Department of Agriculture & Biosecurity
STATE OF HAWAI'I

Hawaii Department of Agriculture & Biosecurity

Pesticide Education Newsletter

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Table of Contents

NOTICE - The Pesticide Safety Newsletter normally produced by the University of Hawaii at Manoa College of Tropical Agricultural and Human Resources (CTAHR) Cooperative Extension Pesticide Program is currently on hiatus until the position responsible for creating the newsletter has been filled. In the meantime, to provide Certified Applicators with additional CEU material, the Hawaii Dept. of Agriculture Pesticides Branch, Pesticides Education Section, will produce and make available its own newsletter.

PESTICIDE CHARACTERISTICS

Frederick M. Fishel

This EDIS publication provides a description of the following pesticide characteristics: solubility, adsorption, persistence, and volatility.

INTRODUCTION

To understand how pesticides move in the environment, one must first understand certain physical and chemical characteristics of pesticides, as well as how these characteristics determine a pesticide's interaction with the environment. Some of these characteristics are described in the Physical and Chemical Properties section (Table 1) of a pesticide's Safety Data Sheet (SDS). Other pesticide properties are found in either the SDS' Stability and Reactivity section or Ecological Information section.

SOLUBILITY

Solubility is a measure of the ability of a pesticide to dissolve in a solvent, which is usually water. Pesticides that are highly soluble in water dissolve easily. Such pesticides are more likely to move with water in surface runoff or to move through the soil in water than less-soluble pesticides.

In the SDS, manufacturers use relative terms—such as miscible, dispersible, suspension, emulsifiable, and water solubility—to describe their product's solubility. Some manufacturers will use a numerical value for this description, such as 2.9 mg/L or ppm. Pesticides with a value of 100 ppm or less are considered relatively insoluble, while pesticides with values greater than 1,000 ppm are considered very soluble.

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ADSORPTION

Adsorption is the process whereby a pesticide binds to soil colloids, which are microscopic inorganic and organic particles in the soil. Colloid is derived from the Greek term meaning glue-like. These particles have an extremely large surface area in proportion to a given volume. It has been calculated that 1 cubic inch of colloidal clay may have 200–500 square feet of particle surface area.

Adsorption occurs because of an attraction between the chemical and soil particles. Typically, oil-soluble pesticides are more attracted to clay particles and to organic matter in soil than water-soluble pesticides. Pesticide molecules with positive charges are more tightly adsorbed to negatively charged soil particles. A pesticide that adsorbs to soil particles is less likely to move from the application site than a chemical that does not adsorb tightly to the soil.

PERSISTENCE

Persistence is the ability of a pesticide to remain present and active in its original form during an extended period before degrading. A chemical's persistence is described in terms of its half-life, which is a comparative measure of the time needed for the chemical to degrade. The longer a pesticide's half-life, the more persistent the pesticide. Persistent pesticide residues are sometimes desirable because they provide long-term pest control and reduce the need for repeated applications. However, some persistent pesticides applied to soil, plants, lumber, and other surfaces or spilled into water or on soil can later harm sensitive plants or animals, including humans. It is especially important to prevent persistent pesticides from moving off-site through improper handling, application, drift, leaching, or runoff.

Application of persistent pesticides presents a hazard to persons and non-target animals entering a treated area and may lead to the presence of illegal residues on rotational food or feed crops. Check the label for statements about the persistence of the pesticide and for replanting restrictions. The rate of pesticide degradation relates to the persistence of the pesticide.

Degradation processes break down pesticide compounds into simpler and often less-toxic chemicals. Some pesticides break down rapidly—in a matter of days or even hours. Other pesticides can be detected in the environment for a year or more.

Pesticides are degraded by the following processes:

- Chemical degradation is the breakdown of chemicals by processes that do not involve living organisms, most commonly by hydrolysis, a reaction with water.
- Microbial degradation is the process in which chemicals are degraded by soil microorganisms, such as fungi and bacteria.

- Photodegradation is the breakdown of chemicals in reaction to sunlight.

Water and temperature both affect the degradation of pesticides. Warm, wet conditions can increase the speed of pesticide degradation; cool, dry conditions slow the degradation process.

VOLATILITY

Volatility is the tendency of a pesticide to turn into a gas or vapor. Some pesticides are more volatile than others. The likelihood of pesticide volatilization increases as temperatures and wind increase. Volatility is also more likely under conditions of low relative humidity.

