USING MARATHON WITH DRIP- OR SUBIRRIGATED PLANTS

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Silverleaf whiteflies (*Bemisia argentifolii*) are among the most common and problematic greenhouse pests. Whiteflies feed on the phloem in the leaves, from which they extract sugars and other nutrients. The direct damage caused by this feeding generally is fairly minor, but whiteflies can reduce the value of your crops in other ways. First of all, consumers do not like to buy plants infested with insects, so simply the presence of whiteflies on your plants will reduce their value. Perhaps a more important problem is that whiteflies secrete a sticky substance referred to as honeydew. Whiteflies extract far more sugars from plants than they can use, so they excrete all the extra sugars in a concentrated 'honeydew' solution. This honeydew will fall on some of the lower leaves of the plants, which will become sticky and shiny. These symptoms are typical for serious aphid and whitefly infestations. Honeydew is the perfect growing medium for a gray-black fungus commonly called sooty mold. Although sooty mold itself does not harm plants, it gives the plants a poor appearance and their quality is greatly reduced.

A few adult whiteflies in a greenhouse are unlikely to cause serious damage. However, populations of whiteflies can explode rapidly under favorable conditions. What may appear to be a minor nuisance one day can turn into a major problem a few days later. For successful whitefly control, it is crucial to prevent reproduction. Currently, Marathon probably is the most widely used pesticide for whitefly control. In previous research, we looked at whether it is possible to apply Marathon through subirrigation systems. We found that subirrigation systems can be used to apply Marathon to plants, and that this results in excellent whitefly control. Now, we would like to update you on research that we have done since then. In these studies, we looked at how to best apply Marathon to plants irrigated in different ways, and how different application methods affect the amount of imidacloprid (the active ingredient in Marathon) that accumulates in the leaves of the plants.

A silverleaf whitefly on the bottom of a poinsettia leaf

BEST WAYS TO APPLY MARATHON

In one study, we either used drip- or sub-irrigation to grow poinsettias and we applied marathon either as a drench or by sub-irrigation. Both application methods were used with both irrigation treatments. Two weeks after the application, we measured the imidacloprid

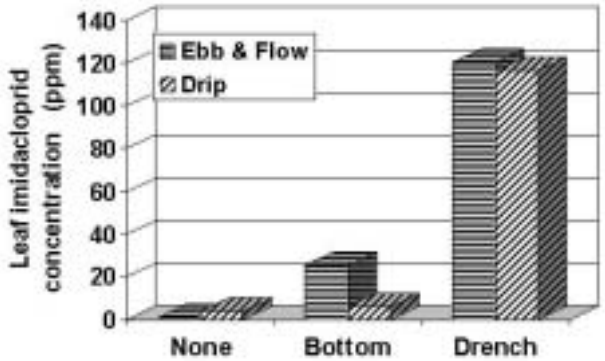


Fig. 1. The concentration of imidacloprid in the leaves of drip- or subirrigated plants depends on the application method. Drench applications of Marathon result in much higher concentration of imidacloprid than applications by subirrigation (bottom). Untreated control plants (none) sometimes contained small amounts of imidacloprid, presumably from application to the stock plant before the cuttings were taken. These data were collected two weeks after the Marathon application.

concentration in the leaves of plants in the different treatments. Irrespective of how the plants were irrigated, plants that had received a Marathon drench contained about 6 times as much imidacloprid as plants that received Marathon by subirrigation (Fig. 1).

This suggested that drench applications would result in better whitefly control than applications by subirrigation. To test this, we placed 10 adult whiteflies in little cages on the leaves of the plants for two days. Three weeks later we came back and counted the number of immature whiteflies that had hatched. Surprisingly, we found that drench application did not necessarily result in better whitefly control, even though we found more imidacloprid in these drenched plants. Specifically, we found that plants that were normally subirrigated had fewer immature whiteflies if the Marathon was applied by subirrigation than when it was applied as a drench (Fig. 2). And conversely, plants that were watered by drip-irrigation had fewer whiteflies if the Marathon was applied as drench, instead of by subirrigation.

IMIDACLOPRID DISTRIBUTION IN THE PLANTS

Our finding that subirrigated plants had fewer whiteflies when Marathon was applied by subirrigation as well made little sense, since these plants contained less imidacloprid than

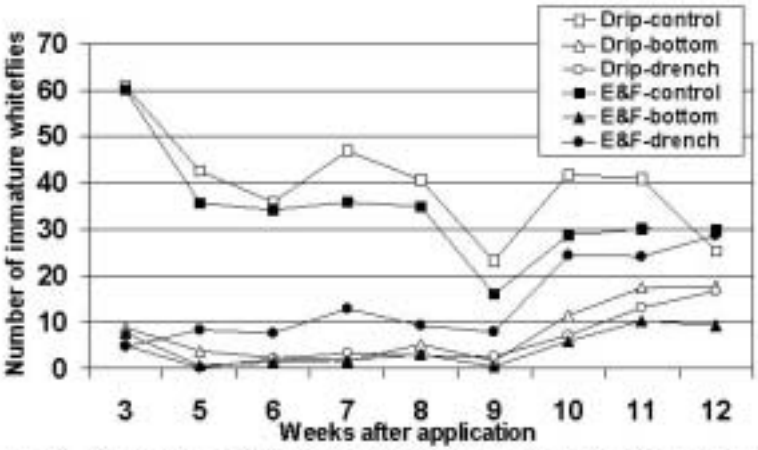
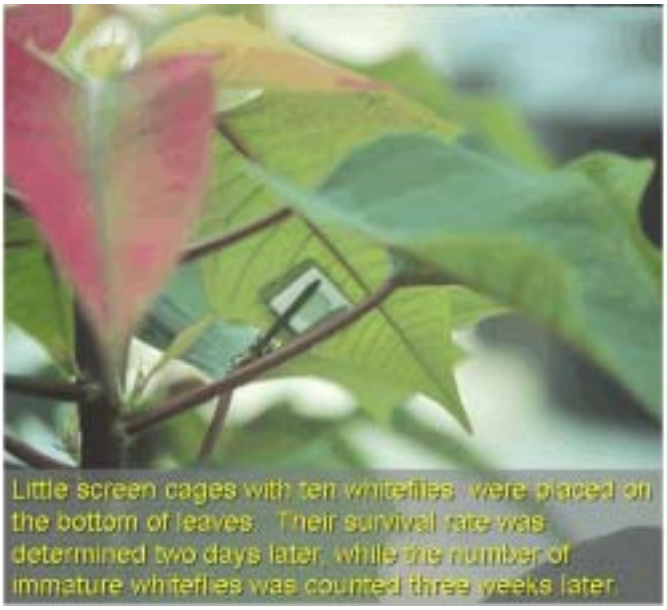


