Wood Boring Insect Infestations in Relation to Mesquite Control Practices

D. N. UECKERT AND H. A. WRIGHT

Highlight: *Wood boring insect activity in mesquite wood is of interest to fire ecologists because infested trees are much easier to burn down than uninfested trees. Wood borer tunnelling in mesquite killed by six different methods was compared over a 2-year period. Basal spraying with diesel oil + 2,4,5-T and girdling resulted in significantly more tunnelling by wood borers. Borer activity was intermediate in trees killed by basal spraying with diesel, and by burning; slight in felled trees (simulated chaining or root-plowing); and insignificant in trees top-killed by 2,4,5-T spray and in the control. Ranchers planning to use prescribed burning as a method of removing dead mesquite stems from rangeland previously treated with conventional mesquite control practices could expect a high degree of wood borer activity, and hence a greater burndown in pastures where trees have been killed in previous years by basal spraying with diesel oil + 2,4,5-T. Wood borer activity will be substantial for good burndown in trees top-killed by basal treatment with diesel oil and by burning.*

Wood boring insect activity is common in honey mesquite trees (*Prosopis glandulosa* var. *glandulosa*) that have been top-killed by fire or drought, but not in trees top-killed with a 2,4,5-T spray (Britton and Wright, 1971). Borer activity is of particular interest to fire ecologists because mesquite trees infested with wood borers burn down much easier. Ranchers in mesquite-tobosa communities, and other plant communities where burning may be feasible, are becoming increasingly interested in prescribed burning to increase forage production and quality, to control live mesquite, and to remove dead mesquite killed by previous brush control programs. This study was undertaken to determine which brush control treatments enhance borer activity, in order to assist ranchers who are considering subsequent removal of dead trees by burning in selecting initial mesquite control treatments.

The authors are associate professor and professor, respectively, Range and Wildlife Management Department, Texas Tech University, Lubbock.

The study is Texas Tech University, College of Agricultural Sciences Publication No. T-9-132.

Manuscript received September 17, 1973.

Boring insect activity in mesquite stems provides a more efficient transfer of heat into the stem and transfer of gas out, resulting in a decreased ignition time (Britton and Wright, 1971). Moreover, Burton et al. (1972) found that intensive activity by wood borers reduced the time required for ignition of mesquite wood by about one-half, without altering the ignition temperature. They theorized that this was caused by factors which resulted in more rapid heating of the wood surface, such as (1) an increased surface-to-volume ratio resulting from unfilled borer tunnels which supplied internal heating paths; (2) a lower sapwood thermal conductivity due to borer tunnels filled with frass; and (3) a combination of both phenomena. Numerous species of wood boring insect larvae, including flat-headed borers (Buprestidae), round-headed borers (Cerambycidae), branch or twig borers (Bostrichidae), and powder-post beetles (Lyctidae) feed and develop within dead mesquite wood (Burke, 1918; Van Dyke, 1918; Fisher, 1942; Craighead, 1921, 1949; Werner and Butler, unpublished). The larval galleries or tunnels of flat-headed borers, usually flattened or oval in cross-section, are always tightly packed with fine, saw-dust-like frass. Flat-headed borers tunnel within the cambium layer, as well as through the sapwood and heartwood. The adults, commonly known as metalic wood borers, emerge from the bark through very characteristic oval or elliptical exit holes. Branch or twig borer and powder-post beetle larvae mine through dry sapwood with small round tunnels which become tightly packed with dry,powder-like frass. The adults emerge through small, round exit holes. Round-headed wood borers usually produce large round tunnels and may produce fine sawdust, flaky chips of wood, or long fibrous, excelsior-like shreds of wood, which may be tightly packed behind the larvae or extruded through small holes, leaving the tunnels or galleries open. Their adults, long-horned beetles, emerge through larger, round exit holes (Craighead, 1949).

