STUDIES ON WOOD PRESERVATION AGAINST CERTAIN WOOD BORERS ATTACK

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Abstract

Studies on boron as wood preservative against certain wood borers were carried out through three methods of application. Boron was applied against *Lyctus africanus*, and *Sinoxylon sudanicum*, through brushing, vacuum-impregnation and dipping techniques.

Obtained results revealed that vacuum-impregnation of seasoned wood by 4% of boric acid equivalent (BAE) or 117 ppm of borone element is the most effective technique against wood borers. The recommended concentration gave 100% mortality for new infestation and over 3 years of protection.

INTRODUCTION

Investigations on wood borers control have been recently directed to find safe chemicals and new techniques for indoor application. Growing pollution and hazard problems resulting from insecticides applied indoors, drew the attention to study new compounds with more safety margins.

Although in Egypt many investigations had been carried out to find some efficient chemicals against wood borers attacking wooden articles and furniture

(Helal and El-Sebay 1980, 1981, 1985; Helal *et al.*, 1985), boron element as a preservative against wood borers had been intensively investigated during the last ten years. The new and old compound (boron) had been investigated by Bunn Rosemary (1974) as timber preservator, by Williams and Mauldin (1986), Williams and Amburgy (1987), Baranes and Williams (1988a, b) and Curtis and Williams (1990).

MATERIALS AND METHODS

Studies on the effect of boron against two post-powder beetles, *Lyctus africanus* Lesne, *Lyctidae* and *Sinoxylon sudanicum* Lesne, Bostrychidae, were carried out during 1990-1993 at the Wood-Boring Insects Res. Dept., Plant Protection Res. Institute, Agric. Res. Centre, Dokki, Egypt.

Cuttings of *Poinciana* wood (preferable host) were prepared (8 X 1 cm) dried in an oven at 105^{o}C for 48h, weighed as dry weight, grouped into three parts, then exposed to one of the following techniques :

a. Brushing technique

Hot and dried wooden boards were immediatly brushed by the eight prepared boric acid concentrations as ten cuttings per each concentration for each tested borer. Ten other wooden boards were treated with distilled water as a control.

b. Vacuum-impregnation technique

The wooden boards were impregnated under vacum by different boric acid concentrations according to .ASTM (1976). The control boards were vacumed by distilled water.

c. Dipping technique

The third group of hot dried wooden boards were dipped into different

concentrations of boric acid (ten replicates each) for 20 minutes, in addition to the control boards which were not treated but with distilled water.

Boric acid concentrations

Boric acid (disodium tetraborate) Na2B4 07.1 $0H_2O$ was prepared into eight concentrations representing 8, 4, 2, 1, 0.5, 0.25, 0.125 and 0.0625%, each comprised 904, 452, 226, 113, 56.5, 28.2 14.1 and 7.1 ppm/ml of equivalent borone content per milliliter of solution, respectively.

In all techniques, hot wooden boards were weighed as dry weight and immediately treated with boron solutions, then reweighed to determine the weight of absorbed solution in each cutting in order to convert it into its equivalent borone content in ppm per each cutting.

Treated wooden boards were left in open air until dryness then were distributed into their separate replicates in glass jars.

From pure culture of *L. africanus* and *Sinoxylon sudanicum* bred under laboratory conditions, ten males and ten females from each species were introduced to each jar and kept under laboratory conditions. Daily observations took place until the next generation and were compared with those of the control. Treated cuttings were exposed to artificial infestation three times a year (April, June, and August). Any wooden board showing signs of infestation was discarded.

Mortality of adults exposed to treated boards were recorded as the initial effect of borone. Number of emerged beetles from the treated boards and period of persistence of borone (protection effect) was recorded through three successive years. The physical effect of borone on the natural colour of treated wood was observed.

RESULTS AND DISCUSSION

The main effect of borone is to act as a wood preservative and protect wood from fungi and borers attack.

Data in Table 1 show the different uptake (absorbtion) of wood cuttings from borone solutions as compared with the solvent (distilled water). Treated cuttings showed different rates of absorbtion according to the concentrations of boric acid solutions.

Brushed wood absorbed more solution when the concentration of boric acid decreased. At 8% concentration, absorbtion reached 0.024 ml/g of wood representing 22 ppm/g, and was 0.065 ml/g when wood was treated with 0.0625% (0.46 ppm/g). Compared with the control absorbtion (distilled water), high concentrations of boric acid showed low ability of penetration in wood surfaces.

The trend of absorbtion was noticed with vacuum impregnation technique. The absorbtion of wood averaged 0.22 ml/g (199.8 ppm/g) at 8% concentration, while was 0.543 ml/g at the concentration 0.625%, representing 3.9 ppm/g.

