Relative Susceptibility of Red and Green Color Morphs of the Green Peach Aphid to Foliar and Systemic Insecticides

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Abstract

Foliar and systemic insecticide bioassay techniques were developed for testing insecticide susceptibility to two color morphs of the green peach aphid. Six foliar and one systemic insecticide were used in our evaluations. These insecticides included three organophosphates, two pyrethroids, one organochlorine, and one chloronicotinyl. One of the green colored populations tested was collected from spinach, and red and green color populations were collected from the within the same cabbage field. The red morph was found to be less susceptiblethan the green morphs to Dimethoate, Karate, and Endosulfan. Their were only slight differences in susceptibility to the foliar insecticide between the green morphs. The green morph from spinach was found to be the most susceptible to Admire, while the two morphs collected from cabbage did not differ. Leveling off of aphid mortality at about 85% with high doses of Admire may indicate highly tolerant types in the populations, or an artifact of the methodology.

Introduction

Green peach aphid (GPA), *Myzus persicae*, is a major pest of spring lettuce, cole crops and leafy greens grown in the Southwestern U.S. The green peach aphid is a light green aphid that feeds primarily on the lower portions of lettuce but at high populations often infests the head. GPA can cause economic damage to lettuce by stunting and delaying crop development, contaminating harvestable portions, and by transmitting viruses. During 1994, pest control advisors in the Yuma area reported the appearance of red color morphs of the GPA, and subsequent difficulty controlling aphids with foliar aphicides. GPA is highly polyphagous and has developed resistance to many insecticides on many crops. Although the red color morph of the green peach aphid has not previously been reported in Arizona, it is common in other areas of the world. In North Carolina, a green form of the tobacco aphid, *Myzus nicotinae*, (formerly classified as *Myzus persicae*), was the predominant aphid pest on tobacco and was relatively easily controlled with conventional aphicides. However, in the mid 1980s, a red form of this aphid appeared and quickly became the predominant color morph because it required fewer days to reach reproductive maturity, produced more nymphs, and began producing nymphs sooner than the green color morph. In addition, the red color morph of the tobacco aphid was resistant to most of the aphicides labelled for use on tobacco. In Arizona lettuce during 1994, where aphid control was difficult many pest control advisors were forced to make additional applications of insecticide tank mixes to often achieve marginal aphid control. Traditionally, green peach aphid has been controlled using foliar applied aphicides. However, because of the difficulty controlling GPA with foliar sprays during 1994 and the high degree of efficacy of Admire to GPA, soil applications of Admire were widely used for GPA control in spring produce during 1995.

In this paper we report the development of a technique for evaluating topical and systemic insecticides for toxicity to GPA. We also report preliminary results of insecticide bioassays for toxicity to red and green color morphs of GPA. We evaluated the response of GPAs to six foliar applied aphicides covering three insecticide classes. Additionally, we report base line data for response of GPA to Admire.

Materials and Methods

GPAs were collected in the Yuma area from cabbage and spinach and screened for susceptibility to eight insecticides. These included two pyrethroids (Capture and Karate), three organophosphates (Dimethoate, Orhene and Phosdrin), one organochlorine (Endosulfan), and one chloronicotinyl (Admire). These insecticides were tested in their commercially formulated forms. Because GPA populations in lettuce were low during 1995, field populations from lettuce were not directly assayed. However, GPA populations from lettuce were collected and cultured for testing at a later date (data not presented). GPA populations were collected from: a single spinach field (green morph), and a single cabbage field (red and green morphs). GPAs were collected from spinach on 2 February 1995, and from cabbage on: 2 March 1995 (green morph) and 7 March 1995 (red morph). All aphids were collected from areas in the field not exposed to insecticides.

GPAs were collected by removing leaves infested with aphids and transporting them to the laboratory in large plastic tubs. In the laboratory, the aphids were immediately tested for susceptibility. Aphids were tested for susceptibility to foliarly applied insecticides using a plant-dip method, while a hydroponic method was used for Admire. Lettuce seedlings were grown in flats divided into 2 cm^2 cells. One plant was planted per cell. Three-leaf stage lettuce seedlings were used in all bioassays. The plants were removed from their cells and the soil was washed from the roots using tap water. Plants that were used for testing foliar sprays were then dipped in the insecticide solutions, while systemically treated plants were not. Six to eight concentrations of each insecticide was used. Cup cages were prepared by melting 1.0 cm diameter holes in the bottoms of 300 ml T-10 Comet Brand clear plastic cups. The plants were placed in these cups with the root protruding out of the hole in the cup's bottom. The plant was secured in place by molding gray-green modeling clay about the stem of the plant and filling the hole so that water could not move between the root area and the leaf cage. The cups containing the plants were then placed into a 230 ml T-8T Comet Brand clear plastic cups forming a 3.0 cm hydroponic reservoir. Approximately 30 ml of distilled water (foliar treatments) or concentrations of Admire (systemic treatments) were added to the reservoirs. Foliarly treated plants were allowed to air dry for approximately 30 minutes while Admire treated plants were allowed to sit at room temperature for 48 hrs before infestation with aphids. Four replicates of each concentration of each insecticide tested were used. Ten adult GPAs from the populations being evaluated were placed on each plant and the cups were sealed with clear plastic lids. The cups were then transferred to a growth cabinet set at 20 ± 2°C and a 14:10 (L:D) photoperiod. After 24 hrs. mortality was determined by removing the aphids from the cups and determining if they could walk. Aphids that could not walk were considered dead.

