Do you know everything about what is in your pesticide storage area? You may need a refresher.

Take Another Look

Start the year off right; get a refresher on the basics of effective use of pesticides.

By Jim Bethke

I really like a variation to a short story "Sharpen Your Axe." It goes like this: A strong, young woodsman impressed the logging camp by felling more trees than usual in his first week of work. The logging foreman could see that the young woodsman had a fine swing and that he would be a good addition to the logging camp. Eventually, the camp was buzzing with the prospect of a challenge between the young woodsman and the old veteran of the camp. So one day the young woodsman challenged the old veteran to a tree-felling match. The young man knew he was stronger and observed that the old man took a lot of breaks during the day. The veteran took the challenge with a wry smile, and they began to cut trees. Before long, the old veteran took a break, and the young woodsman knew this was his chance to surpass the veteran's total. They cut all day long, and the young woodsman became exhausted and could barely swing his axe, but he was confident he was far ahead of the old veteran because the old man had taken so many breaks. At the end of the day they counted the felled trees, and much to the young man's dismay he had lost. The young woodsman couldn't understand why. He was surely stronger, and he had taken far fewer breaks. The young man asked his opponent, "How could that possibly be? You took so many breaks." The old veteran replied, "I only stopped to sharpen my axe."

This story reminds us that we can become complacent with our equipment and our routines, so much so that we fail to see new, more efficient methods or forget the many standards that were once the hallmark of the routine. I must say that the same can be true when it comes to pesticide application and equipment. Day-to-day operations can become so routine that we can forget innovations in technology, ignore new IPM methods or miss new pesticide rotation methodology. I'm hoping that this article will inspire you to take another look. It might be time for you to stop and sharpen your axe.

RATIONALE

One of the reasons pesticides need to be used more effectively is because many of the chemical companies are no longer developing traditional broad-spectrum pesticides. Many of the pesticides currently in use or being developed have short life spans, are more selective and are used at much lower rates of active ingredient. Therefore, applications need to be targeted to achieve more efficient control.

Pesticides registered for use against a specific pest have been tested thoroughly by the manufacturers to ensure efficacy; however, many factors influence pesticide effectiveness, and each grower possesses their own unique pest and pesticide-use profile. This profile includes factors such as:

- the previous use of pesticides, in practice;
- the type of equipment used in applying the pesticide;
- the density of the crop being grown/pesticide coverage;
- local environmental conditions: humidity, temperature, sunlight levels;
- type of growing facility: glasshouse, polyhouse, shadehouse, nursery;
- cultural conditions such as soil type, etc.;
- application technique, low or high volume sprays, and the use of adjuvants, etc.; and
- plant selection within the facility.

Loss of effectiveness within a facility may have a number of causes, and it would behoove us to review and explore the more common causes.

INTEGRATED PEST MANAGEMENT

Control. Not relying on pesticides as the first line of defense can enhance and prolong pesticide effectiveness; therefore, a fully integrated approach to pest control should be adopted. Most people define this as an IPM approach.

Cultural control means to control the pest using growing conditions. For instance, screening pests out of the greenhouse, building an anteroom at the entrance, sterilizing soil, eliminating weeds, using resistant cultivars or building smaller or partitioned houses. We have observed that exclusion and smaller facilities really make a significant difference in the ability to control pests, and it should be one of the first things considered in a pest control program.

Environmental control means to change temperature, light, irrigation, etc. that may inhibit pest population growth.

Biological control is the introduction of biological organisms to naturally control the pest population. This method is becoming more popular in hydroponic perennial crops like gerbera and roses, yet it needs more research for other types of ornamentals.

Scouting. Monitoring or scouting the growing area can warn of a pest incursion and estimate the pest density within the crop. It can prevent problems, reduce the amount of damage and lower the cost of control by providing an early warning system. Plants should be visually inspected at least once a week. Once you have identified an infestation, you can target only that area for control measures, which can reduce the cost, raise the effectiveness and increase the longevity of pesticides. Scouting can also be used to indicate of how well control methods are working. Monitoring and keeping good records can build a pest history on a specific crop and in a specific location.