The potential for a pesticide to volatilize is measured by its vapor pressure. This measurement may be described in units of Pa (Pascals) or mmHg (millimeters of mercury). Pesticides that have high vapor-pressure values are more volatile. Vapors from such pesticides can move off-site and cause injury to susceptible plants. Some volatile pesticide products carry label statements that warn handlers of the product's potential for vapor movement (Figure 2).

SPECIAL PRECAUTION

Off-site movement of spray drift or vapors of Command® 3ME herbicide can cause foliar whitening or yellowing of some plants. Prior to making applications, read and strictly follow all precautions and instructions in the GENERAL APPLICATION PRECAUTIONS, SPRAY DRIFT PRECAUTIONS and SPRAY DRIFT MANAGEMENT sections.

Table 1.

The Physical and Chemical Properties Section of a Pesticide's Material Safety Data Sheet (MSDS).

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor:	Amber colored liquid with slight phenoxy odor.		
Boiling Point:	>212°F (>100°C)	Solubility in Water:	Soluble
Density:	9.0 pounds/gallon	Specific Gravity:	Not determined
Evaporation Rate:	Not determined	Vapor Density:	Not determined
Freezing Point:	32°F (0°C)	Vapor Pressure:	Not determined
pH:	8.0–9.2	Viscosity:	Not determined

Note: Physical data are typical values, but may vary from sample to sample. A typical value should not be construed as a guaranteed analysis or as a specification.

IS THIS PESTICIDE ON MY SHELF STILL GOOD?

Warranties, Expiration Dates, and Strategies to Maximize Product Stability

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EXPIRATION DATE AND SHELF LIFE

You may have seen supermarket shoppers reaching to the back of the cooler for what they perceive to be the “freshest” milk. You are used to checking perishable foods (milk, eggs, meat, bread, juices, and more) for the expiration dates or “Best if used by” dates stamped on them to make sure you are not buying items that will soon spoil. Canned food items have expiration dates, too. But unlike perishable products, their expiration dates are years after the products were processed and preserved. The products inside cans often include preservatives that were added to maintain freshness, and those canned products were pasteurized and sealed against air, moisture, and microbial contamination. Which raises the question: "Why can I open these canned products after the expiration date, and they still look and taste good?" The difference between a product’s expiration date and its actual shelf life may be different.

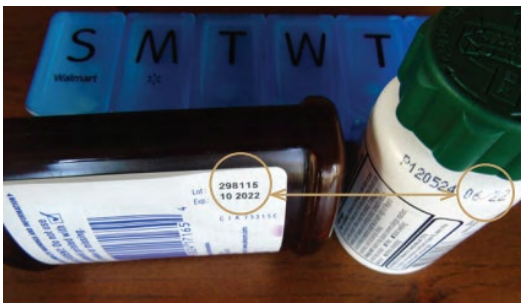
Companies and farmers invest in storing pesticides for future use. But if they fail to use pesticides before their expiration dates, it may cause poor performance, the loss of customers, and costly disposal.

With fresh, perishable products, the expiration dates and shelf life are usually the same; however, the shelf life of nonperishable products often extends well beyond their expiration dates. Consider that durable goods often provide warranty periods, which begin on the date of purchase and extend for a period. With durable goods, the warranty is analogous to the expiration date. But whether it's a watch, a water heater, or a vehicle, we all expect our durable goods to function well beyond their warranty periods. In other words, a durable good's longevity (or shelf life) will most likely exceed its warranty (or expiration date). One of the challenges we face as consumers is extending the life of products we purchase. For example, the life of a truck depends on many factors, including servicing it at regular intervals, keeping

the exterior clean, practicing safe driving habits, and reducing the number of miles you drive each year.

Storing pesticides in a heated shop can extend their shelf life.

Expiration date, warranty, and shelf life are all terms that apply to pesticides too. Farmers and commercial applicators want to know how long they can store pesticide products without losing their efficacy. How long a pesticide will remain effective becomes more difficult to determine if, in addition to being past its expiration or warranty date, the product was opened or stored without protection from moisture, extreme heat, and cold.



