Effects of Color and Trunk-wrap on Pecan Weevil Catch In Pyramidal Traps[1]

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ABSTRACT Pyramidal traps of various colors and trunk-wraps of white plastic and whitewash were evaluated to optimize pyramidal traps for collection of pecan weevils, *Curculio caryae* (Horn). Black traps were superior to all other colors tested and are recommended for use by growers. White plastic wrap was as effective and easier to use than whitewash and both increased trap capture (white plastic 2.8, whitewash 1.8 fold) of pecan weevils.

KEY WORDS Pecan weevil, *Curculio caryae*, pecan, *Caryae illinoensis*, traps, color

Pyramidal traps have been developed recently for monitoring pecan weevil, *Curculio caryae* (Horn), occurrence in pecan orchards (Tedders and Wood, 1994). The traps are suitable for use by pecan growers. Traps painted black (1% reflectance) or dark gray (5% reflectance) are more attractive to weevils than gray or white traps (reflectances ranging from 11-84%) (Tedders and Wood, 1995).

In 1994 pyramidal trap tests refined the effectiveness of the traps for capturing weevils. Tests included: (1) comparison of traps painted various colors or covered with aluminum foil, (2) comparison of the effectiveness of white plastic sheeting wrapped around tree trunks with that of whitewashed tree trunks, and (3) confirmation of previous findings that pyramidal traps were more efficient than cone emergence traps for detecting the presence of weevils.

Materials and Methods

Effect of Colored Paint and Aluminum Foil as Visual Stimuli. Response of adult pecan weevils to pyramidal traps with different coatings was evaluated. Treatments included traps painted with Sherwin-Williams Kem Lustal oil-base enamels of: Gloss Black (F65B1), Tarter Red Dark (F65R2), Bright Blue (F65L10), Lemon Yellow (F65Y2), Gloss White (F65W1), green (mix of 33% Bright Blue + 67% Lemon Yellow) and BLP Mopocote acrylic latex, dark

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gray (mix of 82% Black 40-11 and 18% Super White 40-17), and traps covered with Alcoa aluminum foil. The dark gray traps (reflectance approximately 5%) used the previous season were more attractive to weevils than lighter shades of gray and white, and were not statistically different from traps painted black (approximately 1% reflectance) (Tedders and Wood, 1994, 1995). The oil-based enamels and the aluminum foil covers are the same as in Prokopy and Owens (1978) who evaluated colored light reflectance on trap efficiency for tarnished plant bug, *Lygus lineolaris* (P. de B.), European apple sawfly, *Hoplocampa testudinea* Klug., and apple maggot flies, *Rhagoletis pomonella* (Walsh).

Reflectance of each type trap coating was measured by using light reflected from similarly painted or aluminum-covered swatches of masonite measuring 11.4 × 12.7 cm by the methods of Tedders and Wood (1994). Prior to measurements, swatches were sprayed with Marshall's Permanent Matte Spray (John G. Marshall Mfg. Co., Inc., Brooklyn, NY) to eliminate glare interference on reflected light measurement.

One trap of each color and aluminum was placed at random in a circle surrounding each tree. Traps forming the circle were at 45° and approximately 3.9 m distance from the center of the tree trunk. Thus, traps were approximately 3 m (center to center) apart. There were 10 single-tree replicates (blocks) of the configuration of 8 traps. Eight blocks were 'Stuart' trees and 2 blocks were 'Schley' trees. The test orchard of 79-year-old 'Stuart' and 'Schley' trees had been insecticide-free since 1983. Trunks of all trees were whitewashed to a height of 2.1 m. Traps were examined for weevils every 2 to 3 days beginning August 3 through October 30, 1994. Counts of males, females, and males plus females/trap were statistically analyzed by analysis of variance (PROC ANOVA) (SAS Institute 1992).

