# Effectiveness and Residual Effects of Seven Insecticides on *Dalbulus maidis* (Homoptera: Cicadellidae) and *Peregrinus maidis* (Homoptera: Delphacidae)[1, 2]

James H. Tsai, Bryan Steinberg and Bryce W. Falk[3]

Ft. Lauderdale Research and Education Center, IFAS University of Florida
Ft. Lauderdale, FL 33314

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**ABSTRACT** Effectiveness and residual effects of seven insecticides, methomyl, carbaryl, malathion, diazinon, oxydemeton-methyl, acephate, and dimethoate, on *Dalbulus maidis* (DeLong and Wolcott) and *Peregrinus maidis* (Ashmead), the insect vectors of five tropical corn pathogens were determined by spray application on the upper surfaces of corn leaves. Oxydemeton-methyl, a systemic insecticide, had the greatest effect on both *D. maidis* and *P. maidis* with 99 and 100% mortality respectively at day 0 post-treatment, and its effect continued for 3 days thereafter. Carbaryl, a contact insecticide, displayed the longest residual effect of all insecticides tested against *P. maidis* and D. maidis with mortality continuing up to 10 and 15 days post-treatment, respectively. Malathion, oxydemeton-methyl, carbaryl, dimethoate, and diazinon all killed significantly ($P=0.05$, $F=7.63$) more *P. maidis* than *D. maidis* at one or more post treatment dates suggesting that *D. maidis* may have a greater tolerance to insecticides than *P. maidis*.

**KEY WORDS** *Dalbulus maidis*, *Peregrinus maidis*, corn leafhopper, corn planthopper.

Several insect-borne diseases of corn (*Zea mays* L.) are of economic importance in Florida and Central and South America. Maize stripe virus (MStpV) and maize mosaic virus (MMV) have been reported from southern Florida and are transmitted by the corn delphacid *Peregrinis maidis* (Ashmead) (Bradfute and Tsai 1983, Falk and Tsai 1983). Tsai found 30-63% of *P. maidis* sampled in Ft. Lauderdale carrying the MStpV (Tsai 1975; Ginergy et al. 1979). The corn leafhopper *Dalbulus maidis* (Delong and Wolcott) is the vector of maize rayado fino virus (MRFV) (Bradfute et al. 1980), corn stunt spiroplasma (CSS) (Bradfute et al. 1981), and maize bushy stunt mycoplasma (MBSM) (Tsai 1987). During the fall of 1979 and 1980 these *P. maidis* and *D. maidis* borne diseases became severe (Bradfute et al. 1981). In addition to corn, other cereal crops and certain weed species serve as alternate hosts for these insect vectors making their control more complex (Nault and Knoke 1981).

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[3] Department of Plant Pathology, University of California, Davis, CA 95616.

Reductions of *P. maidis* and *D. maidis* populations would be desireable if it were to reduce the incidence of vector borne diseases. Research in the Philippines resulted in a positive correlation between control of the leafhopper vector *Nephotettix impicticeps* and its transmission of rice tungro virus (Bea and Pathak 1969). Other successes in reducing insect-transmitted viruses and mycoplasmas by the use of insecticides have been reported by Chiykowski and Chapman (1958), Dunnig and Winder (1965), Fenroe and Kerr (1953), Gibson et al. (1951), Thompson (1965), Heinrichs (1979), Reissig et al. (1982), and Heinrichs et al. (1984). Currently in southern Florida, corn growers and breeders rely mainly on methomyl to control armyworm and leafhopper or planthopper outbreaks with occassional use of malathion and chlorpyrifos (D. Wrucke, Pioneer HiBred Int'l., personal communication). In 1980 approximately 52,000 acres of sweet corn were grown with a market value of about $56 million and about 800 acres of corn breeding nurseries and 15,000 acres of seed corn fields were planted in south Florida valued at about $60 million. All fields were greatly affected by the viruses and mycoplasmas. Losses due to these two vector borne diseases in 1980 by one seed company alone were estimated at more than $400,000 (Niblett et al. 1981). This study compares the effectiveness and residual effects of seven common insecticides on *P. maidis* and *D. maidis*.