If you leave a gallon of milk open on the counter overnight, you know it will sour even though it still has a week left on its expiration date. If you open a can of green beans and store it in the refrigerator, the beans will most certainly go bad well before the expiration date listed on the can. Likewise, how long a pesticide can last in storage depends on many factors including its formulation, active ingredient(s), age, storage conditions, and whether it remained sealed or was opened. If you use a pesticide product beyond its expiration date, it may or may not be less effective. Using a pesticide product beyond its expiration date doesn't necessarily mean the product has degraded to the point that it is no longer effective. Then again, there's no guarantee that it hasn't degraded. There are too many factors that can degrade the product (like storage conditions) that are beyond the manufacturer's control. That is why manufacturers make no assurances or warranties about the quality of their products after the expiration date. This publication provides an overview of the processes that are used to determine a pesticide product's storage stability and explores options for what you can do when these products expire. Our overall goal is to encourage you follow best practices when storing pesticides, so you never have to wonder, "Is the product on my shelf still good?"

Clarifying the Terms

Expiration date, shelf life, and warranty are often used interchangeably, but they have different meanings.

Manufacturers set **expiration dates**. The expiration date tells you that a properly stored product will perform as expected if you use it before the expiration date.

Warranties are normally provided for durable goods and are analogous to the expiration dates for perishable products. A pesticide's warranty assures you that there is a period that it is guaranteed to work and will be replaced if it does not.

Shelf life is how long the product will remain effective after its expiration date and warranty have passed. Storage conditions greatly influence how fast a product degrades. That is why there is no set time for the long-term stability of pesticide formulations.

MANAGEMENT OF PEST ANTS IN NURSERIES

Prepared by

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Endorsed by

Big Island Association of Nurserymen

Hawai`i Export Nursery Association

BACKGROUND

Quarantine requirements for exporters of potted plants, flowers and foliage have become more and more stringent. It is easy to understand that moving plant pests from one location to another is detrimental to the nursery industry, but what about pests we have not previously thought of as plant pests? Many insects can hitch a ride with a potted plant, and while they may not harm the plant itself, introducing these pests to new locations can potentially cause other impacts. Ants are one of these pests. They often do not harm the plants they live in, but some species can cause huge economic and ecological damage when they are introduced to new locations. One such species, the Red Imported Fire Ant (Solenopsis invicta) is such a threat that the USDA has specific quarantine requirements for producers moving plants from within the RIFA quarantine zone to locations outside this zone. These requirements include mandatory treatment of stock and potting medium. Fortunately, Hawai`i does not currently have Red Imported Fire Ants. However, there are several other ant species present in Hawai`i that are subject to restrictions for movement of stock between islands and interstate. This manual is a guide to current best-practice nursery management options that minimize the impacts of these ant species to export operations.

PROJECT FUNDING AND EXECUTION

USDA FARM BILL

The project has been funded by the USDA Animal and Plant Health Inspection Service through section 10201 of the 2008 Farm Bill. Safeguard priorities of the implementation strategy is to "safeguard nursery production", and this project was funded under that priority.

HAWAI`I ANT LAB

The Hawai`i Ant Lab is part of the Pacific Cooperative Studies Unit of the University of Hawai`i. Their charter is to prevent the entry of invasive ant species into Hawai`i, develop technologies to manage those ant species already present and work to eradicate them where feasible. The Hawai`i Ant Lab is the lead group in this project, working with the Hawai`i Department of Agriculture and Dr. Arnold Hara of the UH College of Tropical Agriculture and Human Resources.

PARTICIPATING AGENCIES

Two key industry groups have participated in the development of this manual. The Big Island Association of Nurserymen and the Hawai`i Export Nursery Association have both endorsed and supported the project.

BIOSECURITY IMPACTS OF PEST ANTS

Shipments of potted plants, foliage, or flowers that are infested with ants are subject to certain quarantine requirements depending on where they are being transported. As a producer, this could affect your business through seized shipments, liability issues, penalties and monetary losses.

REGULATORY REQUIREMENTS

Intra-island (local sale)

Most pest ants are not "regulated species" and therefore there are no regulatory restrictions on the local sale of plants infested with ants. There is one exception to this – Little Fire Ants (Wasmannia auropunctata). This is a regulated species under Hawai`i Revised Statutes (HRS150A) and Hawai`i Administrative Rules (HAR chapter 4-72). Knowingly moving material infested with LFA is an offense under these laws.

Inter-island sale

The movement of potted plants, foliage, flowers and propagative material from one island to another within the State of Hawai`i is regulated by the Hawai`i Department of Agriculture Plant

Quarantine Branch. All shipments must either be inspected by an DAB inspector or shipped from a nursery certified by the DAB. In addition to other quarantine pests, inspectors will check for Little Fire Ants. Infested material cannot be shipped until it has undergone quarantine treatment. The shipment may be reinspected at the destination island by DAB inspectors located there.