Effect of Substituting White Plastic for Whitewash. Each treatment included one dark-gray trap (5.0% reflectance) located 4.6 m from a tree trunk. The tree trunk was either sprayed with whitewash to a height of 2.1 m, wrapped with 4 mil white polyethylene sheeting to a height of 2.1 m, or left untreated. All traps were placed on the southeastern side of trees on the herbicided tree-row strip. The experimental design was completely random with 10 individual tree replicates/treatment. Trees were 79-year-old 'Stuart' and had been insecticide-free since 1983. Traps were examined for weevil captures every 2 to 3 days from August 3 to October 30. The numbers of weevils captured/trap in each treatment were statistically analyzed by analysis of variance (PROC ANOVA) (SAS Institute 1992).

Comparison of Pyramidal and Cone Traps. Earlier work indicated that pyramidal traps are superior to cone-emergence traps for detecting weevils (Tedders and Wood 1994). To confirm this the two trap types were alternated in sequence around a tree (i.e., pyramidal, cone, pyramidal, cone, etc.) with the beginning trap at the northern position. Ten replicates (individual pecan trees) of 79-year-old 'Schley' having canopy radii averaging 8.3 m were used. The center of each trap was placed at 3.9 m from the center of the tree trunk and traps were approximately 3 m apart (center to center). Five trees had pyramidal traps that began on the northern position and five trees had cone traps that began on the northern position. The selection of trap beginning was random. The trunks of all 10 trees were whitewashed to a height of 2.1 m. Cone traps were the size and design recommended by the Georgia Cooperative Extension

Service (Ellis and Hudson 1993-1994). Traps were examined for captured weevils every 2 to 3 days from August 3 to October 30.

This test also determined the effect of direction on weevil capture for each trap type relative to the tree trunk. Positions of traps were north, northeast, east, southeast, south, southwest, west, and northwest of the tree trunk. Numbers of weevils captured for each trap type and direction were analyzed by analysis of variance (PROC ANOVA) (SAS Institute 1992).

Results and Discussion

Effect of Colored Paint and Aluminum foil as Visual Stimuli. This experiment along with previous test results (Tedders and Wood 1994, 1995) indicates clearly that black pyramidal traps are best for detecting weevils (Table 1). Red ranked second and blue traps ranked third numerically in trap capture. We have no explanation for the high trap capture and the anonmalous high reflectance of red (18%) relative to black (2.6%) or blue (6.5%). Linear regression of trap capture by sex versus reflectance (Table 1) produced significant ($P < 0.02$) and identical slopes. The equations are: male capture = 3.6 - 0.04 (% reflectance), r = 0.78, female capture = 4.3 - 0.04 (% reflectance), r = 0.84. Reflectance explains > 75% of the variation in trap capture in this test without the additional capture provided by changing the tree trunk to white.

Black traps captured better than 25% of the total number of weevils (415). They accurately indicate the duration and variation in the weevil capture period, because capture peaks of the black traps were identical to that of pooled data from all other traps. The first weevil was captured August 3 and the last on October 24. Four peaks were detected – the first was small and occurred about August 8. The largest peak occurred from August 22 and 24. The third (second largest) peak occurred about September 5 and the last small peak occurred on September 12. Thereafter, captures steadily declined.

Effect of Substituting White Plastic for Whitewash. Ten traps adjacent to white-plastic-wrapped tree trunks captured a total of 86 weevils (41 males: 45 females). Ten traps adjacent to whitewashed trees captured a total of 55 weevils (26 males: 29 females) and ten traps adjacent to untreated trees captured 31 weevils (13 males: 18 females). Trap captures were significantly greater ($P \leq 0.05$) than those adjacent to untreated trees but they were not significantly different than those adjacent to whitewashed trees (Table 2).

Comparison of Pyramidal and Cone Traps. Pyramidal traps captured 5.5-fold more weevils (pooled data) than cone emergence traps ($P \leq 0.01$). Thirty-three out of 40 pyramidal traps (82.5%) captured one or more weevils, and weevils were captured in all ten replications of pyramidal traps. Only 18 out of a total of 40 cone emergence traps (45%) captured one or more weevils, and weevils were captured in only eight of ten replications of cone traps.

Significant differences were noted for males, for females, and for males plus females. This confirms results of previous experiments (Tedders and Wood, 1995) where pyramidal traps caught 8.9-fold more weevils than cone traps. Mean capture of weevils in pyramidal and cone traps by direction is presented in Table 3. There was no significant effect of direction on capture that was indicated by position of cone or pyramidal traps ($P \geq 0.01$).