## Materials and Methods

Three systemic (oxydemeton-methyl 50%EC, acephate 9.4%EC, and dimethoate 43.5%EC) and four nonsystemic (methomyl 24%EC, carbaryl 27%EC, malathion 17%EC, and diazinon 48%EC) insecticides were tested. All insecticides except acephate are registered for use on corn insects, but not specifically for *P. maidis* and *D. maidis*. Insecticides were applied to the upper surfaces of the corn leaves with a Solo 455 51 portable air compressor unit calibrated to deliver 2 pts of concentrate spray/acre in order to simulate the aerial spraying by commercial applicators. Ten to twelve pots (16 cm dia) of corn seedlings were treated with a single application of insecticide. Each pot contained 5-7 corn plants at 4-6 leaf stage. A complete randomized experimental design was used. Eight treated replicates and 4 replicates of untreated controls were randomly selected at the time of application (day 0) followed by 1, 3, 5, 7, 10 and 15 days post-treatment intervals. Survival tests for each replicate were done at 26.7°C and 12L:12:D with samples of the treated corn leaves being placed in 16 cm plastic petri-dishes which contained cut tissue paper to absorb moisture. To each petri-dish a total of at least 24 insects was added (12 *D. maidis* and 12 *P. maidis* adults) as competition between these two species had no negative effects. Insects were placed on plants treated only once and counted after approximately 24 hours. If no mortality occurred at any post-treatment sample, no further sampling was done. Since some systemic insecticides may have delayed systemic effects, plants treated with two of the systemic insecticides, oxydemeton-methyl and dimethoate, continued to be sampled until 15 days after treatment. Methomyl and diazinon data were compiled from 2 spray trials and oxydemeton-methyl data were compiled from 3 spray trials. Insects were counted after approximately 24 hours. Analysis of variance was used to determine the significance of treatment effects and a Waller-Duncan k-ratio test of the means was used to determine where the differences occurred (SAS 1982).

## Results and Discussion

Mortality of *D. maidis* and *P. maidis* in response to the 7 insecticides tested is shown in Tables 1 and 2. At day 0 oxydemeton-methyl and acephate had the highest mortality on *D. maidis* (100 and 99% mortality, respectively). The percent mortality of *P. maidis* was greatest at day 0 for diazinon, malathion, acephate, oxydemeton-methyl and dimethoate (100, 100, 99, 99, 99%, respectively). At day 1 post-treatment the most effective insecticides against *D. maidis* were oxydemeton-methyl, diazinon, and carbaryl (64.9, 57.7 and 53.3% mortality, respectively). With *P. maidis* mortality at day 1 post-treatment was greatest for oxydemeton-methyl and diazinon, (96.8 and 94.7%, respectively). The only effects on *D. maidis* were carbaryl and oxydemeton-methyl (23.9 and 11.8% mortality) on day 3 post-treatment. Oxydemeton-methyl, carbaryl, dimethoate, and diazinon were effective against *P. maidis* on day 3 post-treatment (48.5, 39.4, 15.2, and 10.5% mortality, respectively). Oxydemeton-methyl continued to kill *P. maidis* on day 5 post-treatment (10.5% mortality). Carbaryl continued to kill *D. maidis* and *P. maidis* on day 5 (14.3 and 30.9% mortality) and on day 7 post-treatment (9.9 and 39.4% mortality) but only *P. maidis* was affected on day 10 post-treatment (23.2% mortality). A slight delayed systemic effect on *D. maidis* was noticed for dimethoate (4.9% mortality) at day 15. No delayed systemic effects were noticed for oxydemeton-methyl.

The results indicated that the insecticides tested were more effective against *P. maidis* than *D. maidis*. The total number of *D. maidis* and *P. maidis* killed during all combined samplings (days 0-15 post-treatment) was highest for oxydemeton-methyl (161 *D. maidis* and 245 *P. maidis*) and carbaryl (125 *D. maidis* and 272 *P. maidis*). Carbaryl, a contact insecticide, had the longest residual effect on *P. maidis* and *D. maidis* (10 and 15 days post-treatment, respectively) whereas oxydemeton-methyl, a systemic insecticide, killed higher numbers of both *D. madis* and *P. maidis* for days 0 and 1 and was more effective against *P. maidis* than *D. maidis* on day 3 (48.5 vs 8.4%). This suggests that oxydemeton-methyl and carbaryl show the greatest promise in controlling *D. maidis* and *P. maidis* in southern Florida. This study provides a base line for testing these chemicals in the fields.

