Integrated Pest Management in Flowering and Ornamental Shade Trees in the Foothills of North Carolina

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Nursery growers in the foothills produce hundreds of different species and cultivars of flowering and ornamental shade trees. One management tool or approach that growers can use in their production systems to assist in producing high quality, healthy, marketable plants is **Integrated Pest Management or IPM.**

PART ONE: WHAT GROWERS NEED TO KNOW ABOUT IPM

WHAT IS IPM?

IPM can be defined as "a ***sustainable*** approach to ***managing*** pests by combining ***biological, cultural,*** **and** ***chemical*** tools in a way that minimizes economic, health, and environmental risks."

Sustainable

The term *sustainable* means that by adopting IPM practices growers and their families will continue to have a productive nursery for many years to come. It means that groundwater and streams aren't going to be polluted by fertilizers and pesticides. It means that soil isn't going to erode away and end up in streams and lakes. It means that fish and wildlife won't be killed because of pesticides that are applied.

Managing Pests

The key to IPM is *managing* pests. Each grower must *realize* that potentially harmful pests will continue to exist in the nursery. The goal of an IPM program is not complete eradication of all pests from the nursery, as no nursery can be kept totally free of aphids, mites, or caterpillars for extended periods of time. Instead the aim is to reduce pest populations to less-than-damaging numbers.

Combining different control practices is also key to IPM and to sustainability. Reliable pest control that will stand up to the test of time rarely depends on a single control strategy, such as pesticide use. In an IPM program, the cost of chemicals and

sprays to eliminate all pests cannot be justified. This is why control measures should be integrated.

Biological Tools

With IPM, nursery growers attempt to maximize natural control agents. *Biological* pest control is often viewed as releasing insect predators such as ladybugs or praying mantises-something few growers do because it is perceived as not giving the level of pest control needed. A number of different beneficial organisms may inhabit any nursery field. A key component of IPM is to conserve the native predators that are already present and providing free pest control in your nursery. Each grower should strive to create a healthy environment for these "natives" so that they can reduce problems with a number of insect pests.

Cultural Tools

Cultural practices include all things that go into growing an ornamental: proper site selection, plant spacing, fertility, and ground covers. In general, a healthy, vigorously growing plant is much less likely to have problems with pests. Often chemical controls don't work when cultural practices aren't adjusted to reduce the potential for the development of pest problems.

Chemical Tools

Chemical tools are pesticides. These should be applied only when needed based on scouting results. In IPM, growers treat only the blocks of plants, individual plants, or a portion of the plant requiring treatment. This reduces the amount of unnecessary pesticide use in the field. The choice of pesticide is very important in IPM. Select pesticides that are least disruptive to beneficial insects in the nursery (e.g., soaps and oils). Certain commonly used pesticides are broad spectrum materials that kill native predators as well as pests. As a result, the pest population (like mites) reproduces quickly in the absence of native predators.

Site Specific

With IPM, each nursery site or field must be managed as a separate unit and viewed as a separate ecosystem. Temperature, rainfall, irrigation, soil structure, nutrients, plants, animals, insects, mites, weeds, and diseases are often specific for any given site in the foothills. Growers must realize that any nursery management practice may produce unexpected and undesirable effects within any nursery site or field.

Thresholds

Growers adopting and implementing IPM must also understand that a reasonable management objective is to maintain pest populations below acceptable threshold levels. Low levels of pests in the nursery may provide food for beneficial organisms in the managed system. These beneficial organisms may help to control pests at a later time in the nursery when needed.

WHY ADOPT AND IMPLEMENT IPM?

Many growers in the foothills do not get the kind of pest control that they expect or need. The common mistakes are ones that implementing an IPM system can help solve.

Pesticide Timing

The most common mistake is poor timing of pesticide applications. Timing is very important to controlling pests such as scales that have only one stage, the crawler stage, that is vulnerable to a pesticide. Other pests are only exposed to a pesticide at certain critical times in the year such as young caterpillars of bagworms. Once inside the bag-like structure of plant leaves or needles, they become very difficult to control with most pesticides. Scouting is the only way to determine the growth stage of the pest, and to make the best timing decision.