Table 1. Influence of color (reflectance) on pyramidal trap effectiveness for capture of pecan weevil, *Curculio caryae* (Horn). Mean pecan weevils/trap at Byron, GA, 1994. Multiply numbers by 10 to obtain total trap catch.

	Mean Weevils/Trap*			
	% Reflectance	Males	Females	Both Sexes
Gloss Black	2.6	5.8 a	4.9 a	10.7 a
Tartar Dark Red	18.0	3.4 b	4.8 a	8.2 ab
Bright Blue	6.5	3.0 b	4.5 a	7.5 ab
Gray Mixture	6.5	2.5 bc	3.4 ab	5.9 bc
Green Mixture	17.0	1.8 bc	1.9 ab	3.7 bc
Lemon Yellow	46.5	0.5 c	2.1 ab	2.6 c
Gloss White	85.5	0.6 c	1.0 b	1.6 c
Aluminum Foil**	86.5	0.3 c	1.0 b	1.3 c

* Means followed by the same letter are not significantly different, Duncan's New Multiple Range Test, $P = 0.05$, PROC ANOVA (SAS Institute 1992).

** Aluminum foil reflectance averaged 86.5% but was highly variable depending on the angle of measurement and angle of the light source.

Table 2. Influence of white-plastic wrapped and whitewashed pecan tree trunks on pyramidal trap effectiveness for collection of pecan weevil, *Curculio caryae* (Horn). Mean weevils/trap at Byron, GA, 1994.

Treatment to tree trunk	Mean Weevils/Trap*		
	Males	Females	Both Sexes
Plastic Wrap	4.1 a	4.5 a	8.6 a
Whitewash	2.6 ab	2.9 ab	5.5 ab
Untreated	1.3 b	1.8 b	3.1 b

* Means followed by the same letter are not significantly different, Duncan's New Multiple Range Test, $P = 0.05$; PROC ANOVA, (SAS Institute 1992).

Table 3. Influence of direction on male and fmeale pecan weevil, *Curculio caryae* (Horn), capture by pyramidal and cone traps under pcean trees. Mean weevils/trap at Byron, GA, 1994.

Trap Type	Direction	Mean Weevils/Trap*		
		Males	Females	Males and Females
Pyramidal	S	3.2 ab	4.8 a	8.0 a
Pyramidal	SW	4.0 a	4.0 ab	8.0 a
Pyramidal	NW	2.6 abc	3.2 abc	5.8 ab
Pyramidal	W	2.6 abc	2.2 abcd	4.8 ab
Pyramidal	NE	3.2 ab	0.8 cd	4.0 ab
Pyramidal	N	2.4 abc	1.0 cd	3.4 ab
Pyramidal	E	1.2 abc	1.4 bcd	2.6 ab
Pyramidal	SE	0.8 bc	1.2 bcd	2.0 b
Cone	NW	0.6 bc	1.0 cd	1.6 b
Cone	W	0.8 bc	0.6 cd	1.4 b
Cone	SW	1.2 abc	0.2 cd	1.4 b
Cone	SE	0.4 bc	0.6 cd	1.0 b
Cone	N	0.4 bc	0.2 cd	0.6 b
Cone	E	0.4 bc	0 d	0.4 b
Cone	S	0.4 bc	0 d	0.4 b
Cone	NE	0.2 c	0 d	0.2 b

* Means followed by the same letter are not significantly different, $P = 0.05$. Duncan's New Multiple Range Test, PROC ANOVA (SAS Institute 1991).

We feel safe in recommending black pyramidal traps to detect pecan weevils in pecan orchards and for homeowner use. Black paint is easy to describe and is universally available. For homeowners or commercial growers adverse to lime and whitewash or painting trees permanently, white plastic wrapped temporarily around the tree bole (from ground to 1 to 2 meters) will significantly increase (>2 fold) weevil trap catch. Because both female as well as male pecan weevils are captured by the pyramidal traps, optimal weevil capture, particularly under homeowner conditions, is beneficial. Trap-capture thresholds for recommending commercial pesticide treatments is the next logical step for additional research.

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