Misidentification. It is very important to identify the pest before making a control decision. Many misapplications are due to misidentification. Once an insect or mite has been identified as a pest species its biology and seasonal life history can be obtained. The life history will indicate where and how the pest feeds, what type of damage to search for, the number of generations per year, the kinds of plants it infests and the susceptible stage. All of this information is used to determine the best strategy for dealing with the pest.

Pesticide use may be avoided if the pest is in a non-damaging stage of development and an early application is made on the more susceptible stage. For example, when growing perennial gerbera, the leaves are not harvested; only the flowers; therefore, if there is a population of adult leafminers, an application to the adult stage may be a waste of pesticide. The more suscepti-

Figure 1. Types of adjuvants and their uses.

Type	Effect
Acidifiers	reduces pH of tank mix
Defoamer	reduces or eliminates foam build-up in the tank
Drift Reduction Agents	reduces the production of fine droplets
Penetrants	increases penetration of the cuticle
Stickers	increases rain fastness and reduces runoff
Spreaders	increases coverage as influenced by water tension
Water Conditioners	adjusts water hardness

ble stages are the early instars in the leaf. The eggs will hatch in three days, and the larvae will develop in six at about 80° F. So a potential tactic would be the application of larvicides or insect growth regulator on the leaves for the next two weeks, and you will successfully control the leafminers. This depends, of course, on the proper selection of pesticide and that it is efficacious.

PESTICIDE USAGE

Factors that influence the choice of pesticide include:

- What is the pest species?
- What stage of development is the pest in?
- What pesticides have a history of effectiveness against the pest?
- What pesticide has a proven track record against this pest?
- Should the pesticide be a contact, systemic or residual formula?

The labeled rate of the pesticide has been extensively studied; therefore, using the pesticide in a manner not consistent with the labeled rate will eventually lead to problems, not to mention, that it is illegal.

Many pesticides tend to lose their killing power over a period of time, once they have been opened. This process may be sped up with improper handling and improper storage; therefore, it is important to know the shelf life of the pesticide and store pesticides properly to extend their life.

Many pesticides require a specific pH or softer water to increase effectiveness or extend their life. Adjuvants can be used to improve the water quality found on site. See Figure 1, above, for a list of adjuvants and their uses.

LIFE CYCLES AND MOVEMENT

An example of how to use the life cycle of leafminers to suggest potential control measures was seen earlier. Be aware that whiteflies can go through a generation in 21-25 days, leafminers in 15-20, aphids in 8-10 and mites in just a few days depending on temperatures. When applying or rotating pesticides, the number of days to a new generation is very important. The same length of time between applications cannot be made for each of these pests.

Most of the pests that attack ornamentals complete several life cycles each year. A single, well-timed, thoroughly-covering spray of an effective pesticide should provide control but may require more than one spray during the growing season.

In addition to knowing the life cycle, knowing the pest's movement patterns can aid in placement of the pesticide. For instance, whiteflies and mites infest lower leaf surfaces. Aphids can be on lower leaf surfaces but also on terminal buds and stems. Leafminers are confined to and protected by the leaf epidermal layers as a larva. With this knowledge, it is easier to make the decision to use a contact pesticide, a translaminar pesticide, etc.

EQUIPMENT

Keep in mind any misuse of equipment, inadequate agitation, improper calibration, inadequate maintenance, etc. Application equipment needs maintenance just like any other equipment. Many coverage problems occur when the equipment has not been properly calibrated. It can result in too much or too little active ingredient being applied to the target site.

