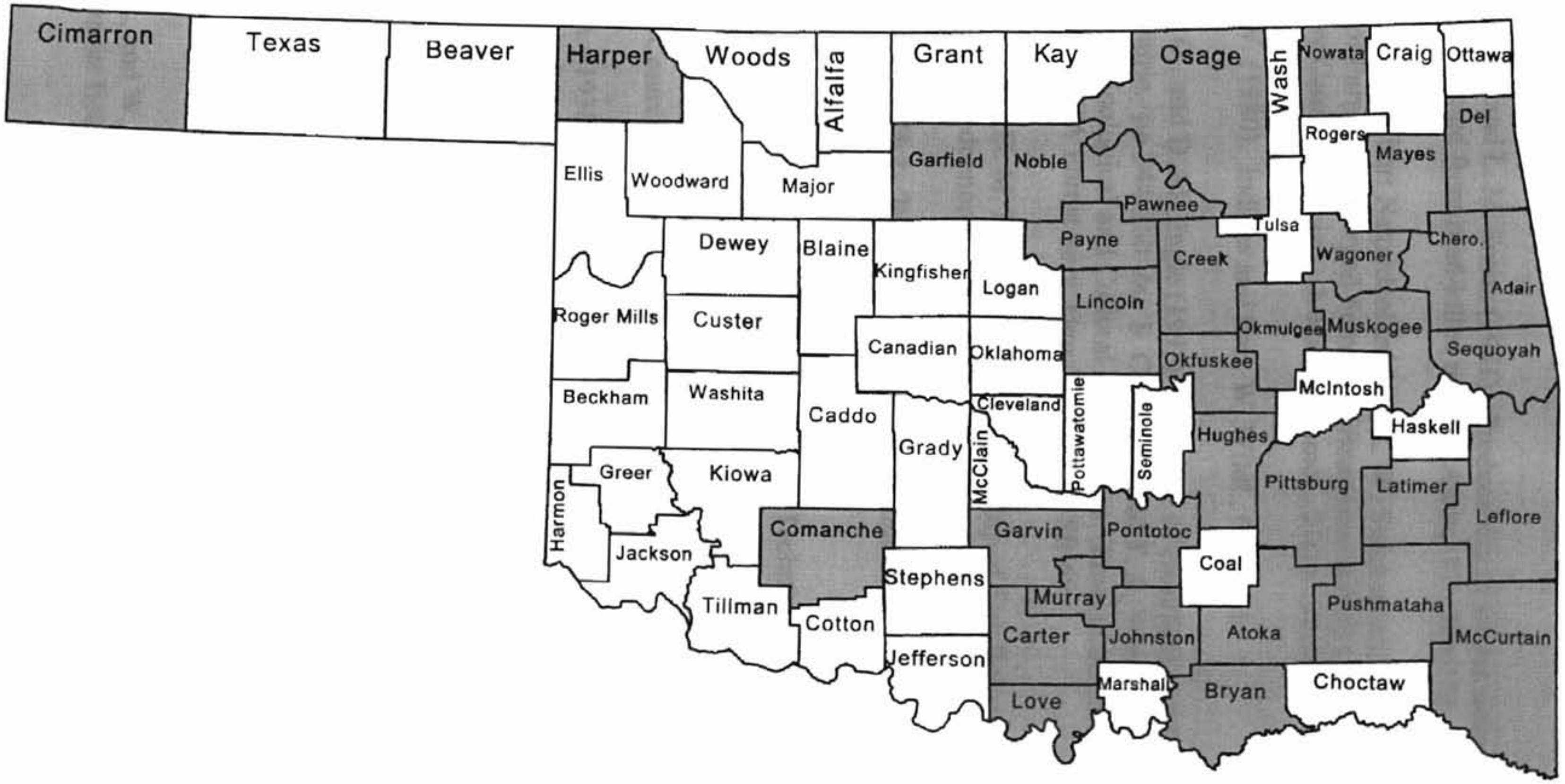
Fuel and Weather Conditions Associated with Burning Treatments in Pasture #15on the Day of Burning. Fuel Measurements are Mean Values (First Study: N = 4, Second Study: N = 5).

Variable	First Study	Second Study
Air Temp (°C)	10.11 ± .50	14.44 ± .20
Rel. Hum. (%)	37.4 ± 1.53	46.75 ± 1.80
Windspeed (km/h)	4.3 ± .48	37.5 ± 62.50
Fuel Loading (kg/ha)	1272.8 ± 67	1721.25 ± 25.43
Fuel Moisture (%)	24.4 ± .60	58.25 ± 8.22

TABLE 5

Fire Behavior Variables on the Day of Burning Used in Canonical Variates to Relate to Herbage Production in Pasture #15, Payne County, Oklahoma, 1995 and 1997.

Fire Behavior Variable	Value			
First Study	**Min**	**Max**	**Mean**	**SE**
Fireline Intensity (kw m^{-1})	248	585	432.8	59.07
Rate of Spread (m min^{-1})	19.20	54.20	34.12	6.76
Heat per Unit Area (kJ m^2)	11250	17700	13566.20	1119.42
Second Study	**Min**	**Max**	**Mean**	**SE**
Fireline Intensity (kw m^{-1})	750	1410	1035.75	137.80
Rate of Spread (m min^{-1})	24	46.25	34.56	4.62
Heat per Unit Area (kJ m^2)	26786	48810	35015.75	4804.79



MAP 1. Distribution of the Winter Tick, *Dermacentor albipictus* (PACKARD), in Oklahoma, 2000

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APPENDIX A

Adult *Dermacentor albipictus* Females Collected From Cattle in Pasture #86,
Lake Carl Blackwell, Payne County, Oklahoma, 1994

