SUITABILITY OF ELM FIREWOOD TO BARK BEETLE ATTACK STORED UNDER POLYETHYLENE SHEETING

by Pavel Svihra

Abstract. Six mil clear polyethylene sheeting, resistant to ultraviolet rays, was used as a seal to prevent the colonization of elm firewood by *Scolytus multistriatus,* the vector of the Dutch elm disease fungus. In California, elm firewood sealed and aged under polyethylene sheeting for up to three months maintained a similar attractiveness to the bark beetle as did freshly cut firewood, after wood was exposed. When wood was aged for four to six months under sheeting and then exposed, the beetles, not only delayed their attacks but also colonized fewer bolts, and in lower densities, than on freshly cut bolts. When firewood was sealed and aged for seven or more months under sheeting before exposure, it was no longer attractive to *S. multistriatus.*

Résumé. Des couvertures claires en polyéthylène, résistantes aux rayons ultraviolets, furent utilisées pour prévenir la colonisation de bûches d'ormes par le *Scolytus multistriatus*, vecteur du champignon responsable de la maladie hollandaise de l'orme. En Californie, des bûches d'ormes, scellées et protégées sous des couvertures de polyéthylène pendant moins de trois mois, ont maintenu une attraction similaire au scolyte que des bûches fraîchement coupées, après que le bois fut exposé. Lorsque le bois fut protégé entre quatre et six mois sous les couvertures, puis exposé, les scolytes n'ont pas seulement retardé leurs attaques, mais ont aussi colonisé moins de bûches, et dans des densités moindres que sur des bûches fraîchement coupées. Lorsque les bûches furent scellées et protégées pendant plus de sept mois sous les couvertures avant de les exposer, elles n'attiraient plus du tout le *Scolytus multistriatus*.

The smaller European elm bark beetle, *Scolytus multistriatus* (Marsham), breeds only in suitable elm material. The length of time elm wood remains suitable for breeding of beetles is unknown. Two factors seem to influence the beetle's propensity to accept or reject a particular elm host as a breeding site: a) species of elm and its physical characteristics, such as diameter (Svihra and Koehler; 2, 3) and b) nutritive characteristics of the elm as it dries and deteriorates after xylem-phloem tissues begin to die. Undoubtedly, there is a threshold of broodwood suitability. One way to collect information about this threshold is to measure the elapsed time after living branches are cut and determine when they no longer become infested. A shortcoming of such observations is that ambient weather significantly influences the rate of desiccation and the threshold of the wood's unsuitability for the beetle.

Krawczyk, et al. (1) reported that six mil clear polyethylene lowered wood moisture content and effectively prevented elm bark beetle escape from beneath the tarp. However, these studies were done under Wisconsin conditions which differ from California's dry, hot summer. S.R. Sanborn (California Department of Forestry, personal communication) observed that if the same kind of polyethylene were used in California, it would crack after two to three months.

The objective of this study was to find answers to the following questions: Does six mil clear, ultraviolet ray resistant (UVR) polyethylene sheeting withstand the California heat and protect uninfested, freshly cut elm firewood from beetle attack for an entire growing season during which the beetle flies? Because polyethylene increases the rate of drying of uninfested elm firewood, how long must it be stored under the sheeting to become unsuitable for bettle attack?

Materials and Methods

A living Siberian elm, *Ulmus pumila,* was felled in Contra Costa County, California, on January 4, 1985, and its branches cut into 75 cm bolts. A total of 120 bolts (75 cm long and larger than 8 cm in diameter) were selected. Bolts were stacked into a firewood configuration and then covered with 6 mil UVR polyethylene sheeting. The edges were buried in a 10 cm deep-trench dug around the base to prevent beetle contact with the wood. All the bolts were left undisturbed except on the first day of each subsequent month, when the sheeting was removed and 10 bolts selected at random for a field test. The sheeting was then reinstalled. This procedure also tested the durability of the sheeting. On the same day, branches were cut from an apparently healthy Siberian elm and 10 bolts, similar in length and diameter to those removed from beneath the sheeting were prepared. The two sets of bolts kept in storage and freshly cut were transported to an elm grove in Port Costa, Contra Costa County, and stacked

5 m apart. This procedure was repeated at monthly intervals from February to October, 1985. Twice each week the bark surface of each bolt was examined to record beetle attack.

On October 26, 1985, all bolts were transported to the laboratory where their diameter and length were measured to calculate bark surface area. Brood production was estimated per one square decimeter in each bolt. The bark was then removed to record the number of egg galleries per one square decimeter beneath the bark.