Fig. 2. The number of immature whiteflies on poinsettias depended on both the irrigation method (drip irrigation or ebb and flow (E&F)), as well as the Marathon application method (to the bottom of the pots by subirrigation, or as a drench). Plants on ebb and flow had fewer immature whiteflies when Marathon was applied to the bottom of the pots, while drip irrigated plants had slightly fewer immatures when the marathon was applied as a drench. Untreated plants were included as a control treatment and always had a lot of immature whiteflies.



Little screen cages with ten whiteflies were placed on the bottom of leaves. Their survival rate was determined two days later, while the number of immature whiteflies was counted three weeks later.

subirrigated plants which received a drench. To try to understand what happened, we conducted another study, in which we measured the imidacloprid in different parts of the plants, and looked at the reproduction of the whiteflies the same way as during the previous study. To look at imidacloprid distribution within the plants, we separated the canopy into upper, middle, and lower leaves (basically young, intermediate, and old leaves), and then analyzed these leaves for imidacloprid. What we found was that in drip-irrigated plants which received a Marathon drench, almost all of the imidacloprid was in the lower part of the canopy. In subirrigated plants, which received the Marathon by subirrigation as well, the imidacloprid concentration in the lower leaves was much lower than in drip-irrigated plants. However, the most important finding here was that the distribution of imidacloprid was much more uniform in subirrigated plants than in drip-irrigated plants (Fig. 3). In drip-irrigated plants, the bottom leaves contained about 20 times more imidacloprid than the top leaves, while in subirrigated plants, the bottom leaves contained only three times as much imidacloprid as the top leaves.

Because of the uneven distribution of imidacloprid in drip-irrigated plants, immature whiteflies did better on leaves in the top of the canopy than in the bottom of the canopy. Immature whiteflies fared equally poor on top and bottom leaves of subirrigated plants. What resumably happens when drip-irrigated plants receive a drench application, is that initially the Marathon is readily available , and

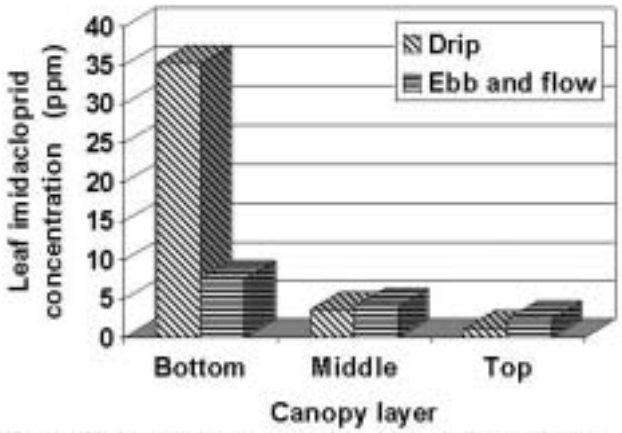


Fig. 3. Leaf imidacloprid concentrations in the bottom, middle and top layers of the canopy at nine weeks after the Marathon application. Drip-irrigated plants received the Marathon as a drench, while plants grown on ebb and flow benches received an equal amount of Marathon by subirrigation. Plants irrigated by ebb-and-flow had a much more uniform distribution of imidacloprid throughout the plant, which resulted in better whitefly control.

is taken up by the plants. However, since Marathon is very water-soluble, it gets leached from the pots during subsequent irrigations, and there may not be any Marathon left in the pots after a few weeks. Since imidacloprid does not get redistributed within the plant very well, the leaves that are formed later do not get enough Marathon, leaving these leaves susceptible to whiteflies. When plants are subirrigated, there is no leaching. The Marathon that is not taken up by the plants remains in the growing medium, and is available for later uptake. This allows uptake of Marathon throughout the growing season, so even leaves that are formed long after the Marathon application still can take up marathon. This results in a good distribution of marathon throughout the plants, and the entire plant will be protected against whiteflies.

OUR ADVICE

In conclusion, applying Marathon by subirrigation is an effective way to control whiteflies. For poinsettias, we recommend a single application, approximately two weeks after sticking rooted cuttings or three to four weeks after sticking unrooted cuttings. This will allow the plants enough time to develop a large enough root system to take up the Marathon. Plants should not be irrigated for two to four days before the application, to make sure that the growing medium is dry enough to take up the required amount of Marathon. This type of application is more effective in controlling whiteflies on subirrigated plants than a drench application.

If you use drip-irrigation, apply the Marathon as a drench. Since Marathon leaches out of the pots easily, it is crucial to minimize leaching, especially during the first few weeks after the Marathon application, but preferable throughout the growing period.

An overview of the experimental setup in the greenhouse. Plants received a single application of Marathon, and survival and reproduction of whiteflies was tested weekly.