Another mistake is applying the pesticides too late or after the damage has already occurred. By the time some growers notice potato leafhopper damage on maples, the damaged leaves and stem tissues have already become stunted and distorted. The grower goes ahead and applies an insecticide based on plant damage. But in some cases the population has already declined, resulting in the insecticide being wasted.

Use Different Pesticides

Some growers often overuse the same pesticide. This repeated use of a pesticide can result in pest resistance. Resistance refers to the development of a pest population which is genetically able to detoxify pesticides. This means that the pesticide will no longer control the target pest.

Identify the Cause of Every Problem

Another problem common to the nursery industry in the foothills is low pH and improper fertility. Sometimes a grower may find plants with poor color or damaged leaves. The problem may resemble insect damage or a disease, but in reality is a nutrient deficiency or fertilizer burn. Growers adopting IPM should take soil samples regularly to ensure the greatest growth possible without the overuse of fertilizers.

BENEFITS OF IPM

Many growers who switch to an IPM approach find that they can grow a better quality plant with fewer pesticides and fertilizers. Some growers who are "over-managing" their trees may not see an improvement in tree quality because they are already producing a high quality plant. However, they will see a decrease in the cost of producing that plant as they become more efficient at controlling pests through scouting and other IPM techniques.

Another benefit is a sense of confidence gained by knowing that a grower is winning the battle against pests. Growers will know why they are putting out a particular pesticide and how well it works. The grower will be on top of the situation. Pest management stops being a seat-of-the-pants decision and becomes a business decision. The trade-off is that for IPM to work, the grower must spend time scouting for pests or pay for someone else to do it. Therefore, the cost of pest control may well be the same as it was before IPM was implemented. However, the benefits in improved plant quality and decreased risks to the environment make it worthwhile. This translates into a better reputation for the grower, as a product with dependable quality is consistently produced.

In order for an IPM program to be effective, the grower should have or develop a strong knowledge of the key pests, key plants, and key locations in the managed system.

The grower should also be able to recognize native predators and have an understanding of how the weather affects both pest and plant growth.

Key Pests

Key pests are those which occur in damaging numbers or levels year after year, and usually consist of a few species of insects, diseases, weeds, and nematodes. The grower should become familiar with the identification, biology, and control of these pests.

Key Plants

Key plants are those most likely to incur damage and require some level of treatment year after year. By knowing the plant species and cultivars most susceptible to pests, growers can reduce losses by growing resistant plants and by targeting monitoring and management activities to pest-prone plants.

Key Locations

Key locations are those fields or areas within the nursery prone to pest problems year after year. For example, lace bugs tend to appear first on susceptible plants on sites exposed to full sun.

Scouting

A grower implementing IPM should monitor or scout by regularly inspecting plants for the presence of insects, weeds, mites, diseases, nematodes, or adverse environmental conditions. Information gained through monitoring can be used to pinpoint the location of pests and to apply control methods in the most effective and timely manner. Monitoring also provides information on the presence and activity of beneficial organisms that may eliminate the need for other controls. Regular monitoring provides the grower with information on how effective previous controls have been. Monitoring includes visual inspections, using trapping devices, and recording weather data such as temperature, rainfall, and humidity.

Proactive Decision Making

Growers who implement an IPM program may find themselves more proactive in their overall decision-making process. Often, the proactive grower will need to address the following questions in a very timely manner based on the information gathered though scouting and monitoring.

<u>Proactive IPM decision-making questions:</u>

1. Is the problem severe enough now or does it have the potential later to cause true damage?
2. Is control most effective at this time or would another time be better?
3. What is the best combination of control tactics to provide results that are economically and environmentally sound?

Once the decision is made to apply control methods, an integrated management plan or strategy using cultural controls, biological controls, resistant plant materials, and chemical controls should be implemented.