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**Table 1. Effectiveness and residual effects of seven insecticides on *Dalbulus maidis* at various post-treatment times.**

| | Days post-treatment (% mortality ± SD)* | | | | | |
|---|---|---|---|---|---|---|
| Treatment | 0 | 1 | 3 | 5 | 7 | 10 | 15 |
| Methomyl | 74.2±29$^{c}$ | 9.7±11$^{bc}$ | 5.3± 4$^{b}$ | 1.4± 3$^{c}$ | | | |
| Diazinon | 89.0±11$^{abc}$ | 57.7±32$^{a}$ | 5.4± 5$^{b}$ | | | | |
| Malathion | 83.3± 9$^{bc}$ | 4.2± 4$^{c}$ | 4.3± 4$^{b}$ | | | | |
| Carbaryl | 48.2±32$^{d}$ | 53.3±26$^{a}$ | 23.9±15$^{a}$ | 14.3±10$^{a}$ | 9.9± 7$^{a}$ | 4.3± 6$^{a}$ | 4.3± 6$^{a}$ |
| Acephate | 99.0± 3$^{ab}$ | 29.7±24$^{b}$ | 4.4± 9$^{b}$ | | | | |
| Oxydemeton-methyl | 100.0± 0$^{a}$ | 64.9±23$^{a}$ | 11.8±12$^{b}$ | 8.4± 9$^{b}$ | 3.2± 4$^{b}$ | 0.0± 0$^{b}$ | 2.2± 5$^{b}$ |
| Dimethoate | 89.2±11$^{abc}$ | 14.3±11$^{bc}$ | 5.4± 6$^{b}$ | 0.0± 0$^{c}$ | | 3.1± 4$^{a}$ | 4.9± 7$^{a}$ |
| Control | 1.2± 2$^{e}$ | 1.2± 2$^{c}$ | 2.1± 4$^{b}$ | 3.6± 1$^{bc}$ | 0.0± 0$^{c}$ | 3.1± 2$^{a}$ | 0.0± 0$^{b}$ |

* Means in a column followed by the same letter are not significantly different (P=0.05; Duncan-Waller K ratio criterion).

**Table 2. Effectiveness and residual effects of seven insecticides on *Peregrinus maidis* at various post-treatment times.**

| Treatment | Days post-treatment (% mortality ± SD)* | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 1 | 3 | 5 | 7 | 10 | 15 |
| Methomyl | 83.5±16$^{b}$ | 7.3±10$^{e}$ | 3.2± 4$^{b}$ | | | | |
| Diazinon | 100.0± 0$^{a}$ | 94.7± 9$^{a}$ | 10.5±13$^{b}$ | 0.0± 0$^{c}$ | | | |
| Malathion | 100.0± 0$^{a}$ | 38.7±19$^{d}$ | 4.2± 9$^{b}$ | | | | |
| Carbaryl | 89.9±13$^{b}$ | 63.4±28$^{b}$ | 39.4±29$^{a}$ | 30.9±14$^{a}$ | 39.4±30$^{a}$ | 23.2±17$^{a}$ | 3.2± 9$^{a}$ |
| Acephate | 99.0± 3$^{a}$ | 45.7±23$^{cd}$ | 2.1± 4$^{b}$ | | | | |
| Oxydemeton-methyl | 99.0± 3$^{a}$ | 96.8± 6$^{a}$ | 48.5±21$^{a}$ | 10.5±10$^{b}$ | 0.0± 0$^{b}$ | 0.0± 0$^{b}$ | 0.0± 0$^{a}$ |
| Dimethoate | 99.0± 3$^{a}$ | 55.8±29$^{bc}$ | 15.2±19$^{b}$ | 1.2± 3$^{c}$ | | 4.2± 4$^{b}$ | 3.5± 7$^{a}$ |
| Control | 2.2± 3$^{c}$ | 1.8± 2$^{e}$ | 3.6± 3$^{b}$ | 0.5± 1$^{c}$ | 1.1± 2$^{b}$ | 1.4± 1$^{b}$ | 0.7± 1$^{a}$ |

* Means in a column followed by the same letter are not significantly different (P=0.05; Duncan-Waller K ratio criterion).

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