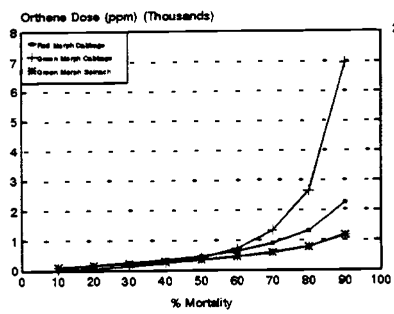
Data were analyzed using probit analysis to develop dose-mortality regression lines. When 95% fiducial limits of LC_{50} values overlapped, populations were considered to be equally susceptible to that particular treatment.

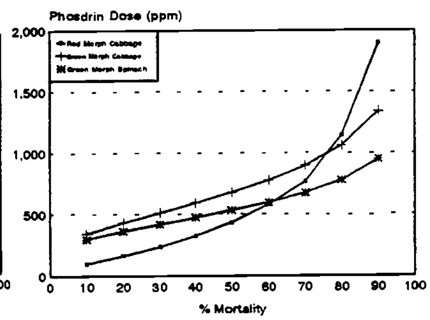
Results and Discussion

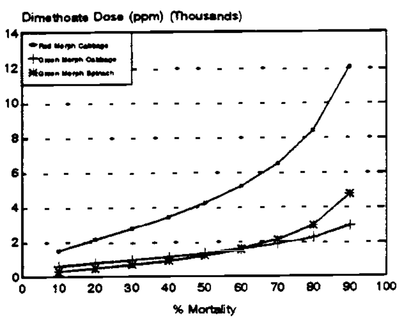
We detected differences in susceptibility in all four classes of insecticides evaluated (Figure 1). Of the organophosphates tested Phosdrin was the most toxic followed by Orthene. Their were no significant differences among aphid populations in response to either Phosdrin or Orthene. However, responses to Dimethoate differed. The green morphs had LC_{50}s of 1297 ppm and 1162 ppm for the cabbage and spinach populations respectively, while the LC_{50} for the red morph from cabbage was 4152 ppm. Of the pyrethroids, Capture was by far the most active. Aphid populations did not differ in response to Capture, but did to Karate. Although the two green morphs slightly differed statistically in response to Karate, spinach population had an LC_{50} of 481 ppm and the cabbage populations had a LC_{50} of 1287 ppm, the red colored morph was by far the least susceptible with an LC_{50} of 7135 ppm. A similar response was noted for Endosulfan. The green morphs differed slightly, the cabbage population had an LC_{50} of 1323 ppm and the spinach population had a LC_{50} of 173 ppm, while the red morph was least susceptible with an LC_{50} of 6912 ppm. All populations tested appeared to be sensitive to Admire. Both the red and green colored morphs from cabbage responded similarly with LC_{50}s of approximately 45 ppm. The green morph collected from spinach was significantly more susceptible and had an LC_{50} of about 10 ppm.

Although these are preliminary findings, it appears that the red color morph is more tolerant of several insecticides. Whether or not the level of tolerance detected in our test population would confer resistance and control failure is not certain. Differences in response to Admire is disturbing. In addition to observing variation among field populations, mortality in all three populations leveled off at about 85%, even at concentrations as high as 1000 ppm. Survivorship at high concentrations could indicate a methodology problem such as a threshold of chemical loading in the test plant, or it may be an indication of highly tolerant individuals in the test population. Further testing will be required to determine the nature of this relationship. When compared to the green morph from cabbage, the fact that the red morph was less susceptible to several of the foliar insecticides but not to Admire, indicates that Admire may be a good resistance management tool for the foliar insecticides.

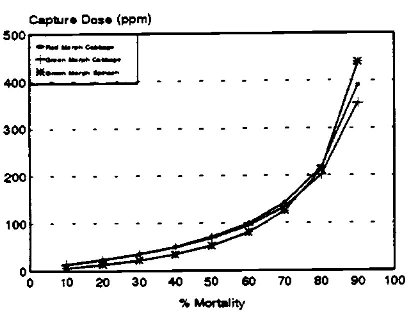
Organophosphates

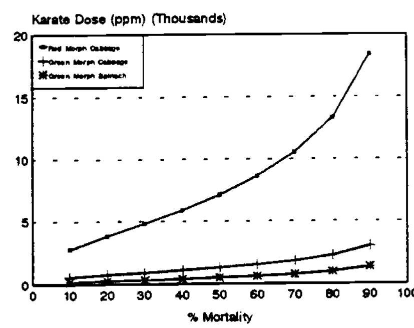




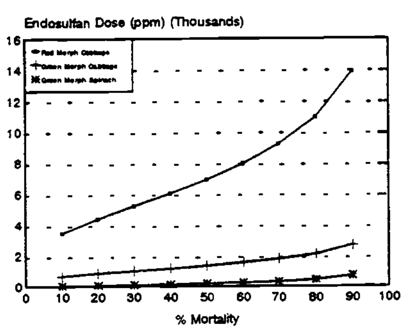


Pyrethroids





Organochlorine



Chloronicotinyl

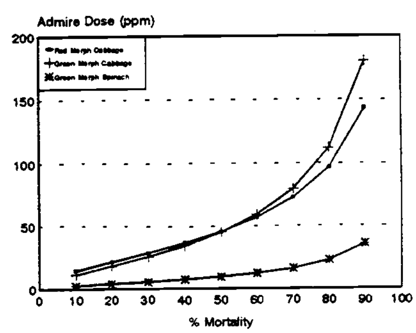


Figure 1. Probit regressions of three green peach aphid populations in response to seven insecticides.