Also, keep in mind that the type of application equipment can have a profound effect on the efficacy of the active ingredient. Use the proper equipment or application technique — low volume vs. high volume, fogging for adults, etc. In addition, the type of equipment, the pressure and the nozzle type will determine the droplet size. Smaller droplet sizes increase drift and potentially, without aid, lead to more active ingredient on benches and floors rather than on the target. ➧

COVERAGE

One of the most important parts of pesticide application is coverage of the infested area. Not spending enough time covering dense foliage will allow some survivorship of the pest. The survivors may have been exposed to sub-lethal doses of the pesticide, which increases the chance for resistance.

The timing of the pesticide application must coincide with a pest stage that is vulnerable to the chemical and application. For instance, whiteflies are most susceptible when they are in the early nymphal stages. They are most tolerant in the redeye stage; therefore, monitoring to establish the pest stage will help determine which pesticide to use. In addition, whitefly nymphs are located on the lower surface of leaves. So the application should be directed to the undersides of leaves for effective coverage. Knowing where to direct the pesticide is just as important as proper coverage.

HIGH POPULATIONS

Ten aphids on a terminal today can become 250 in a week. If there is spider mite webbing visible, the population is probably enormous. A very heavy pest infestation is very difficult, if not impossible, to control. Very high pest populations should be avoided at all costs. This is another good reason to intensively monitor for pests.

Managing pests or pesticide resistance should start with the basics of integrated control mentioned earlier, using everything to avoid the pest first then monitoring or scouting so you can spot treat only when necessary. All these methods are used to reduce reliance on chemical control. When chemical controls are necessary proper rotation of chemicals is the next best way of avoiding or delaying resistance.

The number of pesticides registered for selected pests is dwindling, and the newer registrations have limitations on applications. Resistance management is important to the manufacturers so that their products have a long life in the industry; therefore, they impose user restrictions on the label or a specific IPM program on the label to delay or reduce the chance of resistance buildup. Find out more about avoiding resistance in the sidebar above.

ROTATION

Chemical rotation is a very important concept. Some of the more capable insect species can adapt to different modes of action by detoxifying the pesticide or by rendering the site of action impervious. Research has shown that consistent use of one chemical for an extended period or an off-labeled use can result in pesticide resistance. Most people are aware of that fact already. Unfortunately, research has also shown that highly resistant insects, such as western flower thrips, can metabolize or detoxify more than one chemical or mode of action at a time. Quite simply, this means that treating an insect population with several modes of action at one time can, in time, produce what seems like a super bug; therefore, it is important to avoid or delay resistance by properly using pesticides according to the label and rotating by mode of action as developed by the Insecticide Resistance Action Committee and adopted by the EPA. Rotation should occur every one or two pest generations, so that the new mode of action will kill pests tolerant to the first mode of action used.

It is important to understand the basic biology of the pests in question. How long does it take for the pest to complete one generation? That's the question. With aphids it is very short, so rotation should occur in approximately two weeks; however, whiteflies take about 25 days to develop into an adult. Their generation time is much longer. You can search for your more common pests on the Internet and choose the information provided by the major universities in your region.

FINALLY

I've tried to be as comprehensive as possible without making this article a novelette. Resources covering the effective use of pesticides seem innumerable, and I've tried to summarize the majority of them simply to provoke thought. It is my hope that even one item on one of the lists is something you have inadvertently neglected for a while, and I've brought it to light for you so you will not forget to sharpen your axe. GPN

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Avoid Pesticide Resistance

State with pest collection
- Proper identification of the pest
- Determine the level of pesticide resistance by laboratory assay

Consider including alternative integrated methods of control
- Physical (e.g., exclusion)
- Cultural (e.g., crop rotation)
- Mechanical (e.g., pruning)
- Biological (e.g., parasites or predators)

Use intensive scouting before treatments
- Determine pest species present
- Determine if the infestation is localized
- Is treatment necessary as determined by an economic threshold

Minimize the amount and frequency of application

Always rotate pesticides
- By chemical class
- By mode of action

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