The grower will need to evaluate the success of the IPM program on regular basis. This should include the effectiveness of the control methods used, the cost effectiveness of monitoring and scouting, and the overall value of the IPM program to the nursery and the environment.

PART TWO: THREE STEPS TO IMPLEMENTING IPM

Such a wide variety of flowering and ornamental shade trees is grown in North Carolina that it is difficult to become an EPM expert on every species. However, three steps to take in implementing an IPM program apply to all species or cultivars.

STEP ONE: DECIDE IPM IS IMPORTANT

Attend IPM Training

An IPM program is based on a thorough understanding of cultural practices, fertilizers, pesticides, and pest biology. New skills in scouting and record keeping are required. The North Carolina Cooperative Extension Service has training opportunities in nursery EPM to help growers learn these skills. Contact your local county Extension center for more information on IPM educational programs.

Set Goals

Make IPM and reducing pesticide use an objective for your nursery. Write down this objective where you can see it often. Having a written goal is the best way to change.

Map Fields

Some nurseries in the foothills already have a system for tracking plant species and cultivars, plant age, and plant height. Others may need to take time during the winter to develop a plant inventory map of each field or site that shows blocks of flowering and ornamental shade trees. By mapping the nursery into blocks, a grower will be able to identify and track problem areas or hot spots for scouting and monitoring in the overall IPM program.

Think Big But Start Small

Don't try to change everything at once. Set achievable goals for the next 6 to 12 months. By experimenting in a small way, you can learn what works at your nursery and with your resources. The idea is to reduce the risk of failure so you don't become discouraged. This will give you the confidence and experience needed to expand the EPM approach to the whole nursery.

A good way to start is to pick a block of plants where you have had trouble with a pest commonly scouted for (such as aphids) and start using IPM techniques in that block only. To be more comfortable about changing past pesticide practices, choose plants that are more than a year from sale. Review and record current pest control practices in that block. Start scouting to learn where you stand and if what you're currently doing is working. As you continue regular scouting and adjust your management plans and chemical use, you will begin to see the benefits of IPM. As you gain confidence in the scouting techniques and control decision making practices, what you have learned in one block can be used throughout your nursery.

One word of caution. When you first start using a hand lens while scouting, you will see all the pests that you have always overlooked. The temptation may be to immediately apply a pesticide. Just remember that those pests have always been there. By learning how to scout, you are just learning how to find pests sooner, before they cause any damage.

STEP TWO: LEARNING HOW TO SCOUT

What Is Scouting?

Many pests of the various species and cultivars of flowering and ornamental shade trees grown in the foothills can cause economic loss. Some pests, such as the numerous foliar-feeding caterpillars, can be counted on to be present every year. Other pests, such as certain leaf spot diseases, only become a problem occasionally when weather conditions permit. Only through scouting can a grower determine what pests are present in sufficient numbers to cause economic loss and, therefore, warrant a pesticide application.

Scouting involves regular, repeated inspections of plants in the field throughout the year. The objective is to catch pest problems as they begin to develop so that an effective treatment can be applied before they cause much damage to plants. Scouting also involves keeping records so that trends in pest populations can be followed through the growing season and from year to year.

Beginning in January, growers should schedule plant monitoring and scouting visits for the coming year. This should be written on a calendar; otherwise it may never happen during the busy times of the year. A grower should plan to scout fields, sites, or blocks of flowering and ornamental shade trees once a month during January, February, October, November and December. From March through September, a grower in the foothills should plant to scout fields at least twice a month. During key pest periods, some blocks of key plant species and cultivars may need to be scouted once a week.

The Four Goals of Scouting:

1. To determine what pests are present and their stage of growth. The presence of predators should also be noted.
2. To determine if pest numbers have reached the economic threshold and need to be treated.
3. To determine if it is the proper time to control a particular pest.
4. To determine if pesticide treatments have worked well.