Date	Weight (g)	Date	Weight (g)	Date	Weight (g)	Date	Weight (g)
11/28/94	0.4553	11/30/94	0.3151	12/01/94	0.3094	12/02/94	0.3289
11/28/94	0.4281	11/30/94	0.2935	12/01/94	0.3084	12/02/94	0.3279
11/28/94	0.4229	11/30/94	0.2923	12/01/94	0.3040	12/02/94	0.3276
11/28/94	0.3712	11/30/94	0.2895	12/01/94	0.3035	12/02/94	0.3271
11/28/94	0.3470	11/30/94	0.2875	12/01/94	0.2979	12/02/94	0.3254
11/28/94	0.3366	11/30/94	0.2875	12/01/94	0.2904	12/02/94	0.3210
11/28/94	0.3325	11/30/94	0.2870	12/01/94	0.2845	12/02/94	0.3181
11/28/94	0.3232	11/30/94	0.2805	12/01/94	0.2817	12/02/94	0.3091
11/28/94	0.3224	11/30/94	0.2780	12/01/94	0.2763	12/02/94	0.3057
11/28/94	0.3046	11/30/94	0.2704	12/01/94	0.2744	12/02/94	0.3024
11/28/94	0.3031	11/30/94	0.2649	12/01/94	0.2673	12/02/94	0.3015
11/28/94	0.2997	11/30/94	0.2605	12/01/94	0.2610	12/02/94	0.2689
11/28/94	0.2860	11/30/94	0.2400	12/01/94	0.2586	12/02/94	0.2663
11/28/94	0.2845	11/30/94	0.2399	12/01/94	0.2556	12/02/94	0.2610
11/28/94	0.2720	11/30/94	0.2335	12/01/94	0.2550	12/02/94	0.2604
11/28/94	0.2707	11/30/94	0.2195	12/01/94	0.2510	12/02/94	0.2575
11/28/94	0.2679	11/30/94	0.2110	12/01/94	0.2481	12/02/94	0.2509
11/28/94	0.2638	11/30/94	0.1919	12/01/94	0.2473	12/02/94	0.2485
11/28/94	0.2621	11/30/94	0.1885	12/01/94	0.2463	12/02/94	0.2431
11/28/94	0.2595	11/30/94	0.1870	12/01/94	0.2444	12/02/94	0.2065
11/28/94	0.2538	11/30/94	0.1750	12/01/94	0.2440	12/02/94	0.2062
11/28/94	0.2498	11/30/94	0.1624	12/01/94	0.2435	12/02/94	0.1769
11/28/94	0.2455	12/01/94	0.5975	12/01/94	0.2349	12/02/94	0.1662
11/28/94	0.2405	12/01/94	0.4692	12/01/94	0.2271	12/02/94	0.1326
11/28/94	0.2385	12/01/94	0.4603	12/01/94	0.2265	12/02/94	0.0841
11/28/94	0.2330	12/01/94	0.4551	12/01/94	0.2099	12/05/94	0.4525
11/28/94	0.2208	12/01/94	0.4241	12/01/94	0.2024	12/05/94	0.4185
11/28/94	0.2118	12/01/94	0.4154	12/01/94	0.1735	12/05/94	0.3950
11/28/94	0.1893	12/01/94	0.4034	12/01/94	0.1576	12/05/94	0.3940
11/29/94	0.3690	12/01/94	0.3704	12/01/94	0.1504	12/05/94	0.3920
11/29/94	0.3385	12/01/94	0.3666	12/02/94	0.4564	12/05/94	0.3869
11/29/94	0.2735	12/01/94	0.3546	12/02/94	0.4388	12/05/94	0.3790
11/29/94	0.2730	12/01/94	0.3535	12/02/94	0.4124	12/05/94	0.3780
11/29/94	0.2211	12/01/94	0.3500	12/02/94	0.4106	12/05/94	0.3641
11/29/94	0.1509	12/01/94	0.3489	12/02/94	0.4084	12/05/94	0.3522
11/30/94	0.4975	12/01/94	0.3470	12/02/94	0.3952	12/05/94	0.3485
11/30/94	0.3985	12/01/94	0.3435	12/02/94	0.3886	12/05/94	0.3281
11/30/94	0.3975	12/01/94	0.3350	12/02/94	0.3729	12/05/94	0.3272
11/30/94	0.3655	12/01/94	0.3324	12/02/94	0.3718	12/05/94	0.3266
11/30/94	0.3595	12/01/94	0.3310	12/02/94	0.3676	12/05/94	0.3226
11/30/94	0.3436	12/01/94	0.3297	12/02/94	0.3635	12/05/94	0.3179
11/30/94	0.3337	12/01/94	0.3229	12/02/94	0.3616	12/05/94	0.3167
11/30/94	0.3295	12/01/94	0.3227	12/02/94	0.3585	12/05/94	0.3149
11/30/94	0.3255	12/01/94	0.3121	12/02/94	0.3496	12/05/94	0.3039

APPENDIX A

Continued

Date	Weight (g)	Date	Weight (g)	Date	Weight (g)	Date	Weight (g)
12/05/94	0.3004	12/06/94	0.3354	12/06/94	0.2185	12/08/94	0.3650
12/05/94	0.2990	12/06/94	0.3310	12/06/94	0.2026	12/08/94	0.3635
12/05/94	0.2916	12/06/94	0.3230	12/06/94	0.1958	12/08/94	0.3553
12/05/94	0.2873	12/06/94	0.3210	12/06/94	0.1935	12/08/94	0.3537
12/05/94	0.2779	12/06/94	0.3151	12/06/94	0.1618	12/08/94	0.3449
12/05/94	0.2722	12/06/94	0.3150	12/06/94	0.1607	12/08/94	0.3396
12/05/94	0.2714	12/06/94	0.3126	12/06/94	0.1486	12/08/94	0.3374
12/05/94	0.2701	12/06/94	0.3125	12/06/94	0.1366	12/08/94	0.3324
12/05/94	0.2694	12/06/94	0.3114	12/06/94	0.1329	12/08/94	0.3314
12/05/94	0.2685	12/06/94	0.3081	12/06/94	0.1200	12/08/94	0.3155
12/05/94	0.2658	12/06/94	0.3045	12/06/94	0.1118	12/08/94	0.3100
12/05/94	0.2589	12/06/94	0.3000	12/07/94	0.4338	12/08/94	0.2989
12/05/94	0.2550	12/06/94	0.2995	12/07/94	0.3669	12/08/94	0.2907
12/05/94	0.2507	12/06/94	0.2984	12/07/94	0.3539	12/08/94	0.2900
12/05/94	0.2494	12/06/94	0.2922	12/07/94	0.3500	12/08/94	0.2884
12/05/94	0.2489	12/06/94	0.2864	12/07/94	0.3484	12/08/94	0.2833
12/05/94	0.2470	12/06/94	0.2858	12/07/94	0.3408	12/08/94	0.2820
12/05/94	0.2450	12/06/94	0.2842	12/07/94	0.3398	12/08/94	0.2805
12/05/94	0.2446	12/06/94	0.2842	12/07/94	0.3360	12/08/94	0.2775
12/05/94	0.2394	12/06/94	0.2835	12/07/94	0.3283	12/08/94	0.2730
12/05/94	0.2364	12/06/94	0.2831	12/07/94	0.3269	12/08/94	0.2710
12/05/94	0.2246	12/06/94	0.2830	12/07/94	0.3217	12/08/94	0.2695
12/05/94	0.2204	12/06/94	0.2770	12/07/94	0.3062	12/08/94	0.2664
12/05/94	0.2191	12/06/94	0.2760	12/07/94	0.3042	12/08/94	0.2576
12/05/94	0.2185	12/06/94	0.2720	12/07/94	0.2930	12/08/94	0.2536
12/05/94	0.2110	12/06/94	0.2566	12/07/94	0.2875	12/08/94	0.2507
12/05/94	0.2106	12/06/94	0.2554	12/07/94	0.2742	12/08/94	0.2484
12/05/94	0.1981	12/06/94	0.2540	12/07/94	0.2683	12/08/94	0.2450
12/05/94	0.1708	12/06/94	0.2515	12/07/94	0.2643	12/08/94	0.2443
12/05/94	0.1684	12/06/94	0.2485	12/07/94	0.2612	12/08/94	0.2439
12/05/94	0.1346	12/06/94	0.2485	12/07/94	0.2591	12/08/94	0.2424
12/05/94	0.1150	12/06/94	0.2453	12/07/94	0.2567	12/08/94	0.2341
12/06/94	0.4736	12/06/94	0.2452	12/07/94	0.2416	12/08/94	0.2312
12/06/94	0.4484	12/06/94	0.2445	12/07/94	0.2269	12/08/94	0.2189
12/06/94	0.4076	12/06/94	0.2443	12/07/94	0.2208	12/08/94	0.2133
12/06/94	0.4019	12/06/94	0.2414	12/07/94	0.2195	12/08/94	0.2094
12/06/94	0.3919	12/06/94	0.2400	12/07/94	0.1857	12/08/94	0.2084
12/06/94	0.3757	12/06/94	0.2400	12/08/94	0.3934	12/08/94	0.2054
12/06/94	0.3739	12/06/94	0.2289	12/08/94	0.3920	12/08/94	0.1970
12/06/94	0.3704	12/06/94	0.2228	12/08/94	0.3745	12/08/94	0.1956
12/06/94	0.3451	12/06/94	0.2219	12/08/94	0.3710	12/08/94	0.1753
12/06/94	0.3435	12/06/94	0.2215	12/08/94	0.3695	12/08/94	0.1748
12/06/94	0.3423	12/06/94	0.2200	12/08/94	0.3663	12/08/94	0.1688
12/06/94	0.3357	12/06/94	0.2200	12/08/94	0.3652	12/08/94	0.1476
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APPENDIX B