Mainland USA

The provisions relating to inter-island shipments apply, and additionally, State laws or regulations in the receiving state also apply. In most cases, agriculture or quarantine staff in the receiving State inspects incoming shipments also. At this point, detection of any pest ants may trigger a seizure, destruction of the shipment, or return to the original port.

Hawai`i Revised Statutes HRS150A can be viewed online:

http://www.capitol.hawaii.gov/hrscurrent/Vol03_Ch0121- 0200D/HRS0150A/HRS_0150A-.htm

Hawai`i Administrative Rules HAR can be downloaded here:

http://hawaii.gov/DAB/admin-rules/subtitle-6-division-of-plant-industry/4-72%20HAR-2012

EXPORT CERTIFICATION

Producers can opt for DAB nursery certification. This allows growers to export without inspections of individual shipments and is based on phytosanitary inspections of the benches and/or growing area of stock bound for export. DAB Plant Quarantine officers will conduct at least two inspections every year to determine whether the export section of the nursery meets required standards. For more information about nursery certification, contact your local DAB office or go to:

http://hawaii.gov/DAB/pi/pq/export.

FUNDAMENTAL APPROACH TO MANAGING PEST ANTS

IPM – COMBINING PHYSICAL MANAGEMENT, BIOLOGICAL, AND CHEMICAL SOLUTIONS

Integrated Pest Management or IPM is a pest management approach that utilizes all available pest management methods to keep pest populations below pre-determined thresh-hold levels. Each pest management technique must be environmentally sound and compatible with producer objectives. IPM has several components that work together to allow the grower to develop the most efficient and effective pest management strategy:

1. Setting pest thresh-holds,

2. Survey and scouting,

3. Developing a multi-pronged pest management strategy, and

4. Monitoring outcomes.

SETTING PEST THRESH-HOLDS

Often, the presence of some pests in a production system causes no economic harm, and sometimes, the presence of even one pest individual is too many. In the case of pest ants as a quarantine problem means the pest thresh-hold must be zero. Where pest ants are causing other problems like farming scale insects or mealybugs, the presence of small, scattered colonies may not actually be causing any real economic damage. Knowing what pest loads are present and the identity of the species is therefore an important factor in deciding whether to act or not. The best way to get this information is through regular scouting or pest surveys.

Survey and scouting

Regular survey and scouting are essential in any integrated pest management system. Surveying ants is not difficult and there are three good methods of doing so. In Hawai`i, where it is warm all year round, these surveys should be conducted several times a year (at least twice).

1. Visual searching. Pick up random pots at regular intervals and look underneath each pot. Check out both the underside of the pot and that part of the bench where they have been sitting. Any ants scurrying away can be caught using a piece of scotch tape. Simply press the tape down onto the ant and stick it onto a piece of paper. A more thorough inspection entails taking the pot to a solid bench and slapping it down sideways (not enough to damage the plant, but sufficient to dislodge any ants crawling on foliage) If plants are pot-bound, removing them from their pot and tapping the root ball onto the bench will also dislodge any ants living in the potting medium.

2. Survey for Little Fire Ants. This entails placing chopsticks or popsicle sticks smeared thinly with some peanut butter into shady spots around the nursery. Intervals of 20-30ft are ideal. Leave the chopsticks for about 60 minutes and place them into zip-lock bags. It is helpful to use several bags – one for each part of the nursery because that way it will be possible to narrow down the location of any problem ant species.

3. Complete ant survey. Different ant species are attracted to different kinds of food items. Some like sweet things, others prefer proteins and some like oils. A survey for all ant species

means it is necessary to use three different kinds of baits. This can be done by modifying the Little Fire Ant survey to use different bait types. Instructions for this can be found on page 13. After the survey, they can then be sent to the Hawai`i Ant Lab for identification.