Scouting Blocks

A block is a scouting unit which can include as few as 100 plants or over an acre of plants. Each species and even each cultivar should be scouted separately. There are differences between cultivars of the same species in their susceptibility to many pests, such as Japanese beetle and foliar fungal diseases. Blocks of plants of different ages are also scouted separately since different pests attack plants at different growth stages. Jji addition, the treatment thresholds are often higher on younger plants that won't be marketed as soon. Very large fields of a single species may also be broken into blocks by farm roads to make scouting easier.

Economic Thresholds

The decision to take some action against a pest is based on an understanding of the level of damage a plant can tolerate without an unacceptable economic loss. Ornamentals can withstand little pest damage because of the aesthetic qualities they must possess, as well as their need to pass plant inspections when shipping out-of-state. For some plants to pass inspections, a single beetle or caterpillar may be enough to justify the application of a pesticide. However, for most pests such as aphids, spider mites, scales, and caterpillars, many individuals must be present to justify the cost of a pesticide application.

The economic threshold is the number at which a pesticide application or some other treatment action is taken. It is determined through research and observations over several growing seasons. It takes into account that pests will probably multiply, so that pesticides are not applied too late. The economic threshold is usually expressed as the number of pests found on a set number of plants or as the percentage of plants found with the pest on them. Through scouting, a grower can determine if a particular pest has reached the economic threshold in time to make an effective pesticide application. The economic threshold reflects the economic value of plants. For instance, a grower would be wasting valuable time, money, and pesticide attempting to control pests in a heavily harvested block of maples or oaks in late summer in which the remaining plants will be destroyed in order to prepare that same block for planting the following spring. In contrast, a grower would invest in controlling a pest problem on a block of dogwoods at the peak of its value in the production cycle. In order to make a sound IPM decision on whether to control a potential pest problem, a grower must know the value of the crop today and the anticipated dollar return when the plants are harvested. The cost of pesticide application and the targeted plant quality are factored into the economic threshold.

Equipment Needed to Scout

Effective scouting can be done with very few tools, but all of them are important. Be sure to have the following 10 items:

1. Map of blocks. Even rough sketches can help record scouting results.
2. Soil probe for taking soil samples.
3. Plastic bucket for mixing soil samples.
4. Pruners for taking plant tissue samples or samples of damaged branches.
5. Pocket knife for removing bark samples.
6. Hand lens with 5x to 15x power.
7. Beater tray when scouting for spider mites.
8. Counter to keep track of the number of shoots sampled for mite, insect or disease scouting.
9. Plastic bags to keep samples of damaged shoots or unusual insects that cannot be identified in the field.
10. Flagging to mark problem trees or blocks.

Scouting Guidelines

Growers scouting for plant pests should give more attention to highly susceptible species and cultivars and less attention to plants with fewer known problems that appear healthy.

Scouting Rules

Scout first for:

- the most serious pests (key pests)
- of the most susceptible plants (key plants)

A good IPM scout should also understand the life histories of the pests that develop on the plants being grown in the nursery. The scout should understand and know the pests that can be expected at seasonal periods on certain plants. In general, the southern or most protected side of plants will show damage symptoms first.

The Scouting Calendar

The pests you will be scouting for will depend on the time of year. Most pests are only a problem for several weeks out of each year. As you read through the more detailed information on each pest in later sections of this notebook, take particular note of the time of year when your plants should be scouted.

Many pests scouted for are very small or are found only on a few plants out of thousands. How a scout walks through a block to assess pest problems can determine whether the pest is found or not.

There are three different strategies to walk a field and find different pests of flowering and ornamental shade trees. The first method is *rigid block* scouting which requires a scout to walk the entire length of a set number of rows. The second method is *random walk* scouting, where the scout takes a different path each time the field is scouted. The third method is *hot spot* scouting where a scout makes frequent visits to a previously identified hot spot in order to monitor any changes in populations of specific pests such as mites, insects, diseases, or weeds.

Scouting can be more difficult in containerized nurseries if the pots are packed closely together. Scanning plants in a block, and sampling plants from the outside edge may be enough to spot problems.