Methods and Materials

This study was conducted on a heavy clay range site, dominated by honey mesquite and tobosagrass (*Hilaria mutica*), 16 km south of Post, Texas, in Garza County. Honey mesquite trees on the study area were mostly single-stemmed trees 2-3 m in height and 7-12 cm in diameter. Six treatments, includ-

Feb. 1. *Honey mesquite trees killed by basal application of diesel oil in 1970 were heavily infested with both small wood borers and large wood borers by 1971. Many branches had been severely weakened by borers and had fallen to the ground.*

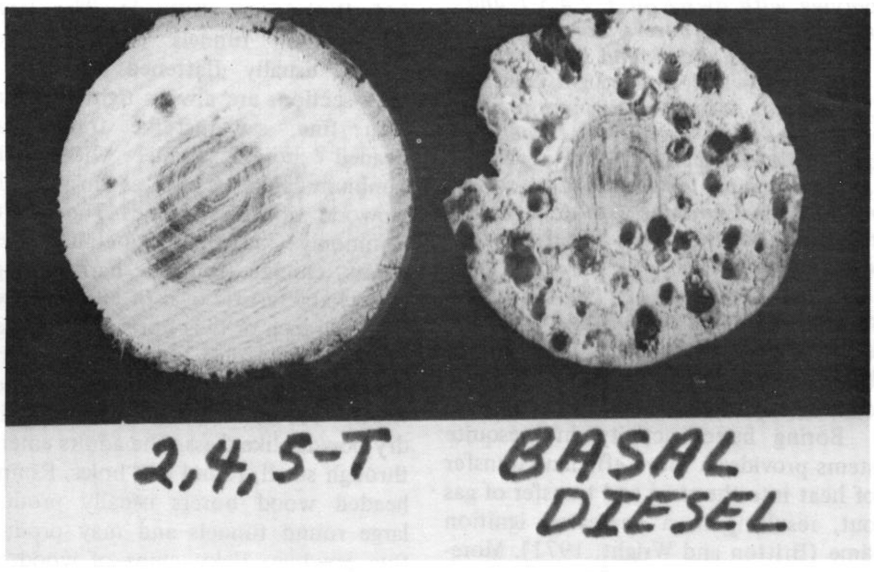

Fig. 2. *Tunnelling by small wood borers was extensive in the sapwood of honey mesquite trees killed by basal application of diesel oil, diesel oil + 2,4,5-T, and by girdling; whereas, trees killed by aerial application of 2,4,5-T and live trees were not infested.*

Table 1. Mean numbers of wood-boring insect tunnels per cross-section in stems and branches of honey mesquite in 1971 and 1972 following application of various brush control treatments in 1970. Means have been adjusted by covariance to remove effect of tree size and branch diameter.

	No. small tunnels		No. large tunnels	
Treatments	1971	1972	1971	1972
Control	0.3 b[1]	0.0 a	0.6 c	0.0 a
Aerial spray (2,4,5-T)	.0 a	.2 a	.5 b	.1 a
Fell	1.4 d	3.6 ab	.5 b	1.8 b
Burn (butane)	.7 c	6.0 ab	1.4 d	2.5 bc
Basal spray (diesel)	5.2 f	10.0 bc	1.8 e	2.3 bc
Basal spray (diesel + 2,4,5-T)	3.7 e	16.9 c	0.2 a	3.0 c
Girdle	11.5 g	16.6 c	2.2 f	2.8 bc

[1] Values within a column followed by similar letters are not significantly different from each other at the 90% level of probability.

ing: (1) aerial spraying with the propylene glycol butyl ether esters of the herbicide 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T); (2) basal treatment of mesquite stems with diesel oil + 2,4,5-T; (3) basal treatment of mesquite stems with diesel oil; (4) burning with butane torch (simulated range fire); (5) felling at ground level with a chain saw (simulated chaining or root-plowing); and (6) girdling with chain saw, were each applied to randomly selected groups of 10 trees in late June, 1970. Ten randomly selected trees were left untreated as a control. All trees were permanently marked for future reference.