Environmental Data Recorded At Pasture #15, Payne County, Oklahoma, 1994-1995

Date	STID	Rain (cm²)	Air (°C)	Grnd (°C)	Date	STID	Rain (cm³)	Air (°C)	Grnd (°C)
12/30/94	1	0.00	9.00	9.00	03/24/95	1	0.00	26.50	29.00
12/30/94	2	0.00	8.50	8.50	03/24/95	2	0.00	22.00	32.50
12/30/94	3	0.00	10.50	8.50	03/24/95	3	0.00	21.00	22.00
12/30/94	4	0.00	8.50	8.50	03/24/95	4	0.00	14.50	22.00
01/08/95	1	6.00	18.00	26.00	03/30/95	1	2.80	11.50	14.00
01/08/95	2	5.00	19.00	23.00	03/30/95	2	2.80	12.00	13.90
01/08/95	3	4.00	17.50	23.00	03/30/95	3	0.60	11.50	13.30
01/08/95	4	5.00	18.00	23.00	03/30/95	4	2.60	24.90	14.50
01/13/95	1	0.50	8.90	8.90	04/06/95	1	0.00	24.50	26.00
01/13/95	2	0.33	9.90	12.00	04/06/95	2	0.03	27.00	28.00
01/13/95	3	0.50	10.00	11.50	04/06/95	3	0.01	26.00	19.50
01/13/95	4	0.25	9.90	10.10	04/06/95	4	0.01	27.00	21.00
01/27/95	1	1.00	14.00	14.00	04/13/95	1	Defect	26.50	27.00
01/27/95	2	1.00	14.00	11.00	04/13/95	2	0.60	25.00	26.00
01/27/95	3	1.00	14.00	17.00	04/13/95	3	0.60	27.00	21.50
01/27/95	4	1.00	14.00	16.00	04/13/95	4	0.60	18.00	24.00
02/03/95	1	0.00	11.90	12.90	04/21/95	1	4.00	19.50	27.00
02/03/95	2	0.00	12.90	12.10	04/21/95	2	4.10	22.00	21.50
02/03/95	3	0.00	13.00	12.00	04/21/95	3	4.10	18.50	20.50
02/03/95	4	0.00	12.80	16.10	04/21/95	4	4.30	30.50	23.00
02/09/95	1	0.00	17.00	24.00	04/27/95	1	3.00	21.50	25.00
02/09/95	2	0.00	14.20	19.00	04/27/95	2	3.00	20.00	19.00
02/09/95	3	0.00	16.00	20.50	04/27/95	3	3.10	21.00	18.00
02/09/95	4	0.00	15.20	16.50	04/27/95	4	3.00	24.00	19.00
02/16/95	1	0.20	6.50	7.00	05/04/95	1	3.80	22.50	34.50
02/16/95	2	0.20	5.50	6.00	05/04/95	2	4.00	24.50	27.00
02/16/95	3	0.20	4.00	5.50	05/04/95	3	4.00	21.00	33.00
02/16/95	4	0.20	4.00	5.00	05/04/95	4	4.00	22.50	22.50
02/24/95	1	0.00	20.00	22.00	05/12/95	1	6.20	22.00	26.00
02/24/95	2	0.00	16.00	21.00	05/12/95	2	6.40	21.00	23.00
02/24/95	3	0.00	19.00	16.00	05/12/95	3	6.40	21.00	25.00
02/24/95	4	0.00	10.50	30.00	05/12/95	4	6.30	22.25	22.50
03/09/95	1	1.20	9.00	5.00	05/19/95	1	0.20	22.50	41.50
03/09/95	2	broken	8.00	7.50	05/19/95	2	0.20	25.25	34.25
03/09/95	3	broken	7.00	9.50	05/19/95	3	0.20	25.50	38.50
03/09/95	4	1.50	27.00	8.00	05/19/95	4	0.30	20.00	34.00
03/16/95	1	6.60	24.00	37.00	05/29/95	1	7.20	19.50	25.00
03/16/95	2	replaced	26.00	20.00	05/29/95	2	7.00	21.50	26.50
03/16/95	3	replaced	22.00	18.00	05/29/95	3	7.10	19.00	24.00
03/16/95	4	7.00	24.00	20.00	05/29/95	4	7.10	32.00	22.00

APPENDIX B

Continued

Date	STID	Rain (cm²)	Air (°C)	Grnd (°C)	Date	STID	Rain (cm²)	Air (°C)	Grnd (°C)
06/20/95	1	7.80	32.00	34.00	10/06/95	3	2.10	13.00	11.00
06/20/95	2	6.90	32.50	34.50	10/06/95	4	2.00	12.00	11.00
06/20/95	3	6.80	30.00	27.25	10/13/95	1	0.00	23.00	26.00
06/20/95	4	6.30	32.50	31.50	09/29/95	2	0.00	24.00	26.00
07/06/95	1	1.90	35.00	39.00	09/29/95	3	0.00	24.00	26.00
07/06/95	2	2.20	35.00	34.50	09/29/95	4	0.00	25.00	22.00
07/06/95	3	2.00	34.00	33.00	10/20/95	1	0.00	21.00	25.00
07/06/95	4	2.00	34.00	32.00	10/20/95	2	0.00	20.00	22.00
07/19/95	1	0.00	32.50	39.00	10/20/95	3	0.00	20.00	30.00
07/19/95	2	0.00	33.00	36.00	10/20/95	4	0.00	20.00	21.00
07/19/95	3	0.00	32.00	39.00	10/27/95	1	0.00	22.00	34.00
07/19/95	4	0.00	33.00	41.00	10/27/95	2	0.00	23.00	25.00
08/15/95	1	7.80	30.00	34.00	10/27/95	3	0.00	23.00	32.00
08/15/95	2	6.80	30.00	31.00	10/27/95	4	0.00	22.00	22.00
08/15/95	3	7.20	28.00	35.00	11/03/95	1	0.40	10.00	18.00
08/15/95	4	6.20	29.00	31.00	11/03/95	2	0.40	10.00	15.00
08/25/95	1	1.00	35.00	40.00	11/03/95	3	0.20	10.00	15.00
08/25/95	2	0.90	34.00	35.00	11/03/95	4	0.30	11.00	11.00
08/25/95	3	0.80	35.00	38.00	11/08/95	1	0.00	9.00	20.00
08/25/95	4	1.00	34.00	35.00	11/08/95	2	0.00	10.00	15.00
09/22/95	1	11.60	15.00	24.50	11/08/95	3	0.00	10.00	19.00
09/22/95	2	11.80	14.50	19.00	11/08/95	4	0.00	9.00	14.00
09/22/95	3	12.00	16.00	21.00	11/11/95	1	0.01	0.00	0.00
09/22/95	4	11.80	15.00	14.00	11/11/95	2	0.01	0.00	2.00
09/29/95	1	0.38	31.00	29.00	11/11/95	3	0.01	0.01	2.00
09/29/95	2	1.00	31.00	28.00	11/11/95	4	0.01	0.30	4.00
09/29/95	3	0.80	29.00	27.00	11/13/95	1	0.00	15.00	17.00
09/29/95	4	0.80	31.50	25.00	11/13/95	2	0.00	15.00	15.00
10/06/95	1	2.10	11.00	11.00	11/13/95	3	0.00	15.00	15.00
10/06/95	2	2.10	12.00	11.00	11/13/95	4	0.00	14.00	15.00