With the dipping technique, at 8% boric acid, wood absorbed 0.113 ml/g (102.2 ppm/g wood), while at 0.0624%, absorbtion reached 0.195 ml/g (1.4 ppm/g wood).

Data in Table 1 showed that, vacuum impregnation technique is the most suitable for wood since it absorbed the highest concentration of boric acid or borone equivalent. Vacuum - impregnated wood gained 99.8 ppm/g at 8% concentration, while at the same concentration, wood got 102.2 or 22 ppm with either dipping or brushing techniques. Control wood absorbed 0.6 ml/g weight in vacuum - impregnation technique, while absorbed 0.2 or 0.073 ml/g in dipping or brushing technique.

Effect of borone element on adult mortality

As shown in Table 2, the highest mortality (100%) was attained for either *L. africanus* or *S. sudanicum*, when vacuum impregnation technique was applied. However, the highest mortality percentages were only 62 and 43% for *L. africanus* or 58 and 21% for *S. sudanicum* beetles in either dipping or brushing techniques. At 0.25% concentration, brushing or dipping techniques gave no mortality for the two wood borers. At the same concentration however, vacuum impregnation technique gave 30% and 10% mortality for *L. africanus* and *S. sudanicum* , respectively.

Table 1. Rate of borone diffusion through *Poinciana* wood with the three treatments.

Conc.	Treatments					
	Brushing		Vacuum		Dipping	
	ml/g	ppm/g	ml/g	ppm/g	ml/g	ppm/g
8 %	0.024	22.0	0.221	199.8	0.113	102.2
4 %	0.029	13.1	0.259	117.1	0.130	58.8
2 %	0.034	7.7	0.270	61.0	0.149	33.7
1 %	0.039	4.4	0.290	32.8	0.163	18.4
0.5 %	0.043	2.4	0.352	19.9	0.169	9.5
0.25 %	0.050	1.4	0.481	13.8	0.175	4.9
0.125 %	0.058	0.92	0.522	7.4	0.182	2.6
0.063 %	0.065	0.46	0.543	3.9	0.195	1.4
Cont.	0.073	---	0.600	---	0.200	---

Table 2. Effect of borone on adult mortality of *L. africanus* and *S. sudanicum* exposed to treated wood.

Conc.	Mortality in different techniques					
	Brushing		Vacuum		Dipping	
	*L.	**S.	L.	S.	L.	S.
8 %	43 %	21 %	100 %	100 %	62 %	58 %
4 %	25 %	12 %	100 %	98 %	43 %	41 %
2 %	10 %	3 %	81 %	70 %	28 %	23 %
1 %	6 %	1 %	70 %	46 %	17 %	15 %
0.5 %	1 %	0.1 %	58 %	21 %	5 %	4 %
0.25 %	0 %	0 %	30 %	10 %	0 %	0 %
0.125 %	0 %	0 %	10 %	0 %	0 %	0 %
0.063 %	0 %	0 %	0 %	0 %	0 %	0 %
Cont.	0 %	0 %	0 %	0 %	0 %	0 %

* *Lyctus africanus* ** *Sinoxylon sudanicum*

Persistent Period of Boron Element in Wood (Protective period)

Borone protective period could be estimated by two biological parameters, the number of emerged beetles from infested wood (artificial infestation was carried out three times a year), and the period of borone persistence against new infestation by borers.

Data in Tables 3 and 4 show that the longest presistence period occurred through vacuum-impregnation technique at 0.5% boric acid which is equivalent to 20 ppm/g wood and gave more than 3 years protection against *L. africanus* and / or *S. sudanicum.*

The highest number of emerged beetles from treated boards was 77.6 + 4.7 of *L. africanus* at 0.0625% boric acid in the dipping technique, followed by 69.7 + 8.4 and 36.9 + 3.9 beetles in brushing and vacuum-impregnation techniques. The shortest periods of persistence were, 1.6 + 0.5, 2.4 + 0.7 and 15.7 + 4.4 months in dipping, brushing and vacuum-impregnation techniques, respectively.

Accordingly, it could be suggested that vacuum-impregnation technique at 4 % boric acid or 117 ppm borone/g wood is the most effective technique to preserve seasoned wood against infestation by *L. africanus* or *S. sudanicum* borers for more than 3 years.

However, during the experiment, it was noticed that boric acid affected the natural colour of treated wood. Wood became darker by the increase of boric acid concentration, thus reducing the wood value in market and industry. It is suggested not to use boric acid in wooden articles and furniture, unless such wood will be painted.

Table 3. Persistence period in months of borone against *L. africanus* beetles in treated boards using different techniques.