On August 2, 1971, three trees from each of the treatments were collected and taken to the laboratory where cross-sections of various sizes of branches were cut and the numbers of woodboring insect tunnels per cross-section and the diameter of each cross-section were recorded. Approximately 20 cross-sections (range 8-29) were taken from each tree. On June 30, 1972, five additional trees from each treatment were collected and taken to the laboratory, where 25 cross-sections from each tree were cut, and similar data were recorded. These data were analyzed as randomized complete block designs with covariance to determine differences between treatments for (1) tunnelling activity by small borers such as branch borers, death-watch beetles, and powder-post beetles and (2) tunnelling activity by larger borers such as flat-headed and round-headed borers. Cross-section diameters were used as the covariant, to eliminate variation in branch and tree size. Ten billets, 15 cm in length, were cut from mesquite stems over 2.5 cm in diameter from trees collected in 1972, the bark was removed, and tunnelling damage in the cambium layer by maturing flat-headed borers was ranked by three observers on a scale from 0-5, where 0 indicated the absence of tunnels and 5 indicated that over 80% of the cambium layer had been consumed by flat-headed borers. The averages of the three observers' rankings were used as data. These data were analyzed with analysis of variance as a randomized complete block design. Duncan's multiple range test was used where appropriate to separate treatment means. A paired t-test was used to determine if total wood boring insect activity on all the treatments increased from 1971 to 1972.

Mesquite wood samples from each of the treatments and the control were enclosed in rearing cages in the laboratory for collecting adult specimens of wood borers for identification. Specimens of the adult insects were shipped to appropriate specialists for taxonomic determinations.

Results and Discussion

The method of top-killing honey mesquite had a significant effect on the ensuing infestations of the dead wood by boring insects. Quantitative counts of small borer tunnels in cross-sections of mesquite branches in 1971 (Table 1) revealed that girdling and basal treatment with diesel oil resulted in the highest degree of small wood borer activity (Figs. 1 and 2).

Girdling and basal treatment with diesel oil also proved to be the treatments which attracted most larger borers (Table 1; Fig. 3). Examination of cross-sections of mesquite branches in 1972, the second year following application of treatments, revealed very similar results for both small and large borer activity, with the major exception that both small and large borer activity had increased tremendously in trees killed by basal application of diesel oil + 2,4,5-T (Table 1). In 1972, activity by small borers was highest in trees killed by basal application of diesel oil + 2,4,5-T, girdling, and basal application of diesel oil. Small borer activity was negligible in the control and in trees top-killed with aerial application of 2,4,5-T, and was intermediate in trees top-killed by felling and burning. In 1972, large borer activity was greatest in trees basally treated with diesel oil + 2,4,5-T, intermediate in trees killed by girdling, burning, and by basal treatment with diesel oil, and negligible in untreated trees, in trees top-killed with aerial application of 2,4,5-T, and in felled trees. The total number of all sizes of wood borer tunnels increased significantly ($P < .05$) from 1971 to 1972, with the greatest increase occurring in trees treated basally with diesel oil + 2,4,5-T. In 1971, girdling and basal application of diesel oil resulted in the greatest degree of wood borer activity; however, by 1972, basal treatment with diesel oil + 2,4,5-T and girdling resulted in the highest degree of activity, while basal treatment with diesel oil and the burning treatment were in an intermediate category. In both years, total activity by wood borers was lowest in untreated trees, in trees killed by aerial application of 2,4,5-T, and in those which were felled. Examination of bolts in 1972 for activity by flat-headed borer larvae in the cambium of treated mesquite trees (Table 2; Fig. 4) revealed very similar results.