APPENDIX C

Pasture #15 Burn Study Research Plot Assignments, Payne County, Oklahoma, 1995

Plot	Zone	Weight (g)	Plot	Zone	Weight (g)	Plot	Zone	Weight (g)
1	2	0.2185	5	16	0.2485	10	9	0.2643
1	3	0.2775	5	20	0.3710	10	13	0.4564
1	4	0.2720	5	21	0.3217	10	15	0.3695
1	5	0.1893	5	22	0.3952	10	16	0.3451
1	7	0.3374	6	2	0.2997	10	17	0.1885
1	8	0.2679	6	7	0.3484	10	22	0.3780
1	9	0.2695	6	10	0.3039	10	24	0.2246
1	11	0.2550	6	11	0.1329	11	2	0.4019
1	12	0.3057	6	13	0.3149	11	6	0.2817
1	13	0.3269	6	16	0.2189	11	8	0.2191
1	18	0.2720	6	17	0.2760	11	13	0.3151
2	1	0.2341	6	19	0.3155	11	15	0.4388
2	2	0.3227	6	21	0.1956	11	16	0.3496
2	7	0.3210	6	23	0.2024	11	17	0.2664
2	8	0.3360	6	24	0.3886	11	22	0.3539
2	9	0.1476	7	4	0.3500	11	24	0.3712
2	10	0.2858	7	6	0.3084	12	1	0.2845
2	14	0.4154	7	7	0.2586	12	2	0.1607
2	15	0.1708	7	8	0.1326	12	4	0.3408
2	16	0.3091	7	10	0.2842	12	5	0.2446
2	21	0.1769	7	13	0.4736	12	6	0.2515
2	25	0.2550	7	16	0.3652	12	8	0.3655
3	3	0.2540	7	18	0.1684	12	13	0.2470
3	4	0.3283	7	19	0.3094	12	14	0.4692
3	5	0.2864	7	24	0.3470	12	19	0.3114
3	9	0.2990	8	2	0.3042	12	20	0.3289
3	10	0.2830	8	5	0.3757	13	2	0.4106
3	11	0.2923	8	6	0.3616	13	5	0.2860
3	17	0.4241	8	8	0.2489	13	7	0.2576
3	20	0.2484	8	10	0.3150	13	14	0.3325
3	22	0.3423	8	11	0.2780	13	15	0.3641
3	24	0.2473	8	16	0.2054	13	17	0.4338
4	3	0.3690	8	17	0.2439	13	18	0.3121
4	4	0.2084	8	23	0.2110	13	21	0.3310
4	7	0.3650	8	24	0.2443	13	23	0.2566
4	8	0.2507	8	25	0.2211	14	3	0.2744
4	9	0.2133	9	3	0.3272	14	7	0.2884
4	11	0.2453	9	5	0.3745	14	9	0.3950
4	12	0.2435	9	9	0.3295	14	12	0.2185
4	17	0.4076	9	10	0.4603	14	13	0.3151
4	20	0.3229	9	15	0.3310	14	14	0.2405
4	21	0.1735	9	16	0.3869	14	16	0.3546
4	23	0.2065	9	19	0.3436	14	20	0.3435
5	8	0.3940	9	22	0.1958	14	24	0.2364
5	9	0.1576	9	23	0.2575	14	25	0.3281
5	12	0.4084	10	2	0.2900	15	4	0.2204
5	14	0.2400	10	4	0.2195	15	6	0.2710
5	15	0.4229	10	6	0.2742	15	12	0.2554

APPENDIX C

Continued

Plot	Zone	Weight (g)	Plot	Zone	Weight (g)	Plot	Zone	Weight (g)
15	13	0.2805	17	10	0.3663	19	4	0.3666
15	14	0.3279	17	13	0.3635	19	5	0.2567
15	15	0.2208	17	14	0.2200	19	7	0.2094
15	18	0.4124	17	15	0.2450	19	9	0.2649
15	19	0.2683	17	18	0.3357	19	11	0.3790
15	21	0.3232	17	19	0.3024	19	13	0.1935
15	22	0.1509	17	21	0.2638	19	15	0.2424
15	24	0.2722	17	22	0.2714	19	17	0.3522
16	4	0.3226	17	23	0.3635	19	18	0.2026
16	8	0.3000	18	2	0.3920	20	3	0.2779
16	9	0.2399	18	7	0.3535	20	4	0.2394
16	10	0.2335	18	10	0.2833	20	5	0.3676
16	13	0.2704	18	11	0.2485	20	7	0.2330
16	14	0.2730	18	18	0.3385	20	12	0.3266
16	17	0.3179	18	19	0.3485	20	13	0.2873
16	18	0.1981	18	20	0.4484	20	14	0.3595
16	19	0.3276	18	21	0.3181	20	15	0.2591
16	21	0.2612	18	25	0.2707	20	16	0.1748
16	24	0.2538	19	1	0.2694	20	19	0.2349
17	4	0.2673	19	3	0.2610	20	25	0.2445

Pasture #15 Burn Study Research Plot Assignments, Payne County, Oklahoma, 1995
Sentinel Animal Study