Forty bolts of the above described length and diameter were cut from branches of an apparently healthy Siberian elm on each of the following dates: January 4, April 1, and June 1, 1985. They were then moved into an elm grove in Lafayette, Contra Costa County. On each of those dates, twenty bolts were stacked into a firewood configuration and covered with 6 mil UVR polyethylene sheeting whose edges were buried in a trench around the base. The remaining 20 control bolts were stacked 1 meter from the tarped stack and left uncovered. The site was monitored weekly; only the bark surface of control bolts was checked for bark beetle attack. At the same time, the polyethylene tarping was examined for cracks but was otherwise left undisturbed. On October 26, 1985, the bolts from all three replicates were moved to the laboratory to determine whether firewood sealed by sheeting was attacked.

Results and Discussion

S. multistriatus responded to the firewood aged for different time periods under the tarp and to the freshly cut bolts exposed at the same time in the following patterns (Tables 1 and 2): a) beetles colonized the bolts aged one, two, or three months under the tarp at the same time but in significantly less density than freshly cut bolts; b) when bolts were stored for four to six months under the sheeting, beetles colonized significantly fewer bolts at a lower attack density but also attacked them 17 to 24 days later than freshly cut bolts that the beetle colonized on the first day of exposure; and c) after bolts were stored under the sheeting for seven or more months, they lost all attractiveness to the beetle, while freshly cut bolts continued to be attacked on the first day of their exposure.

The counts of exit holes indicated that if firewood were stored under the sheeting for one month or longer, significantly fewer young adult beetles emerged from such wood than from freshly cut bolts (Table 3). However, when bark was peeled from these bolts, a few larvae were found to be diapausing. Therefore, a more accurate measurement of the affect of the sheeting on elm wood attractiveness is made from an evaluation of attack density. The analysis of variance showed that *S. multistriatus* attacked

Table 1. *Scolytus multistriatus* attack on stored (after exposed) and freshly cut elm bolts.

Time of exposure	*No. of bolts attacked*		
or cutting	*Stored*	*Freshly cut*	*Chi-square*
February	7	10	
March	8	7	x = 2.64
April	6	10	d.f. = 2
May	3*	10	
June	4*	10	x = 14.62
July	1**	8	d.f. = 2
August	0	7	
September	0	9	
October	0	4	

* attacked 17 days later than freshly cut bolts
** attacked 24 days later than freshly cut bolts

Table 2. Attack density in firewood stored under polyethylene sheeting and freshly cut bolts.

Date of exposure	*No. of egg galleries per 1 sq. dm.*	
	Stored	*Freshly cut*
February	2.2	3.9
March	3.4	4.1
April	2.7	5.2
May	1.3	6.6
June	0.2	4.6
July	0.1	4.9
August	0	3.6
September	0	2.7
October	0	0.3

f = 15.22
b = .001

Table 3. Counts of exit holes chewed by offspring from stored wood under sheeting and freshly cut elm bolts.

Date of exposure	*No. of exit holes per 1 sq. dm.*	
	Stored	*Freshly cut*
February	32	53
March	41	116
April	37	107
May	16	123
June	0	136
July	0	15
August	0	0
September	0	0
October	0	0

f = 5.24
p = .05

freshly cut bolts in significantly higher densities as compared to bolts aged under sheeting (Table 2). Hence, upon contact with elm tissues, the females began to discriminate between the two different wood qualities, penetrated beneath the bark of aged wood under the sheeting in significantly fewer numbers, subsequently resulting in less progeny.

If 6 mil UVR plastic sheeting is used as a barrier to protect freshly cut elm firewood from beetle attack, this method successfully prevents such attack during that growing season. Bark removal from bolts used in the trials installed in January, May, and July were conclusive: beetles heavily attacked all control bolts and their offspring subsequently emerged from the bolts during that growing season, while none of the bolts stored under and protected by the plastic sheeting was attacked. These bolts were dry with the bark tightly attached to the wood, therefore, no longer suitable for *S. multistriatus* reproduction.

Conclusion

Elmwood stored beneath UVR polyethylene sheeting prevented *S. multistriatus* from reproducing, therefore, only UVR polyethylene sheeting has been proved to be effective. Wood stored under a sheeting completely lost its attractiveness to the beetle after seven months, allowing its safe use as fuel. The method is simple and can be applied by the homeowner; firewood should be sealed with tarping on the day of felling.

Acknowledgments. This research was supported by the California Department of Forestry. Critical review by Dr. Carl S. Koehler, the University of California Cooperative Extension, Berkeley, is appreciated.

Literature Cited

1. Krawczyk, J.H., C.J. Kostichka, G.L. Worf and D.L. Mahr. 1982. *Polyethylene tarping of elm firewood to prevent elm bark beetle flight. J. Arboric.* 8:292-295.
2. Svihra, P. and C.S. Koehler. 1981. *Attraction of flying Scolytus multistriatus to cut wood of three elm species in California.* Environ. Entomol. 10:565-566.
3. Svihra, P. and C.S. Koehler. 1982. *Attack and development of Scolytus multistriatus in small diameter elm branches.* Environ. Entomol. 11:594-597.

University of California
Cooperative Extension
224 W. Winton Avenue, Room 174
Hayward, CA 94544