Pest identification

Ants are unusual in a pest management context because there is no one-size-fits-all solution. Each ant species has a unique biology and often solutions need to be tailored to suit each individual species. For this reason, knowing which ant species are present in your production system is very important. We have over 60 ant species in Hawai`i, and most of these are not nursery pests. Only a handful poses problems for the nursery industry. A brief description of the main pest species can be found on page 18. Fortunately, there are many identification resources available to growers. The Hawai`i Ant Lab and Hawai`i Department of Agriculture are all too pleased to provide identification of any ant species you might find during your scouting and survey activities. Once you know the identity of the ant species in your nursery, you are in a much better position to develop a plan of action. The presence of some ant species may pose no biosecurity or regulatory issues at all, and it is then up to you to determine if they are causing any impact to your stock. Other ant species can pose substantial problems, especially for inter-island and interstate exports. The most serious of these is the Little Fire Ant. However, interstate agriculture agencies are becoming increasingly cautious about the presence of any ant species.

PHYSICAL FACTORS

NURSERY DESIGN AND LAYOUT

The nursery “industry” in Hawai`i is very diverse and ranges from large, high-volume wholesale enterprises, smaller retail establishments that sell direct to the public, to hobbyists who grow plants and sell them at farmers markets and other venues. Your nursery layout has probably “evolved” over the years as your business grows, shrinks, or changes according to market demands. The gradual changes to nursery layout over time result in three key design elements that hamper pest management. The first is the lack of a clear boundary between the growing area and neighboring properties. Ants do not respect boundaries, and without a clear buffer between your business and neighbors, it can be difficult to manage pest ants. You may be very successful at eliminating an ant problem in your business, but if those ants can re-infest your property from neighboring land, all your efforts could be wasted. If possible, establish a clear buffer around your enterprise. Wider is better, but at a minimum, this should be 6 feet or better. This buffer can be utilized as a “firebreak” between you and the ants beyond. The second common design element many nurseries have is the use of windbreaks or planted areas through the nursery or adjacent to greenhouses or growing areas. These windbreaks often contain palms and other tropical trees. While they may look attractive and serve a useful

purpose, they are also a harborage for pest ants and other plant pests. Often it becomes very difficult to manage ant populations when windbreaks are close to growing areas. A final aspect of nursery layout that can hamper pest management is the presence of "fallow" areas – growing beds or shade-houses containing old pot bound stock, accumulations of supplies and equipment that are not being used, and unused space in general. This build-up of "stuff" that might be useful one day and unused growing beds or shade houses are a haven for pest ant populations to establish and develop. Because these areas do not get much attention, they serve as a quiet place for pest populations to build up unnoticed. So, wherever possible, change your layout so you have a cleared buffer around your operation, remove unnecessary windbreaks and other vegetation, and keep unused areas of the nursery as tidy as possible. These simple changes will greatly reduce the cost and time needed to manage pest ants in your operation.

HABITAT REDUCTION

The previous section deals with changing the basic layout of a nursery operation to reduce the amount of effort needed to manage nursery pests. It goes hand in hand with reducing available habitat. Nursery operations can be frantic and diverse as you respond to market demands. Growing several different products with market demands that ebb and flow often results in an accumulation of equipment and supplies necessary for each aspect of your business. One day you need 1000 1-gallon pots, and the next week demands change, and the left-over pots sit somewhere gathering moss – and pest ants. Accumulations of pots, cinder, peat and other supplies that are left idle until they are needed, provide excellent habitat for pest ants to establish and spread. Often these piles of unused items are left adjacent to growing beds, shade-houses, etc. where they pose the biggest threat to your growing stock. Wherever possible, keep these items organized, and if possible, in some central location away from production areas. Spaces around shade houses etc. should be clear of equipment, supplies and dunnage. Not only does this prevent ants from sneaking into your stock, but it will also make managing these pests much easier and more cost effective.

MANAGEMENT FACTORS

STOCK AND GOODS INWARD

One of the main pathways for pest ants to enter your nursery is through goods moving into the nursery production system from elsewhere. Items such as stock, pots, potting media, landscaping material, items for resale, etc., all potentially harbor pest ants. Any materials coming onto the property should be first held in a quarantine area and inspected or surveyed to ensure they are ant free. Refer to the survey protocols at the end of this manual for appropriate methods. Plants being purchased or returns from customers or landscaping projects can also potentially become infested while they are outside your nursery. These should also be

quarantined and surveyed. Trucks, machinery and employees' vehicles can also harbor ants. Again, ensure a designated car park is used for these vehicles and either survey regularly, or better yet, treat with barriers sprays every 4-6 weeks.