Plot	Zone	Weight (g)	Plot	Zone	Weight (g)	Plot	Zone	Weight (g)
21	6	0.2219	21	99	0.2265	22	39	0.3920
21	15	0.3314	21	100	0.2605	22	52	0.2099
21	22	0.3704	21	106	0.3500	22	56	0.2831
21	28	0.2907	21	117	0.3100	22	62	0.2805
21	29	0.3739	21	130	0.2452	22	77	0.2621
21	37	0.2494	21	131	0.3255	22	85	0.2589
21	44	0.2658	21	133	0.2228	22	94	0.2604
21	46	0.3704	21	136	0.2106	22	97	0.2842
21	47	0.1624	21	145	0.2845	22	98	0.3297
21	50	0.3126	21	147	0.2195	22	99	0.2770
21	52	0.2870	21	149	0.3035	22	102	0.2200
21	54	0.3210	22	3	0.2820	22	116	0.3718
21	59	0.3254	22	5	0.3449	22	123	0.2989
21	60	0.2875	22	8	0.3338	22	127	0.2701
21	63	0.3934	22	10	0.3919	22	133	0.3125
21	64	0.3398	22	13	0.2269	22	134	0.3062
21	67	0.3045	22	16	0.2875	22	135	0.4551
21	78	0.2904	22	18	0.3004	22	140	0.3585
21	84	0.2595	22	19	0.2916	22	147	0.3537
21	87	0.2895	22	36	0.3729	22	150	0.3553

APPENDIX D

Marina Mesonet Station and Pasture #15 Environmental Data

Collection Data		Marina Mesonet Station			Pasture #15 Averages		
Date	Time	Rain (cm)	Air (°C)	Grnd (°C)	Rain (cm)	Air (°C)	Grnd (°C)
12/30/94	16:45	0.00	6.72	8.50	0.00	9.13	8.63
01/08/95	14:30	0.61	5.22	5.11	5.00	18.13	23.75
01/13/95	12:00	0.03	7.89	7.61	0.40	9.68	10.63
01/27/95	10:30	2.03	10.78	8.39	1.00	14.00	14.50
02/03/95	14:00	0.08	12.22	12.50	0.00	12.65	13.28
02/09/95	13:00	0.00	12.28	10.11	0.00	15.60	20.00
02/16/95	14:00	0.25	3.00	3.72	0.20	5.00	5.88
02/24/95	13:30	0.00	14.28	15.00	0.00	16.83	22.25
03/09/95	10:00	3.76	-7.61	-0.28	1.35	12.75	7.50
03/16/95	12:00	5.74	19.50	17.72	6.80	24.00	23.75
03/24/95	12:00	0.00	19.72	21.00	0.00	21.00	26.38
03/30/95	16:15	2.06	9.61	13.72	2.20	14.98	13.93
04/06/95	17:15	0.43	21.78	25.28	0.01	26.13	23.63
04/13/95	16:00	0.61	19.50	22.72	0.60	24.13	24.63
04/21/95	17:00	3.38	20.39	25.50	4.13	22.63	23.00
04/27/95	18:00	3.63	10.39	18.61	3.03	31.63	20.25
05/04/95	16:00	2.92	14.39	14.50	3.95	22.63	29.25
05/12/95	14:42	7.26	21.28	27.11	6.33	21.56	24.13
05/19/95	12:00	0.20	13.78	17.78	0.23	23.31	37.06
05/29/95	13:00	6.48	22.50	27.00	7.10	23.00	24.38
06/20/95	17:00	21.08	29.89	40.61	6.95	31.75	31.81
07/06/95	18:00	2.77	34.22	42.00	2.03	34.50	34.63
07/19/95	16:00	0.10	32.27	42.89	0.00	32.36	38.75
08/15/95	-----	20.29	33.78	45.28	7.00	29.25	32.75
08/25/95	14:00	1.32	34.61	42.39	0.93	34.50	37.00
09/22/95	13:30	12.45	7.00	12.72	11.80	15.13	19.63
09/29/95	14:00	0.64	28.39	29.11	0.75	30.63	27.25
10/06/95	8:30	2.62	11.89	12.38	2.08	12.00	11.00
10/13/95	14:30	0.00	29.89	31.89	0.00	24.00	25.00
10/20/95	14:00	0.00	22.78	27.61	0.00	20.25	24.50
10/27/95	13:30	0.00	26.78	25.72	0.00	22.50	28.25
11/03/95	13:30	0.48	4.72	12.78	0.33	10.25	14.75
11/0895	11:00	0.03	11.11	13.89	0.00	9.50	17.00
11/11/95	10:00	0.03	19.78	16.11	0.01	0.08	2.00
11/13/95	16:00	0.08	21.00	20.11	0.00	14.75	15.50

APPENDIX E

Dermacentor albipictus Laboratory Reared Specimens for Headfire and Backfire Comparison, Oklahoma State University, Stillwater, Oklahoma, 1996

Date	Weight (g)	Date	Weight (g)	Date	Weight (g)	Date	Weight (g)
09/15/96	0.6094	09/15/96	0.4738	09/15/96	0.4298	09/15/96	0.3870
09/15/96	0.5827	09/15/96	0.4647	09/15/96	0.4267	09/15/96	0.3841
09/15/96	0.5404	09/15/96	0.4638	09/15/96	0.4206	09/15/96	0.3806
09/15/96	0.5386	09/15/96	0.4636	09/15/96	0.4185	09/15/96	0.3805
09/15/96	0.5375	09/15/96	0.4622	09/15/96	0.4160	09/15/96	0.3785
09/15/96	0.5272	09/15/96	0.4616	09/15/96	0.4125	09/15/96	0.3780
09/15/96	0.5252	09/15/96	0.4610	09/15/96	0.4125	09/15/96	0.3760
09/15/96	0.5231	09/15/96	0.4610	09/15/96	0.4120	09/15/96	0.3758
09/15/96	0.5214	09/15/96	0.4591	09/15/96	0.4100	09/15/96	0.3751
09/15/96	0.5205	09/15/96	0.4569	09/15/96	0.4099	09/15/96	0.3723
09/15/96	0.5164	09/15/96	0.4523	09/15/96	0.4089	09/15/96	0.3715
09/15/96	0.5156	09/15/96	0.4519	09/15/96	0.4086	09/15/96	0.3652
09/15/96	0.5109	09/15/96	0.4499	09/15/96	0.4081	09/15/96	0.3630
09/15/96	0.5079	09/15/96	0.4470	09/15/96	0.4068	09/15/96	0.3595
09/15/96	0.5078	09/15/96	0.4449	09/15/96	0.4066	09/15/96	0.3566
09/15/96	0.4996	09/15/96	0.4435	09/15/96	0.4059	09/15/96	0.3495
09/15/96	0.4971	09/15/96	0.4425	09/15/96	0.4016	09/15/96	0.3456
09/15/96	0.4968	09/15/96	0.4388	09/15/96	0.3996	09/15/96	0.3429
09/15/96	0.4919	09/15/96	0.4381	09/15/96	0.3957	09/15/96	0.3331
09/15/96	0.4895	09/15/96	0.4336	09/15/96	0.3951	09/15/96	0.3250
09/15/96	0.4844	09/15/96	0.4330	09/15/96	0.3950	09/15/96	0.3231
09/15/96	0.4805	09/15/96	0.4317	09/15/96	0.3947	09/15/96	0.3087
09/15/96	0.4771	09/15/96	0.4309	09/15/96	0.3934	09/15/96	0.2929
09/15/96	0.4754	09/15/96	0.4309	09/15/96	0.3925	09/15/96	0.2049
09/15/96	0.4740	09/15/96	0.4304	09/15/96	0.3918	09/15/96	0.1966