Rigid Block Scouting

The rigid block scouting method is the most time consuming and thorough of the scouting methods. It is based on searching for spider mites which requires the most intensive scouting. Comparisons of the nnumbers of spider mites found from one visit to the next will show whether a population is increasing or decreasing.

To scout a block using the rigid block scouting method, enter the block two to four rows from one corner. Record the row you start with on the scouting form so that on your next visit you will be able to start your survey one or two rows above or below this row. Walk the full length of the row, scanning from side to side up to five rows in each direction, depending on the size of the plants. To detect mite problems, it is necessary to see the top half of every plant, and a full side of most plants. When you see a problem plant, go to it for a closer look, but return to your original row to continue through the field. When you reach the end of the row, step over six to ten rows as previously determined from tree size. Continue this pattern until you have covered the entire block. Record scouting results.

Random Walk Scouting

The random walk scouting method is less time consuming, but it does not give you the confidence you need to scout for certain pests like spider mites. It is appropriate to determine disease and weed problems, bagworms, aphids, and many other pests.

To scout using the random walk scouting method, enter the block from one side, and circle through the block, trying to see into all areas of the field. Each time you scout the block, enter from a different side and take a different path. Walk toward any problem trees that can be seen from a distance. Record scouting results, and draw your path through the block on a field map so that a different path will be taken the next time trees are scouted.

Hot Spot Scouting

Hot spot scouting can be used to keep track of developing problems. The hot spot becomes a representation of what is going on in the rest of the block. Hot spot scouting can be used to monitor a slowly spreading problem such as *Rhizoctonia* Web Blight These hot spots may only need to be visited once or twice a year. Hot spot scouting can also be used to determine the size and stage of weeds to time herbicide treatments, the presence of dogwood borer moths in a pheromone trap, or to monitor the effects of the weather on spider mites or powdery mildew on individual plants that are prone to damage. In these cases, frequent trips for several weeks may be necessary.

Identify the hot spot through other scouting methods and mark it with flagging and on a field map. If the pests in the hot spot are becoming more active, use another scouting method to determine if the entire block requires a pesticide application.

Monitoring Techniques

A number of monitoring techniques and devices are often used by nursery scouts in an IPM program. Pheromone traps can be used to time for sprays for clearwing moth borers (banded ash borer, lilac/ash borer, oak borer, dogwood borer, rhododendron borer, peachtree borer), conifer tip moths, Japanese and Oriental beetles, and bagworms. Sticky traps can be used to sample for aphids, adelgids, thrips, leafhoppers, and other pests that fly among host plants. To detect mites and other minute sucking pests, leaves or portions of branches are often beaten on a white surface or beater tray. Visual inspections of plant leaves and bark for the presence of pests must be made by the scout where other monitoring techniques are not available.

Soil Sampling

Establishing and maintaining good fertility is an IPM practice. The best defense against pest problems is to grow healthy, vigorous plants. The best way to keep plants growing at their greatest potential is to fertilize on the basis of soil samples. Your county Cooperative Extension agent can better help you determine what fertilizers to use if a representative soil sample is available. It is often the job of the scout to collect such samples.

In field nurseries, a soil sample is made up of soil sample cores from five to ten different locations in each block. Be sure to sample in areas around each plant where

fertilizer has been applied, and around areas where fertilizer has not been applied.

Always use a soil probe made for taking soil cores to take a soil sample. Your county Extension agent can advise you on the depth of the sample, but usually a sample from 4 to 6 inches in depth is sufficient. Remove any surface debris such as dead leaves from each core. Mix all cores from all the locations from each block in a plastic bucket before placing a single sample in the soil sample box. Metal buckets can actually affect the soil sample readings! You can obtain soil sample boxes and forms from the Extension Center in your county.

Do not take soil samples for six weeks after fertilizer applications. Fall is often a good time to take soil samples and quickly get results back from the NCDA & CS Soil Testing Lab to make decisions about fertilizer needs in the coming year.