WORKFLOW, PRODUCTION FLOW

A defined workflow is also important, especially when you have production or growing areas you use to harvest cuttings and other propagule material. It's a good idea to chart out how things move around within the nursery and keep these flows well-defined. As stock moves from one part of the production line to the next, there are different risks of contamination. If there is a pest problem that becomes too difficult or expensive to control, it may be possible to design a management plan in which some areas early in the production chain receive less treatment, with control gradually strengthened as the product approach their final stages.

CHOOSING BATTLE LINES

Nursery enterprises are sometimes very large and can span many acres. Treating these larger enterprises can be costly and time consuming. An alternative might be to choose your battle lines and leave certain parts of the property untreated. This approach can work well, especially when planned in conjunction product workflows. The important thing is to have pest-free plants at the end of the production chain, and sometimes it is possible to do this without the need to treat the entire operation.

BIOLOGICAL SOLUTIONS

For many insect pests, the introduction of natural predators or pathogens is the most effective and least costly solution. There are thousands of very successful biocontrol programs that save agriculture millions, even billions of dollars per year. However, most insect pests are solitary – they live out their lives with little or no contact with other insects (except for mating). This means a natural predator, for example, can reduce the pest problem one insect at a time. Ants are one of the few insect families that live together in a social colony. Each ant has a specific task, and most foraging ants (the ones we see) are the older workers assigned to the high-risk task of finding food. A large portion of the colony stays out of sight. All the workers are sterile daughters of a queen. The workers protect the queen and normally she is very difficult to find.1 If some workers are killed during foraging, by a natural predator for example, the queen simply lays more eggs to replace those lost workers. Research of potential biocontrol against Little Fire Ants is in its infancy and to date, no potential candidates have been identified and tested. The history of biological control efforts against ants in general has met with mixed success. Three or so species of phorid fly have been released in southern USA to combat the Red Imported Fire Ant (not the Little Fire Ant). They appear to have established well; however, the impact on the Red Imported Fire Ant population has been only slight. Other agents that

have been researched for their effect on Red Imported Fire ants include several species of protozoa and a species of fungus. This work has been progressing for some years but currently has not resulted in a miracle cure. However, together, all the biocontrol will reduce the total Red Imported Fire Ant population somewhat, but not eliminate them.

CHEMICAL TREATMENT OPTIONS

WHOLE OF NURSERY (NURSERY NOT CURRENTLY INFESTED WITH ANTS)

If there are no ants of quarantine concern present in the nursery, it is good practice to keep it that way. This avoids having problems later. There are two activities that a grower should do:

1. Regular surveys of the nursery

2. Bait or chemical treatment of the nursery boundary.

Surveys

There are three ways that ants can enter the nursery system: purchase of infested plants, potting media or other items; ants traveling on cars and trucks driven by staff, customers and delivery vehicles; and ants spreading from a neighboring property. Good nursery quarantine procedures, hygiene and designated parking can reduce the risk of the first two pathways, but natural spread from an adjoining property is more difficult. It is important to conduct regular surveys of high-risk areas within the nursery, such as: car parking areas, quarantine areas and the nursery boundaries. This can be done quickly and easily using the survey procedures on page 12 of this manual. The recommended frequency of this survey type would be 2-4 per year, with at least one survey conducted over the entire property. These survey activities should be backed up by regular treatments around the boundaries and the car parking areas.

Prophylactic treatment

Prophylactic treatment refers to treating an area for a pest although it “probably” is not infested. It’s a good approach to take, because ant infestations, when colonies are just starting to spread, can be very difficult to detect with a survey. These treatment types can be done using baits or spraying residual pesticides. Baits are preferable, less expensive and easier to apply.

WHOLE OF NURSERY (NURSERY IS CURRENTLY INFESTED WITH ANTS)

If ants of quarantine concern have infested the nursery, there are two options open to the grower. The first option is to eradicate the ants from the entire nursery. The other option is to eradicate the ants from those sections of the nursery that are most critical – the export benches, packing and processing areas. Treating an entire nursery is preferable, because there

is greater certainty that any plants sold or moved from the nursery are ant free. Depending on the type of operation being carried out, either baits, chemical sprays or both can be used. Baits tend to be less expensive, take less time to apply and are more effective over larger areas. An additional benefit is that far less insecticides are used, because baits are directly targeted at the ant rather than being applied everywhere. However, some operations are better suited to treatment by residual insecticides.

PROTECTING STOCK

Although it is preferable to have an ant-free nursery, and therefore ant-free plants, there may be times when the grower has stock that is infested. Plants and the potting media can be treated prior to sale or export to ensure they are ant free. There are three main methods for treating plants: dip, drench and spray with an insecticide; adding controlled release chemicals to the potting media before use, and heat treatment immediately prior to shipment. Each has advantages and disadvantages.