APPENDIX F

Burn Study Research Plot Assignments, Pasture #15, Payne County, Oklahoma, 1996

Plot	Zone	Weight (g)	Plot	Zone	Weight (g)	Plot	Zone	Weight (g)
1	5	0.3934	3	3	0.3785	5	3	0.4304
1	7	0.4919	3	5	0.4591	5	7	0.3231
1	9	0.4738	3	11	0.1966	5	9	0.3715
1	12	0.2049	3	13	0.5386	5	10	0.4435
1	18	0.3566	3	17	0.4499	5	22	0.4125
1	22	0.4381	3	24	0.6094	5	24	0.4647
2	4	0.3947	4	7	0.4309	6	13	0.4089
2	7	0.5156	4	3	0.4081	6	1	0.4425
2	8	0.3780	4	9	0.3806	6	3	0.4120
2	11	0.5214	4	11	0.5231	6	9	0.5272
2	14	0.4309	4	21	0.2929	6	18	0.4068
2	24	0.4099	4	22	0.4771	6	20	0.3495

APPENDIX G

Comparison of Laboratory and Field Oviposition, Payne County, Oklahoma, 1995

Weight (g)	Date	No. Eggs	Group	Ovip. Day	No. Hatch	Loss Day
0.7927	12/20/94	3226	L	01/18/95	---	---
0.7386	12/20/94	3059	L	01/18/95	---	---
0.7081	12/21/94	1881	L	01/18/95	---	---
0.6954	12/21/94	2431	L	01/18/95	---	---
0.6654	12/20/94	2528	L	01/18/95	---	---
0.6574	12/21/94	2468	L	01/18/95	---	---
0.6300	12/20/94	2066	L	01/18/95	---	---
0.6065	12/20/94	1962	L	01/18/95	---	---
0.5974	12/20/94	2011	L	01/18/95	---	---
0.5970	12/21/94	2320	L	01/18/95	---	---
0.5959	12/21/94	2087	L	01/18/95	---	---
0.5848	12/21/94	1483	L	01/18/95	---	---
0.5814	12/21/94	1866	L	01/18/95	---	---
0.5800	12/20/94	1882	L	01/18/95	---	---
0.5799	12/20/94	1740	L	01/18/95	---	---
0.5769	12/20/94	1715	L	01/18/95	---	---
0.5689	12/20/94	1715	L	01/18/95	---	---
0.5664	12/20/94	1969	L	01/18/95	---	---
0.5600	12/20/94	1337	L	01/18/95	---	---
0.5584	12/21/94	1468	L	01/18/95	---	---
0.5485	12/20/94	1786	L	01/18/95	---	---
0.5309	12/21/94	4706	L	01/18/95	---	---
0.5284	12/20/94	1412	L	01/18/95	---	---
0.5176	12/20/94	1223	L	01/18/95	---	---
0.3396	12/08/94	2459	L	01/18/95	---	---
0.7596	12/20/94	---	F	---	---	6
0.6781	12/20/94	---	F	---	---	27
0.6763	12/20/94	---	F	---	---	27
0.6679	12/20/94	---	F	---	---	6
0.6618	12/20/94	---	F	---	---	111
0.6554	12/21/94	---	F	---	---	6
0.6522	12/21/94	---	F	---	---	6
0.6430	12/20/94	1299	F	04/06/95	1	N/A
0.6300	12/20/94	1092	F	04/21/95	437	N/A
0.6241	12/21/94	---	F	---	---	6
0.6166	12/20/94	1432	F	04/21/95	37	N/A
0.6150	12/20/94	---	F	---	---	62
0.6039	12/21/94	---	F	---	---	---
0.5966	12/21/94	1602	F	04/13/98	811	---
0.5825	12/20/94	---	F	---	---	6
0.5819	12/21/94	---	F	---	---	111
0.5694	12/21/94	---	F	---	---	6
0.5670	12/20/94	---	F	---	---	6
0.5585	12/20/94	---	F	---	---	27
0.5530	12/21/94	---	F	---	---	27
0.5500	12/20/94	---	F	---	---	62
0.5448	12/20/94	---	F	04/06/95	---	111
0.5448	12/21/94	---	F	---	---	---
0.5068	12/21/94	622	F	04/13/95	13	N/A
0.4971	12/20/94	---	F	---	---	---

APPENDIX H

Post Burn Sampling of Engorged Female *Dermacentor albipictus* Ticks, Pasture #15, Payne County, Oklahoma, 1995-1996 from Treatment (B) and Control (C) Groups

Date	Weight (g)	Group	Date	Weight (g)	Group	Date	Weight (g)	Group
12/06/95	X	B	12/13/95	0.2635	C	12/14/95	X	C
12/06/95	X	C	12/13/95	0.2636	C	12/14/95	X	C
12/07/95	X	B	12/13/95	0.2654	C	12/15/95	0.1642	B
12/07/95	X	C	12/13/95	0.2655	C	12/15/95	0.1767	B
12/08/95	X	B	12/13/95	0.3301	C	12/15/95	0.2048	B
12/08/95	X	C	12/13/95	X	C	12/15/95	0.2668	B
12/09/95	X	B	12/13/95	X	C	12/15/95	0.2671	B
12/09/95	X	C	12/13/95	X	C	12/15/95	0.2821	B
12/11/95	X	B	12/13/95	X	C	12/15/95	0.2825	B
12/11/95	0.2680	C	12/13/95	X	C	12/15/95	0.2990	B
12/11/95	0.2739	C	12/14/95	0.2142	B	12/15/95	0.2994	B
12/11/95	0.4066	C	12/14/95	0.2249	B	12/15/95	0.3030	B
12/12/95	0.0000	B	12/14/95	0.3661	B	12/15/95	0.3091	B
12/12/95	0.0434	C	12/14/95	0.4137	B	12/15/95	0.3344	B
12/12/95	0.0656	C	12/14/95	0.4605	B	12/15/95	0.3615	B
12/12/95	0.0673	C	12/14/95	0.4724	B	12/15/95	0.3657	B
12/12/95	0.0676	C	12/14/95	0.4781	B	12/15/95	0.3869	B
12/12/95	0.0721	C	12/14/95	0.0643	C	12/15/95	0.3997	B
12/12/95	0.0725	C	12/14/95	0.0845	C	12/15/95	0.4029	B
12/12/95	0.0738	C	12/14/95	0.0861	C	12/15/95	0.4064	B
12/12/95	0.0744	C	12/14/95	0.0890	C	12/15/95	0.4206	B
12/12/95	0.0745	C	12/14/95	0.0965	C	12/15/95	0.4709	B
12/12/95	0.0769	C	12/14/95	0.1129	C	12/15/95	X	B
12/12/95	0.3634	C	12/14/95	0.1208	C	12/15/95	0.0463	C
12/12/95	X	C	12/14/95	0.1289	C	12/15/95	0.0581	C
12/12/95	X	C	12/14/95	0.1391	C	12/15/95	0.0643	C
12/13/95	0.2505	B	12/14/95	0.1536	C	12/15/95	0.0975	C
12/13/95	0.2627	B	12/14/95	0.1995	C	12/15/95	0.1181	C
12/13/95	0.0242	C	12/14/95	0.2186	C	12/15/95	0.1449	C
12/13/95	0.0432	C	12/14/95	0.2194	C	12/15/95	0.1528	C
12/13/95	0.0440	C	12/14/95	0.2268	C	12/15/95	0.1624	C
12/13/95	0.0505	C	12/14/95	0.2316	C	12/15/95	0.1785	C
12/13/95	0.0685	C	12/14/95	0.2418	C	12/15/95	0.1824	C
12/13/95	0.0688	C	12/14/95	0.2840	C	12/15/95	0.1829	C
12/13/95	0.1005	C	12/14/95	0.3174	C	12/15/95	0.1839	C
12/13/95	0.1163	C	12/14/95	0.3176	C	12/15/95	0.1846	C
12/13/95	0.1470	C	12/14/95	0.3396	C	12/15/95	0.1861	C
12/13/95	0.1601	C	12/14/95	0.3406	C	12/15/95	0.1885	C
12/13/95	0.1676	C	12/14/95	0.3520	C	12/15/95	0.2136	C
12/13/95	0.1815	C	12/14/95	0.3526	C	12/15/95	0.2160	C
12/13/95	0.1936	C	12/14/95	0.3644	C	12/15/95	0.2260	C
12/13/95	0.1984	C	12/14/95	0.3691	C	12/15/95	0.2350	C
12/13/95	0.2081	C	12/14/95	0.3869	C	12/15/95	0.2536	C
12/13/95	0.2181	C	12/14/95	0.3891	C	12/15/95	0.2611	C
12/13/95	0.2483	C	12/14/95	X	C	12/15/95	0.2624	C
12/13/95	0.2501	C	12/14/95	X	C	12/15/95	0.2681	C
12/13/95	0.2609	C	12/14/95	X	C	12/15/95	0.2707	C
12/13/95	0.2619	C	12/14/95	X	C	12/15/95	0.2838	C
12/15/95	0.2871	C	12/16/95	0.3047	B	12/16/95	0.3070	C
12/15/95	0.2905	C	12/16/95	0.3085	B	12/16/95	0.3089	C
12/15/95	0.2962	C	12/16/95	0.3105	B	12/16/95	0.3109	C
12/15/95	0.2973	C	12/16/95	0.3182	B	12/16/95	0.3125	C
12/15/95	0.2976	C	12/16/95	0.3709	B	12/16/95	0.3138	C
12/15/95	0.3001	C	12/16/95	0.3794	B	12/16/95	0.3209	C
12/15/95	0.3035	C	12/16/95	0.4341	B	12/16/95	0.3240	C