Differential response of wood boring insects to mesquite wood killed by different methods can perhaps be explained physiologically. Wood boring larvae feed on the wood which they inhabit, and most species rely on starches and sugars in the wood as sources of energy. The application of lethal quantities of 2,4,5-T to the leaves of honey mesquite is believed to result in one or more of several phenomena, including: (1) depletion of carbohydrates normally stored in the pith and xylem parenchyma cells; (2) formation

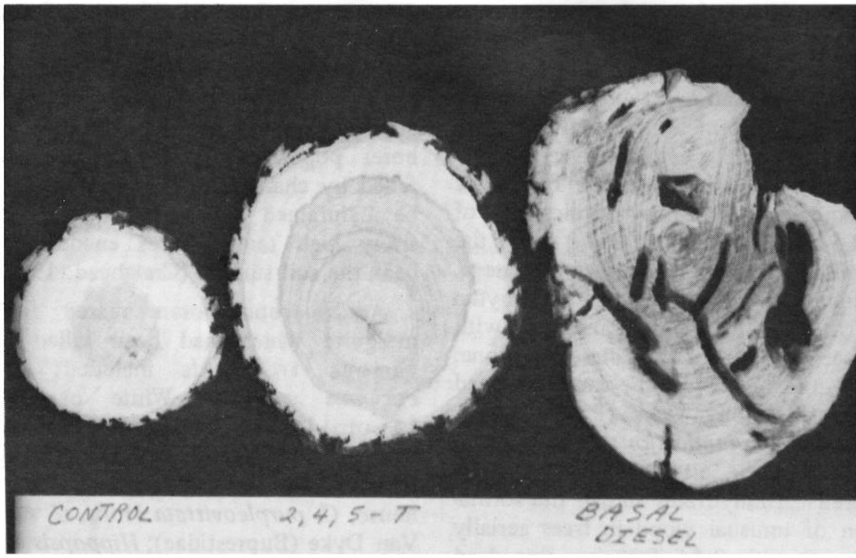

Fig. 3. *Large flat-headed borers tunnelled extensively in the heartwood of honey mesquite trees killed by burning, basal application of diesel oil, or diesel oil + 2,4,5-T, and by girdling; whereas live trees and those killed by aerial application of 2,4,5-T were not infested. (Frass has been removed from galleries for illustration.)*

Fig. 4. *Examples of various degrees of flat-headed borer tunnelling in the cambium layer of honey mesquite trees killed by various methods. (Numerical values indicate increasing degrees of tunnelling.)*

Table 2. Ranking of degree of flat-headed borer activity in the cambium layer of dead mesquite wood in 1972 following various brush control treatments applied in 1970.

Treatments	Tunnelling in cambium layer
Control	0.0 a[1]
Aerial spray 2,4,5-T	.6 a
Fell	1.9 b
Burn (butane)	2.2 bc
Basal spray (diesel + 2,4,5-T)	2.1 bc
Girdle	2.6 bc
Basal (diesel)	3.0 c

[1] Values within a column followed by similar letters are not significantly different at the 95% level of probability.

of an abnormal wood with narrow, thick-walled vessels and axial parenchyma cells in which wall thickening is inhibited; and (3) the transformation of the fusiform initials into septate parenchyma cells (Meyer, 1970; Robnett and Morey, 1973). Topkill of mesquite with foliar application of 2,4,5-T is slow, and in 4 to 6 weeks the cambium may be indistinct or absent, being replaced by septate parenchyma cells. Basal treatment of mesquite with diesel oil + 2,4,5-T, or diesel oil alone, kills quickly, leaving the cambium dead and structurally weak (P. R. Morey, *personal communication*).

Apparently, either the depletion of stored carbohydrates and/or the formation of unusual wood in trees aerially sprayed with 2,4,5-T makes this dead mesquite wood unsuitable for wood boring larvae, either because the wood no longer is nutritionally suitable, or because the unusual structure of the new wood creates a habitat unfavorable for egg deposition, incubation, or development and movement of young larvae.

Other physiological changes in the mesquite wood following application of top-killing treatments may also explain differential infestations of wood boring insects. Some brush control treatments, such as basal treatment with diesel oil, basal treatment with diesel oil + 2,4,5-T, and burning may significantly reduce relative water content of honey mesquite, while others such as aerial spraying with 2,4,5-T may increase relative water content in the cambium and sapwood and create conditions which fail to elicit oviposition response of adult beetles or create intolerable conditions for brood development (Hodges and Pickard, 1971; Williamson, 1971). A preference for vertical host configuration in mesquite wood boring insects may be the reason that felled trees were somewhat resistant to attack by wood borers (Vite and Crozier, 1968). Wood borer populations in mesquite wood felled by chaining or root-plowing may be maintained at low levels by excessively high temperatures encountered near the soil surface (Craighead, 1920).