In containerized nurseries, sample the potting media before potting. After plants have been in pots for a year, knock out soil from several pots to make a sample. Mix these thoroughly before placing them in the soil sample box. One common problem in containerized nurseries is low soil pH, especially in plants that have been potted for a year or more. The pH and soluble salts can be tested on site with the proper meters, although these measurements are not as accurate as those obtained from the NCDA & CS Soil Testing Lab.

Record Keeping

One of the major differences between an IPM program and traditional pest control program is the importance of good record-keeping practices. An IPM program will need records of scouting results, soil sample results, and pesticide and fertilizer applications. Items to record for each scouting visit include date and weather, location of site, time in and out of site, major problems observed, and location on nursery maps, control decisions made, control techniques used, and evaluation of previous control activities. A record of name and volume of pesticides used, where they where used, when they where used, and why they were sprayed should also be recorded.

Information should be kept on each block of plants from the time they are first planted until harvest. Records can help keep a grower from repeating past mistakes.

STEP THREE: DETERMINE THE BEST CONTROL STRATEGY

For most flowering and ornamental shade trees, flowers or flower buds are more susceptible to pest attack than leaves, stems, and roots. Where flower quality is essential on ornamental plants, control decisions must be made rapidly.

Leaves are the next most susceptible plant part with respect to pest injury. It is important to know whether the leaves affected will be the final leaves for the season or if the plant will put out new leaves to mask low levels of early season damage from either an insect or leaf disease.

Stems, twigs, and branches rarely suffer from low levels of pests such as scale insects. However, woody parts of the plant can be seriously damaged by borers that girdle the stem or trunk as they feed.

Whether the damage is on the flowers, leaves, stems, or roots, a pesticide application may not always be the answer for pest control. Often, if not coupled with appropriate cultural practices, a pesticide will give only short term or ineffective control. An IPM approach to pest

Management integrates several control strategies.

Cultural Practices

Several cultural practices can reduce problems with insects, mites, diseases, and weeds. These include proper plant spacing, proper watering and fertility, ground cover management, and sanitation. Important cultural practices to help reduce pest numbers are listed for each specific pest. Be sure to follow these practices in conjunction with properly timed pesticide applications.

Least-Toxic Material

When pesticide treatment is needed, it is important to choose the least-toxic material possible, especially if beneficials are present. The primary concern is toxicity to insect and mite predators. The material should also be least-toxic to wildlife, especially to aquatic species. If pesticides are used, take care not to allow them to drift or spill into streams or ponds.

Pesticide Cost

Cost, availability, and compatibility with other practices is also important. Many of the newer pesticides that are specific to certain pests are very expensive by the quart or gallon, but are similar in price when looked at on a per-acre basis which is the true cost to the grower. However, if your nursery is small, you might not be able to afford a gallon of an expensive material that would take you years to use. In this case, sharing the cost with another grower may be an option.

Pesticide Spray Coverage

Many growers do not achieve the coverage needed to get good control. Coverage is more important for pests that do not move around much such as scales and adelgids and when applying pesticides that are not systemic. Good coverage is also important for applications of preventive fungicides that protect the plant from infection. When a pesticide fails, it is often because coverage was not adequate, not because the material did not control the pest.

Avoid Mixing Materials

Spraying flowering and ornamental shade trees with a foliar insecticide is expensive and labor intensive. Therefore, many growers like to combine pesticides and even foliar fertilizers together to reduce the number of times plants have to be sprayed. Also, if growers are treating for a pest that is difficult to control, they may be tempted to mix two materials that control the same thing or to double the rate, hoping to achieve better results or make up for poor spray coverage. Unfortunately, this does not help achieve better kill.

Pesticides can be inactivated by the addition of other chemicals. In particular, materials containing sulphur or oil can deactivate many pesticides. Experience has shown that the best approach is to treat for one pest at a time with one pesticide at a time.

For more information on pest control and the current list of materials labeled for each species, contact your local Cooperative Extension agent.