APPENDIX H

Continued

Date	Weight (g)	Group	Date	Weight (g)	Group	Date	Weight (g)	Group
12/15/95	0.3080	C	12/16/95	0.4566	B	12/16/95	0.3269	C
12/15/95	0.3109	C	12/16/95	0.0629	C	12/16/95	0.3280	C
12/15/95	0.3112	C	12/16/95	0.0943	C	12/16/95	0.3294	C
12/15/95	0.3124	C	12/16/95	0.0965	C	12/16/95	0.3436	C
12/15/95	0.3130	C	12/16/95	0.1168	C	12/16/95	0.3440	C
12/15/95	0.3131	C	12/16/95	0.1290	C	12/16/95	0.3444	C
12/15/95	0.3175	C	12/16/95	0.1525	C	12/16/95	0.3489	C
12/15/95	0.3234	C	12/16/95	0.1536	C	12/16/95	0.3500	C
12/15/95	0.3292	C	12/16/95	0.1564	C	12/16/95	0.3797	C
12/15/95	0.3315	C	12/16/95	0.1616	C	12/16/95	0.3825	C
12/15/95	0.3345	C	12/16/95	0.1630	C	12/16/95	0.3851	C
12/15/95	0.3359	C	12/16/95	0.1660	C	12/16/95	0.3991	C
12/15/95	0.3395	C	12/16/95	0.1764	C	12/16/95	0.4106	C
12/15/95	0.3421	C	12/16/95	0.1806	C	12/16/95	0.4427	C
12/15/95	0.3456	C	12/16/95	0.1896	C	12/16/95	0.7270	C
12/15/95	0.3550	C	12/16/95	0.1910	C	12/16/95	0.8691	C
12/15/95	0.3611	C	12/16/95	0.1990	C	12/16/95	X	C
12/15/95	0.3666	C	12/16/95	0.2029	C	12/16/95	X	C
12/15/95	0.3669	C	12/16/95	0.2070	C	12/16/95	X	C
12/15/95	0.3691	C	12/16/95	0.2129	C	12/16/95	X	C
12/15/95	0.3722	C	12/16/95	0.2149	C	12/16/95	X	C
12/15/95	0.3861	C	12/16/95	0.2174	C	12/16/95	X	C
12/15/95	0.3905	C	12/16/95	0.2256	C	12/16/95	X	C
12/15/95	0.4150	C	12/16/95	0.2267	C	12/16/95	X	C
12/15/95	0.4494	C	12/16/95	0.2304	C	12/17/95	0.1761	B
12/15/95	X	C	12/16/95	0.2382	C	12/17/95	0.2242	B
12/15/95	X	C	12/16/95	0.2398	C	12/17/95	0.2530	B
12/15/95	X	C	12/16/95	0.2444	C	12/17/95	0.2954	B
12/15/95	X	C	12/16/95	0.2498	C	12/17/95	0.3031	B
12/16/95	0.0850	B	12/16/95	0.2559	C	12/17/95	0.3166	B
12/16/95	0.1091	B	12/16/95	0.2625	C	12/17/95	0.3215	B
12/16/95	0.1965	B	12/16/95	0.2643	C	12/17/95	0.3239	B
12/16/95	0.2076	B	12/16/95	0.2842	C	12/17/95	0.3314	B
12/16/95	0.2364	B	12/16/95	0.2866	C	12/17/95	0.3824	B
12/16/95	0.2435	B	12/16/95	0.2916	C	12/17/95	0.4050	B
12/16/95	0.2527	B	12/16/95	0.2954	C	12/17/95	X	B
12/16/95	0.2651	B	12/16/95	0.2985	C	12/17/95	X	B
12/16/95	0.2658	B	12/16/95	0.3000	C	12/17/95	0.0532	C
12/16/95	0.2677	B	12/16/95	0.3004	C	12/17/95	0.0688	C
12/16/95	0.3016	B	12/16/95	0.3029	C	12/17/95	0.1422	C
12/16/95	0.3040	B	12/16/95	0.3035	C	12/17/95	0.1437	C
12/17/95	0.1625	C	12/18/95	0.4220	C	12/26/95	0.1748	C
12/17/95	0.1984	C	12/18/95	X	C	12/26/95	0.1889	C
12/17/95	0.1990	C	12/18/95	X	C	12/26/95	0.2026	C
12/17/95	0.2024	C	12/18/95	X	C	12/26/95	0.2151	C
12/17/95	0.2219	C	12/18/95	X	C	12/26/95	0.2474	C
12/17/95	0.2358	C	12/18/95	X	C	12/26/95	0.2786	C
12/17/95	0.2372	C	12/19/95	X	B	12/26/95	0.2942	C
12/17/95	0.2426	C	12/19/95	X	C	12/26/95	0.3267	C
12/17/95	0.2515	C	12/20/95	0.2570	B	12/26/95	X	C
12/17/95	0.2632	C	12/20/95	0.2876	B	12/27/95	0.1566	B
12/17/95	0.2750	C	12/20/95	0.2925	B	12/27/95	0.4283	B
12/17/95	0.2780	C	12/20/95	0.2979	B	12/27/95	0.0506	C
12/17/95	0.2984	C	12/20/95	0.3588	B	12/27/95	0.0715	C
12/17/95	0.3026	C	12/20/95	0.4036	B	12/27/95	0.0794	C
12/17/95	0.3156	C	12/20/95	0.1861	C	12/27/95	0.1158	C