Dip/drench/spray options

Ants can nest and live in either the potting medium or the foliage of potted plants (sometimes both). Therefore, the entire plant needs to be treated. Though some pesticide labels allow foliar application, few allow for dip or drench applications. In addition, not all products are labeled as edible crops. Be sure to read and follow the pesticide label. Here are some examples of effective products:

Sevin®

Sevin is a trade name, and several products are registered under that name. It contains the active ingredient carbaryl. Treatment recommendations are for Sevin RP4®, (EPA reg. 264-335) which is labeled for this purpose. Sevin can be used as a foliar spray on some plants. It provides short-term control. Foliage sprays are mixed at a rate of 1.5 oz per gallon.

Talstar Select®

This product (EPA reg. 279-3155) is registered for use in nurseries by licensed applicators only. It can be used as both a spray and a drench for potted plants; however, the rate depends on the bulk density of your potting medium. Talstar Select®, applied at this rate provides up to six months control of insects in the potting mix. To calculate your bulk density, use a measuring jug and fill it exactly to the one-quart mark with your potting mix compacted as you would for a potted plant. Dry the measured amount in an oven turned on low until no water remains and the mix is perfectly dry. Weigh the dry mixture using a postal scale or good kitchen scale. The chart below shows how many ounces Talstar Select®, to add to 100 gallons of water. If you use a measuring jug that is oven-proof, you could weigh the jug before filling it and subtract the

container weight after weighing. For both Sevin® and Talstar Select®, there may be equivalent generic versions available at your chemical supplier.

Weight of 1 quart dried medium (oz)	Ounces Talstar Select per 100 gallons water
6.9 or less	24
7.0-11.5	4.8
11.6-20.7	7.2
16.2-20.7	9.6
20.8-25.3	12.0
25.4-30.0	14.4

Each pot needs to be drenched with at least 1/5 of the pot volume for treatment to be effective.

Potting media treatment

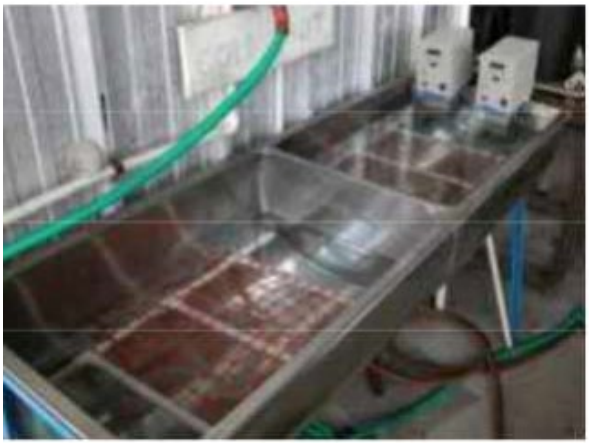
It is possible to "pre-treat" the potting medium of some nursery stock. Granular products such as Talstar Nursery® and generic equivalents are available and can be used without the need for an applicator license. These products can be dosed to exclude ants for a period exceeding two years. Again, the bulk density of the potting medium determines how much Talstar Nursery® will be needed. Also, more products are required as the desired length of protection increases. Use the table below to calculate how many pounds need to be added to each cubic yard of potting medium.

Weight of 1 quart dried medium (oz)	lbs Talstar Nursery per cu. yard			
	6 mth	1 yr	2 yr	>2yr
6.9 or less	1.0	1.2	1.5	2.5
7.0-11.5	2.0	2.4	3.0	3.5
11.6-16.1	3.0	3.6	4.5	7.5
16.2-20.7	4.0	4.8	6.0	10.0
20.8-25.3	5.0	6.0	7.5	12.5
25.4-30.0	6.0	7.2	9.0	15.0

Heat treatment

Dr. Arnold Hara and his team at the Komohana Extension Center (UH College of Tropical Agriculture and Human Resources) have developed novel heat treatment systems that can eliminate most, if not all living ants from potted plants. The system relies on heating the plant and pot to a temperature hot enough to kill ants but not hot enough to harm the plants. Dr. Hara can be contacted through his web page here:

http://www.ctahr.hawaii.edu/haraa/



Hot water dip tank for treating nursery plants

Hot water spray room for treating nursery plants