# THE IMPACT OF CARBOFURAN APPLIED TO PECAN ORCHARD SOIL ON EMERGING PECAN WEEVIL ADULTS AND FOLIAGE FEEDING APHIDS AND MITES

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## ABSTRACT

Applications of a granular formulation of carbofuran to the soil beneath pecan trees at (16 and 32 kg actual insecticide per ha) to control adult pecan weevils as they emerged from the soil reduced pecan aphid populations and increased pecan leaf scorch mite populations. Pecan weevil damage was not decreased by the treatments and adults trapped from treated soil were similar to adults trapped from untreated soil with respect to fecundity and ability to damage pecans.

Key Words: Carbofuran, pecan weevil, aphids, mites, *Curculio caryae,* pecan orchard

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## INTRODUCTION

Foliar application of carbaryl as an adulticide against pecan weevil, *Curculio caryae* (Horn), is the most efficacious control tactic for preventing oviposition and direct destruction of the pecan kernel (Payne et al. 1982). The exposure of populations of 3 species of foliar aphids, *Monellia caryella* (Fitch), *Monelliopsis pecanis* Bissell, and *Melanocallis caryaefoliae* (Granovsky), and the pecan leaf scorch mite, *Eotetranychus hicoriae* (McGregor), to these carbaryl applications causes destruction of associated beneficial insects and allows the subsequent resurgence of aphids and mites to foliage damaging population levels (Boethel and Ezell 1978, Dutcher 1983, Dutcher and Payne 1983). A toxic barrier of carbaryl applied to the soil of pecan weevil infested orchards did not significantly reduce the incidence of pecan weevil damage (Payne et al. 1985). We tested the efficacy of a barrier of carbofuran against adult pecan weevil emergence to control nut damage by pecan weevil and we measured the ability of pecan weevils which emerged through the carbofuran barrier to oviposit viable eggs. We also measured the impact of the carbofuran treatments on the incidence of the three foliar aphids and pecan leaf scorch mite.

## METHODS AND MATERIALS

The experiment was conducted at the U.S.D.A. Southeastern Fruit and Tree Nut Laboratory, Peach Co., Georgia. The test orchard was a 14 ha block of 60 yr. old improved cultivar trees and seedlings (48 Schley, 56 Stuart,

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4 Mahan, and 5 seedling). The plot was divided in half. The north half contained the carbofuran treatments and the south half contained untreated trees. Two border rows separating the orchard halves were treated with foliar sprays of carbaryl at 2.5 kg/ha with 45 1 final spray per tree, to reduce migration of emerging weevils from untreated to treated plots. Carbofuran was applied as Furadan 15G (FMC Corp.) with a John Deere 6200 seed drill at 16 and 32 kg actual insecticide/ha in four 1.2 ha plots per treatment. Treatments were applied on July 27, 1983, to a soil depth of 5-10 cm in a cross-hatched pattern by driving the seeder rig north to south and then east to west. Each of the four replicates was scouted weekly for the remainder of the season for foliar insects. The relative population densities of the 3 foliar aphid species and pecan leaf scorch mite were measured by direct count of individuals from three foliar terminals (current years stem growth) per tree and two trees per replicate. Pecan weevil emergence was monitored in each replicate with 6 cone emergence traps (Raney and Eikenbary 1969). Each treated replicate plot had a paired untreated control plot on the southern half of the orchard and concomitant insect population variables were measured in each control plot. Control plots could not be randomly placed within the treated area since weevils emerging in the control plots would have infested pecans in treated plots and damage incidence measurements would not be possible. Plot size constraints eliminated the possibility of surrounding each plot with a border of carbaryl treated trees. The damage potentials of weevils emerging in the control and treated areas were compared by caging 10-17 mating pairs on untreated pecans. One male and one female were placed on each pecan cluster on six dates between the water stage (10 August) and shuck split stage (29 September) of the pecan fruit. Clusters were harvested and pecans were examined by dissection for pecan weevil feeding and oviposition sites and percent infestation of the kernel on 17 October. Results of oviposition studies by Dutcher and Payne (1981) were used as a metric for detecting aberrant oviposition. Pecan yield was measured in each plot by weighing total crop from 2 trees per plot. Kernels were analyzed for 3-hydroxycarbofuran residues and whole chopped pecans with shells were analyzed for carbofuran residues using methods of Spittler and Marafioti (1983).