Adult wood borers reared from mesquite which had been killed by various treatments included: *Tricorymus extremus* White or near (Anobiidae); *Acmaeodera gibbula* LeConte, *Chrysobothris acaciae* Knull, *C. exesa* LeConte, *C. lateralis* Waterhouse, *C. purpleovittata* Horn, *C. rossi* Van Dyke (Buprestidae); *Hippopsis* sp., *Oncideres rhodosticta* Bates, *Taranomis bivittata* (Dupont) (Cerambycidae), *Amphicerus bicaudatus* (Say), *Apatides fortis* (LeConte), *Xyloblaptus quadrispinosus* (LeConte) (Bostrichidae), *Trogoxylon parallelopipedum* (Melsheimer) (Lyctidae), and *Oryzaephilus surinamensis* (L.) (Cucujidae).

Ranchers planning to use prescribed burning as a method of removing dead mesquite stems from rangeland previously treated with conventional mesquite control practices could expect a greater burndown in pastures where trees have been controlled in previous years by basal treatment with diesel oil + 2,4,5-T. Previous control methods such as basal treatment with diesel oil and burning would also result in satisfactory results. Basal application of diesel oil or diesel oil + 2,4,5-T is often not economically feasible on large acreages of mesquite or in dense stands. However, where mesquite density is light and pastures are relatively small, ranchers may wish to consider basal treatment in order to promote borer activity and increase burndown of dead mesquite with controlled burning in subsequent years.

Literature Cited

Britton, C. M., and H. A. Wright. 1971. Correlation of weather and fuel variables to mesquite damage by fire. J. Range Manage. 24:136-141.

Burke, H. E. 1918. Notes on some southwestern Buprestidae. J. Econ. Entomol. 11:209-211.

Burton, C. E., W. M. Portnoy, and H. A. Wright. 1972. Borer activity and mesquite ignition parameters. Proc. Southern Weed Sci. Soc. 25:303-313.

Craighead, F. C. 1920. Direct sunlight as a factor in forest insect control. Proc. Entomol. Soc. Washington 22:106-107.

Craighead, F. C. 1921. Protection of mesquite cordwood and posts from borers. U. S. Dep. Agr. Farmer's Bull. 1197:3-10.

Craighead, F. C. 1949. Insect enemies of eastern forests. U. S. Dep. Agr. Misc. Pub. No. 657. 679 p.

Fisher, W. S. 1942. A revision of the North American species of buprestid beetles belonging to the tribe Chrysobothrini. U. S. Dep. Agr. Pub. No. 470. 275 p.

Hodges, J. D., and L. S. Pickard. 1971. Lightning in the ecology of the southern pine beetle, *Dendroctonus frontalis* (Coleoptera: Scolytidae). Canadian Entomol. 103:44-51.

Meyer, R. E. 1970. Picloram and 2,4,5-T influence on honey mesquite morphology. Weed Sci. 18:525-531.

Robnett, W. E., and P. R. Morey. 1973. Wood formation in *Prosopis*: Effect of 2,4-D, 2,4,5-T, and TIBA. Amer. J. Bot. 60:(In press).

Van Dyke, E. C. 1918. New species of Buprestidae (Col.) from the Pacific states - No. 2. Entomol. News 29:53-58.

Vite, J. P., and R. G. Crozier. 1968. Studies on the attack behavior of the southern pine beetle. IV. Influence of host condition on aggregation pattern. Contrib. Boyce Thompson Inst. 24:87-94.

Williamson, D. L. 1971. Management to reduce pine beetle infestations. Forest Farmer. Jan., 1971; 6-7 & 18.

SRM
28th Annual Meeting

- **Maria Isabel-Sheraton**
- **México City**
- **February 10- 14, 1975**