Conc. %	Residual effect in months					
	Brushing		Vacuum - Ipregnation		Dipping	
	No. of emerged beetles	Period in month	No. of emerged beetles	Period in month	No. of emerged beetles	Period in month
8	1.4 ± 1.2	33.4 ± 1.9	0.0 ± 0.0	36.0 ± 0.0	0.0 ± 0.0	36.0 ± 0.0
4	9.4 ± 2.7	23.2 ± 2.7	0.0 ± 0.0	36.0 ± 0.0	11.1 ± 9.5	29.0 ± 7.2
2	16.2 ± 3.7	25.0 ± 3.1	0.0 ± 0.0	36.0 ± 0.0	19.6 ± 5.2	23.3 ± 8.8
1	32.9 ± 1.9	14.3 ± 2.8	0.0 ± 0.0	36.0 ± 0.0	28.7 ± 5.8	15.6 ± 9.7
0.5	36.9 ± 3.1	6.5 ± 0.8	0.0 ± 0.0	36.0 ± 0.0	40.4 ± 4.8	7.5 ± 1.5
0.25	45.2 ± 5.3	3.5 ± 0.8	2.5 ± 1.9	33.6 ± 3.8	50.4 ± 1.9	5.0 ± 1.1
0.125	51.0 ± 7.9	2.6 ± 0.7	6.2 ± 3.1	33.5 ± 3.6	63.2 ± 2.0	2.1 ± 0.9
0.063	69.7 ± 8.4	2.4 ± 0.7	36.9 ± 3.9	15.7 ± 4.4	77.6 ± 4.7	1.6 ± 0.5
Cont.	78.5 ± 2.6	0.3 ± 0.0	42.3 ± 1.3	1.5 ± 0.3	79.3 ± 1.8	1.3 ± 0.7

Table 4. Persistence period in months of borone against *S. sudanicum* beetles in treated boards using different techniques.

Conc. %	Residual effect in months					
	Brushing		Vacuum - Ipregnation		Dipping	
	No. of emerged beetles	Period in month	No. of emerged beetles	Period in month	No. of emerged beetles	Period in month
8	3.4 ± 1.8	32.1 ± 4.1	0.0 ± 0.0	36.0 ± 0.0	0.0 ± 0.0	36.0 ± 0.0
4	12.6 ± 3.5	21.8 ± 3.1	0.0 ± 0.0	36.0 ± 0.0	0.0 ± 0.0	36.0 ± 0.0
2	23.7 ± 4.1	16.2 ± 2.5	0.0 ± 0.0	36.0 ± 0.0	4.2 ± 0.0	36.0 ± 0.0
1	31.2 ± 3.2	6.4 ± 1.3	0.0 ± 0.0	36.0 ± 0.0	15.3 ± 3.1	31.2 ± 0.0
0.5	40.1 ± 2.9	2.3 ± 0.8	0.0 ± 0.0	36.0 ± 0.0	32.1 ± 2.8	20.2 ± 2.5
0.25	43.5 ± 3.1	1.6 ± 0.9	1.4 ± 1.1	32.3 ± 2.9	39.4 ± 2.1	20.2 ± 2.5
0.125	46.2 ± 4.1	1.4 ± 0.7	5.8 ± 3.2	24.2 ± 3.5	41.2 ± 0.9	12.3 ± 2.7
0.063	49.8 ± 3.2	1.4 ± 0.8	16.7 ± 1.8	12.8 ± 2.1	43.2 ± 1.2	7.3 ± 2.1
Cont.	53.9 ± 2.4	1.4 ± 0.8	32.4 ± 1.3	1.8 ± 2.1	44.3 ± 0.9	1.7 ± 1.1

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دراسة استخدام حافظ للخشب ضد الإصابه بناخرات الأخشاب

يسرى السباعى

معهد بحوث وقاية النباتات – مركز البحوث الزراعيه – الدقى.

أجريت الدراسه على مادة البورون والتى تجرى عليها البحوث الآن فى العالم لرخص ثمنها وحدود الأمان العاليه لتأثيرها على الإنسان والبيئه.

وتم استخدام مادة البورون فى البحث من خلال ثلاث طرق للتطبيق وهى الدهان السطحى والغمر والغمر تحت ضغط وتعريض نوعين من ناخرات الأخشاب السائدين فى مصر وهما خنافس ليكتس الساحقه وسينوكسيلون سودانيكم الساحقه للخشب.

وأثبتت الدراسه أن معاملة الخشب الجاف بالغمر تحت ضغط بمحلول ٤٪ حمض البوريك أو ١١٧ جزء فى المليون منه لكل جرام من وزن الخشب هى أفضل الطرق ضد الإصابه بالناخرتين لأنها أعطت نسبة موت ١٠٠٪ ومناعه للخشب ضد الإصابه لأكثر من ثلاث سنوات.