## RESULTS AND DISCUSSION

Monthly rainfall during adult pecan weevil emergence at the experimental orchard was 4.9 cm in August, 14.0 cm in September, and 3.0 cm in October. Major rainfall occurred on 2, 7, August, 1, 3, 6, 20 September and 5 October with 1.9, 2.3, 5.1, 1.1, 1.7, 3.8 and 1.2 cm of rainfall, respectively. Pecan weevil adult emergence was low before the 1 September rainfall and increased after this rainfall. (Fig. 1 and 2). Female pecan weevils emerged in 2 peaks near 8 and 20 September, and males emerged in one peak near 16 September. There were no significant differences in female or male pecan weevil emergence rates between the carbofuran treated plots and the control or between carbofuran rates of application. Pecan weevils collected from carbofuran treated plots were not different from pecan weevils reported in the literature from untreated pecan orchard soils (Dutcher and Payne 1981) in their ability to mate and damage pecans (Table 1). Tree yields and percent damage by pecan weevil were not different between treatments. The means (n, $s^2$) for yield and percent pecan weevil damage in the 32 kg

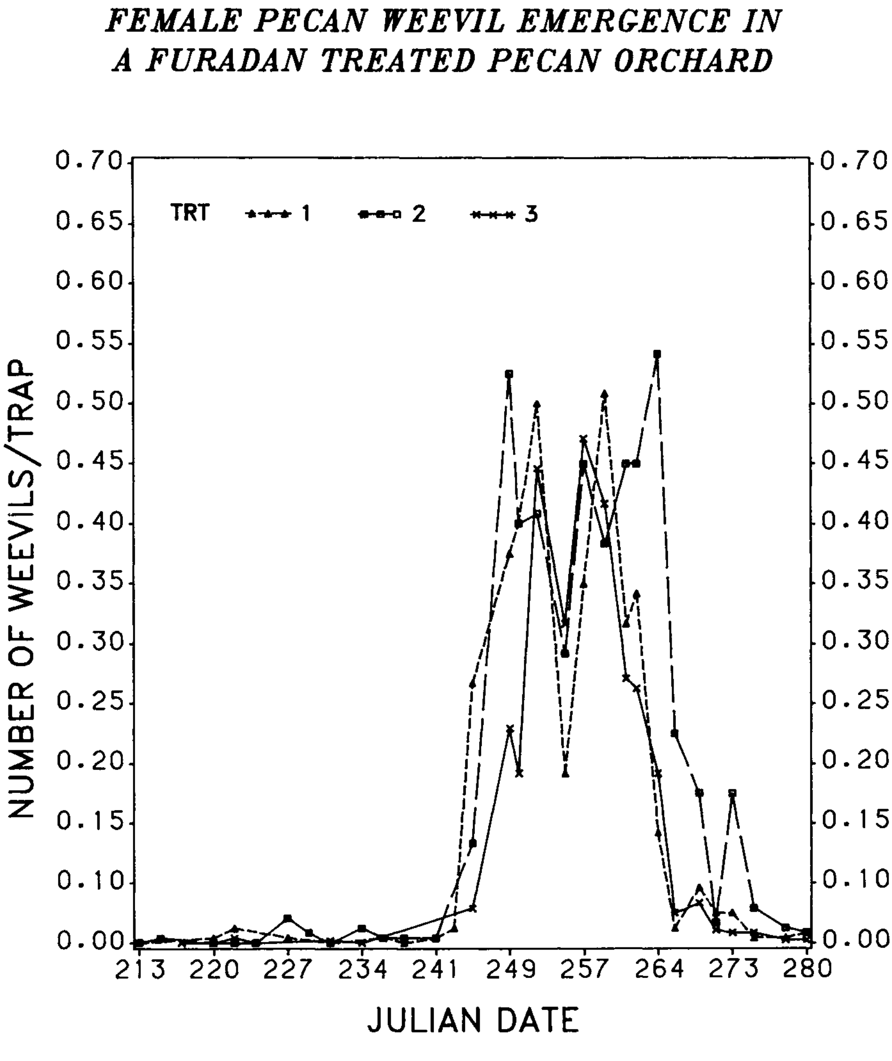


Fig. 1. The emergence patterns of adult female pecan weevils were not different between control (solid line and "x") and carbofuran-treated (16 kg ai/ha = narrow dash and triangle, 32 kg ai/ha = broad dash and square) treatments of pecan orchard soils.

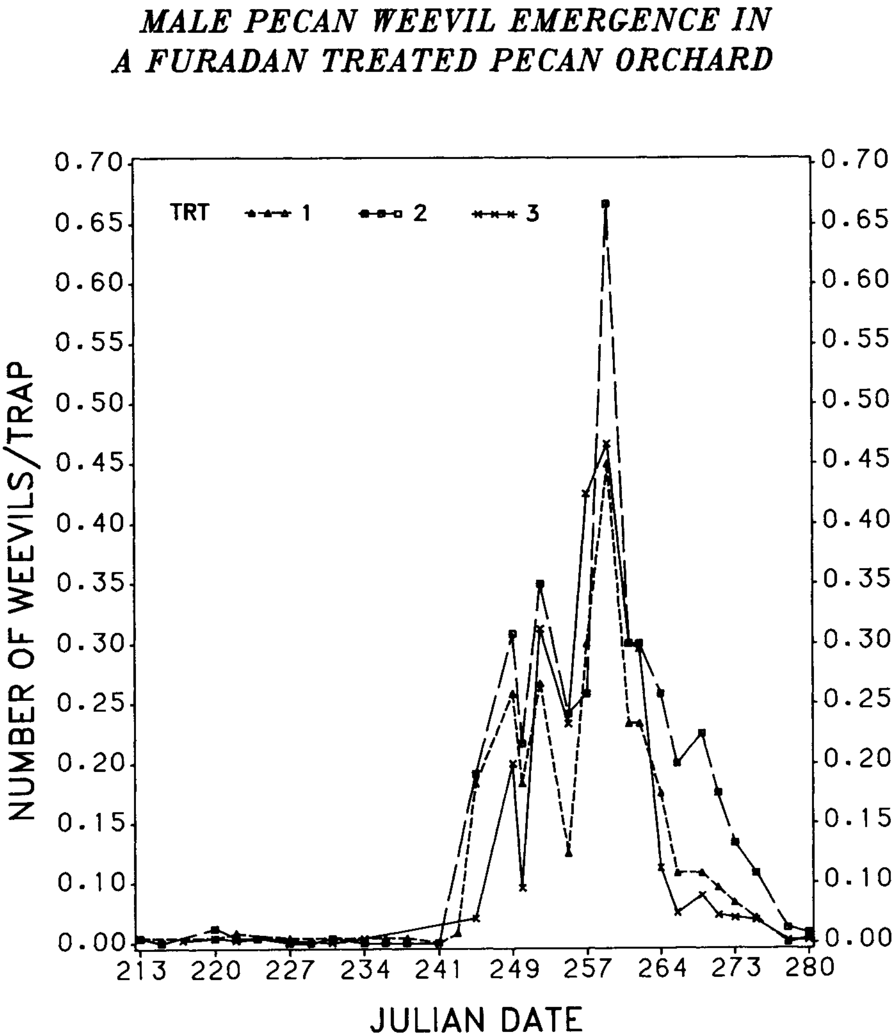


Fig. 2. The emergence of adult male pecan weevils were not different between control (solid line and "x") and carbofuran-treated (16 kg ai/ha = narrow dash and triangle, 32 kg ai/ha = broad dash and square) treatments of pecan orchard soils.