APPENDIX H

Continued

Date	Weight (g)	Group	Date	Weight (g)	Group	Date	Weight (g)	Group
12/17/95	0.3285	C	12/20/95	0.1864	C	12/27/95	0.1252	C
12/17/95	0.3424	C	12/20/95	0.2747	C	12/27/95	0.1366	C
12/17/95	0.3597	C	12/20/95	X	C	12/27/95	0.1430	C
12/17/95	0.3630	C	12/20/95	X	C	12/27/95	0.2272	C
12/17/95	0.3807	C	12/21/95	0.1001	B	12/27/95	0.2348	C
12/17/95	0.4259	C	12/21/95	0.2071	B	12/27/95	0.2554	C
12/17/95	X	C	12/21/95	0.2136	B	12/27/95	0.2963	C
12/18/95	0.1186	B	12/21/95	X	C	12/27/95	0.2971	C
12/18/95	0.2728	B	12/22/95	0.2429	B	12/27/95	X	C
12/18/95	0.2837	B	12/22/95	0.2186	C	12/28/95	0.1486	B
12/18/95	0.3352	B	12/22/95	0.2267	C	12/28/95	0.2026	B
12/18/95	0.3394	B	12/22/95	0.2919	C	12/28/95	X	B
12/18/95	X	B	12/22/95	0.4182	C	12/28/95	0.0736	C
12/18/95	X	B	12/23/95	0.1577	B	12/28/95	0.1006	C
12/18/95	X	B	12/23/95	0.1928	B	12/28/95	0.1282	C
12/18/95	0.0389	C	12/23/95	X	B	12/28/95	0.1294	C
12/18/95	0.1125	C	12/23/95	X	C	12/28/95	0.1298	C
12/18/95	0.1639	C	12/24/95	0.0000	B	12/28/95	0.1430	C
12/18/95	0.1806	C	12/24/95	0.0000	C	12/28/95	0.1842	C
12/18/95	0.1816	C	12/25/95	0.1996	B	12/28/95	0.2076	C
12/18/95	0.1854	C	12/25/95	0.2079	B	12/28/95	0.2212	C
12/18/95	0.1869	C	12/25/95	0.2663	B	12/28/95	0.2243	C
12/18/95	0.2658	C	12/25/95	0.1305	C	12/28/95	0.2285	C
12/18/95	0.2885	C	12/25/95	0.2536	C	12/28/95	0.2288	C
12/18/95	0.2906	C	12/26/95	0.1748	B	12/28/95	0.2359	C
12/18/95	0.2997	C	12/26/95	0.1890	B	12/28/95	0.2371	C
12/18/95	0.3055	C	12/26/95	0.2135	B	12/28/95	0.2564	C
12/18/95	0.3059	C	12/26/95	0.0655	C	12/28/95	0.2616	C
12/18/95	0.3141	C	12/26/95	0.0916	C	12/28/95	0.2621	C
12/18/95	0.3192	C	12/26/95	0.1266	C	12/28/95	0.2735	C
12/18/95	0.3196	C	12/26/95	0.1528	C	12/28/95	0.2768	C
12/18/95	0.3319	C	12/26/95	0.1533	C	12/28/95	0.2826	C
12/18/95	0.4157	C	12/26/95	0.1724	C	12/28/95	0.2888	C
12/28/95	0.3085	C	12/29/95	0.2562	C	12/31/95	0.2367	C
12/28/95	0.3314	C	12/29/95	0.3042	C	12/31/95	0.2430	C
12/28/95	0.3594	C	12/29/95	X	C	12/31/95	0.2439	C
12/28/95	0.3748	C	12/29/95	X	C	12/31/95	0.2676	C
12/28/95	0.3845	C	12/29/95	X	C	12/31/95	0.3788	C
12/28/95	0.4254	C	12/30/95	0.1869	B	12/31/95	X	C
12/28/95	X	C	12/30/95	0.2281	B	01/01/96	0.2091	B
12/28/95	X	C	12/30/95	0.2340	B	01/01/96	0.2375	B
12/28/95	X	C	12/30/95	0.3185	B	01/01/96	0.2989	B
12/28/95	X	C	12/30/95	0.2138	C	01/01/96	0.4398	B
12/28/95	X	C	12/31/95	0.1872	B	01/01/96	0.1824	C
12/28/95	X	C	12/31/95	0.2627	B	01/02/96	0.0000	B
12/28/95	X	C	12/31/95	0.1191	C	01/02/96	0.1709	C
12/29/95	0.1114	B	12/31/95	0.1248	C	01/02/96	0.2041	C
12/29/95	0.1581	B	12/31/95	0.1705	C	01/03/96	0.0000	B
12/29/95	0.2034	B	12/31/95	0.1780	C	01/03/96	0.0000	C
12/29/95	0.2051	B	12/31/95	0.1971	C	01/04/96	0.3185	B
12/29/95	X	B	12/31/95	0.2024	C	01/04/96	0.3134	C
12/29/95	0.1142	C	12/31/95	0.2159	C	01/05/96	X	B
12/29/95	0.1680	C	12/31/95	0.2225	C	01/05/96	X	C
12/29/95	0.2561	C	12/31/95	0.2286	C	-----	-----	-----

The "X" denotes ticks stepped on and destroyed by the calves included here for total count only.

VITA

Jason Paul Gibson

Candidate for the Degree of Master of Science

Thesis: **FALL BURNING OF GRASSLAND TO CONTROL *DERMACENTOR ALBIPICTUS* (PACKARD) LARVAE**

Major Field: Entomology

Biographical:

Personal Data: Born in Little Rock, Arkansas, April 3, 1970, the son of Harold L. and Alice Gibson.

Education: Graduated from Shawnee High School, Shawnee, Oklahoma in May 1988; Completed Bachelor of Science in Agricultural Sciences and Natural Resources from Oklahoma State University, Stillwater, Oklahoma in December 1992; Completed the requirements for the Master of Science degree with a major in Entomology at Oklahoma State University in December 2000.

Experience: Graduate Research Assistant and Graduate Teaching Assistant, Oklahoma State University, Department of Entomology, 1994 to 1997; Medical Service Corps Officer, Oklahoma Army National Guard, 1993 to present; Instructor and Training Officer, Oklahoma Regional Training Institute, 1998 to present.

Professional Memberships: Entomological Society of America; Southwestern Entomological Society; Association of Military Surgeons of the United States.