Table 1. Oviposition by pecan weevils* placed on untreated pecan clusters at approximate weekly intervals during the period of adult emergence from the soil, Peach County, Georgia, 1983.

| Inoculation date | Fruit stage | No. of clusters | No. of pecans | No. feeding or oviposition sites/pecan | % infestation of clusters | % infestation of pecans |
|---|---|---|---|---|---|---|
| 10 August | water | 10 | 25 | 0.40 | 20.0 | 16.0 |
| 19 August | gel | 10 | 24 | 1.54 | 80.0 | 37.5 |
| 26 August | dough | 10 | 24 | 1.25 | 60.0 | 33.3 |
| 2 September | dough | 17 | 43 | 1.28 | 64.7 | 32.6 |
| 13 September | dough | 10 | 24 | 2.04 | 90.0 | 41.7 |
| 29 September | dough | 10 | 22 | 0.72 | 40.0 | 18.2 |

* Pecan weevils were collected in cone cages as they emerged from the 5 carbofuran treatments. There were no significant differences ($P < 0.05$) between high and low rate treatments in weevil damage impact parameters.

actual carbofuran/ha treatment and the adjacent control were: 10.9 (8, 197.4) kg/tree and 62.5 (8, 532.3) percent; and, 18.5 (8, 470.3) kg/tree and 57 (8, 384) percent, respectively. The means (n, $s^2$) for yield and percent pecan weevil damage in the 16 kg actual carbofuran/ha treatment and the adjacent control were: 10.2 (8, 243.4) kg/tree and 54 (8, 250) percent; and, 9.6 (8, 238.0) kg/tree and 57 (8, 376) percent, respectively. Carbofuran residues were less than 0.2 ppm in the whole chopped nuts with shells and 3-hydroxycarbofuran residues were less than 0.14 ppm in the kernels of treated and control pecan trees.

The systematic movement of carbofuran into the pecan foliage reduced pecan aphid populations. Pecan aphids in the control reached mean population densities of 21 and 156 aphids per foliar terminal on 16 and 23 September, respectively. These total aphid densities were: 92% *M. caryella,* 4% *M. caryaefoliae,* 4% *M. pecanis;* and, 82% *M. caryella,* 13% *M. caryaefoliae,* 5% *M. pecanis* on 16 and 23 September, respectively. Pecan aphids in the carbofuran treated trees reached mean population densities of 12 and 7 aphids per terminal on 23 September in the 16 and 32 kg actual insecticide/ha treatments, respectively. Pecan leaf scorch mite (PLSM) populations were signficantly higher in the carbofuran treated trees than in the control and the high rate of carbofuran induced higher PLSM populations than the low rate (Fig. 3). The resurgence of pecan leaf scorch mite may have been related to the increased vigor of the pecan foliage in the carbofuran treated plots which experienced reduced aphid populations. In summary, soil application of carbofuran as a toxic barrier is not efficaceous against emerging pecan weevil adults.

## ACKNOWLEDGMENT

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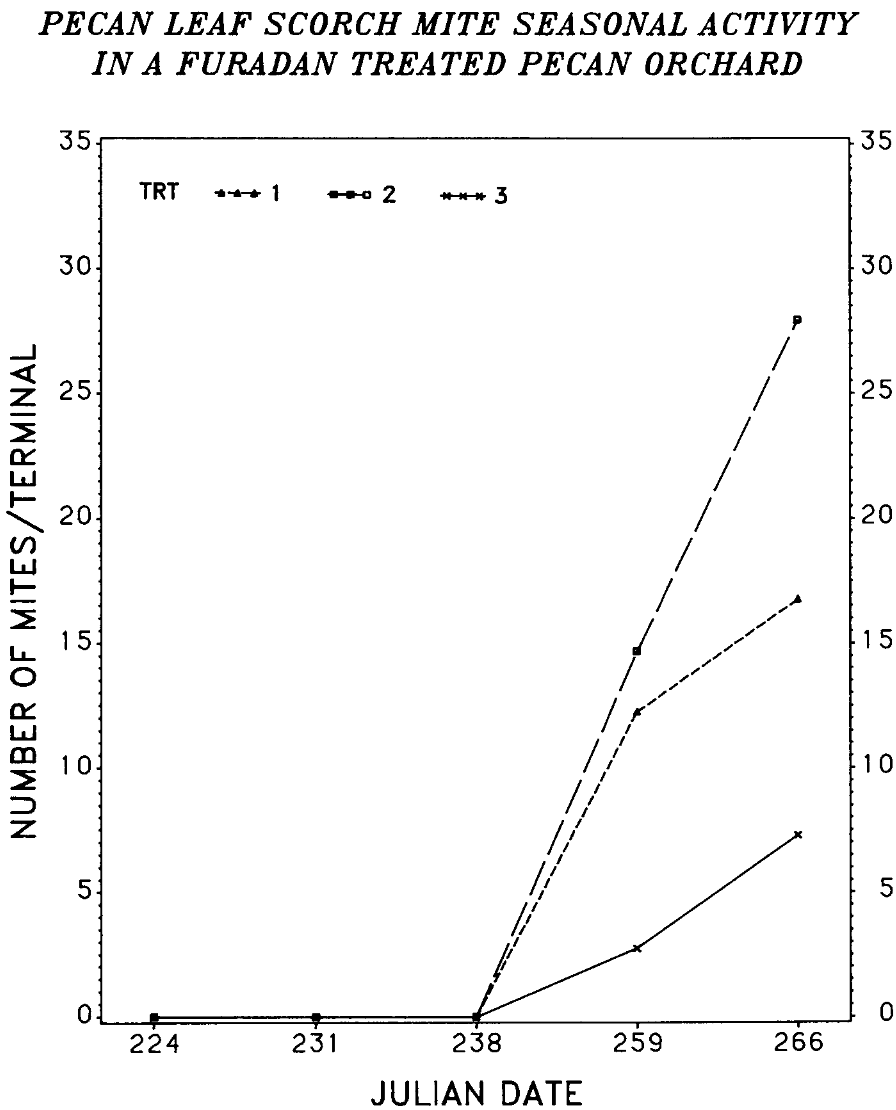


Fig. 3. Populations of pecan leaf scorch mite found in pecan orchards receiving carbofuran treatments to the soil. Pecan leaf scorch mite populations were significantly higher in the 32 kg ai/ha treatment than in the 16 kg ai/ha treatment on the final sample date, 266.

## LITERATURE CITED

Boethel, D. J., and J. E. Ezell. 1978. Influence of spray programs on seasonal abundance of pecan leaf scorch mite and phytoseiids in Louisiana. J. Econ. Entomol. 71: 507-17.

Dutcher, J. D., and J. A. Payne. 1981. Pecan weevil bionomics: a regional research problem. Misc Publ. Entomol. Soc. Am. 12(2): 45-68.

Dutcher, J. D. 1983. Carbaryl and aphid resurgence in pecan orchards. J. Georgia Entomol. Soc. 18: 492-5.

Dutcher, J. D., and J. A. Payne. 1983. Impact assessment of carbaryl, dimethoate, and dialifor on foliar and nut pests of pecan orchards. J. Georgia Entomol. Soc. 18: 498-507.

Payne, J. A., J. D. Dutcher, and H. C. Ellis. 1982. Performance of pecan insecticides: past, present and future. Insecticide and Acaricide Tests. Special Report. 7: 5-6.

Payne, J. A., J. D. Dutcher, and H. C. Ellis. 1985. Low pressure soil application of carbaryl for control of the pecan weevil, *Curculio caryae.* J. Agri. Entomol. 2: 1-5.

Raney, H. G., and R. D. Eikenbary. 1969. A simplified trap for collecting adult pecan weevils. J. Econ. Entomol. 63: 697-700.

Spittler, T. D., and R. A. Marafioti. 1983. An efficient method for the analysis of carbofuran and its metabolities. J. Chromato. 255: 191.