by MICHAEL BROWNBRIDGE

SEVERAL new pest control products have been recently registered for use on ornamentals and more should appear on the market in the next few years. Many of these products are classified as "biorational" or "reduced-risk" pesticides.

What Are Biorationals?

Unlike conventional synthetic pesticides, which are classified on the basis of their chemistry, biorational pesticides are grouped on the basis of some shared characteristics. For example, they pose minimal to no risk to the environment due to their chemical make-up, rapid degradation, or the small amounts required to effect control. These pesticides are safe to applicators and are compatible with biological controls due to their selective or short
residual activity.

Biorational products include insect growth regulators (synthetic or botanically derived), oils, soaps, many of the new products with novel chemistries, microbially-derived products, and living microbes such as fungi and bacteria. The way a product is formulated and applied can also affect its classification as a biorational.

Marathon, for example, may be regarded as a biorational due to its granule formulation and method of application, which prevents direct contact with beneficials and poses reduced risks to applicators. But it's not compatible with many natural enemies, including predators and hymenopteran parasitoids, so it doesn't fit the full biorational profile.

Using Biorationals

Biorationals can't be used the same way as traditional means because most of them are not cheap. Secondly, unlike the older synthetic insecticides, many biorationals have narrower spectra of activity, minimal to no residual activity, or short persistence. Many are active only after contacting the target pest. Therefore, it is critical to use them properly to make them cost- and pest-effective.

It is imperative to use biorationals within an integrated pest management (PM) program to ensure the correct selection of the most appropriate product according to the pest species, the developmental stage(s) being targeted, and optimal timing and placement of an application. Most
biorationals are better suited to use as preventative rather than curative treatments. This requires basic scouting and monitoring components be in place. Your own experiences will prepare you for the type of pests that may be encountered on certain crops from year to year, which is where good record- keeping pays off. This information will help you formulate a plan.

Some products also need to be used on an "in-first" basis. The biofungicides RootShield and PlantShield serve to illustrate this point well. These products need to be applied before diseases invade plant tissues. The fungus used in these preparations, Trichoderma harziunum T-22, helps block the entry of plant pathogens into the plant tissues by colonizing niches on the root, stem or leaf surface, which are preferred sites of infection for these pathogens. The fungus can also actively attack and kill invading pathogens.

Rhapsody, which is based on the bacterium Bacillus subtilis, has a similar mode of action. But it is a preventative, not curative, biocontrol product. Understanding how your control tools work and what they can do, or perhaps more importantly what they can't do, is critical to their successful use.

Early pest detection is vital, therefore a strategy to prevent populations getting out of control can be implemented as soon as possible. Consider the rapid potential for thrips' and aphids' population growth and spread if allowed to go unchecked. Aphids can spread approximately 120 square feet per day in a chrysanthemum crop. Correct identification of the pest is key to the selection of the best product for its control.

Nicotinoid, Marathon or other systemic insecticides, and Flagship work well against piercing and sucking in-sects like aphids and whiteflies, but not U-trips. Endeavor, which is also a systemic but with a completely different and new chemistry, works well against aphids, but not so well against whiteflies. The IGRs Distance and buprofezin work well against whiteflies, but not against aphids. Conserve has excellent efficacy against thrips, caterpillar pests, and leaf miners, but does not work against aphids and whiteflies.

Many of these new products have a much more restricted spectrum of activity than their predecessors. It is no longer a case of one-stop shopping for all your insecticide needs. Product selections need to be made carefully, according to the target pest and your own experience with that pest. Learning from other growers, extension specialists, meetings, and trade magazine articles can also help guide this choice. Also, be sure to read the label for proper usage.

Targeting Pests

Targeting a developmental stage is also an important consideration in product selection. Some materials work as adulticides, ovicides, or larvicides. Because mixed-age populations are usually present, use products that will control different stages in the initial phases of a management program to obtain better early control of the whole population. However, it is unlikely total control of all developmental stages will be achieved, therefore follow-up monitoring is essential to determine efficacy and the need to re-treat.

With the exception of systemic products mentioned earlier, or those with some translaminar activity such as Distance or the miticide Pylon, using good spray techniques to obtain thorough coverage of infested foliage is essential because many biorational must contact the pest directly to be effective. The short residual activity of many biorationals also makes it imperative to efficiently target the pest.

One of the main reasons many products fail is because they either do not reach the target pest or quantities reaching the pest are too low. Placing water- or oil-sensitive spray cards throughout a crop will provide an instant record of where sprays have reached. When used consistently this technique can lead to the adoption of better spray practices, more efficient use of resources, and ultimately superior levels of pest control.

Applying Biorationals

Spray equipment also needs to be properly maintained to obtain the type of coverage required. Certain types of spray equipment are more suitable for biorationals than others. For example, when applying fungicides, we have generally obtained superior levels of insect control using high-volume, "wet" sprays in the greenhouse compared to most low-volume sprays.

When considering application, you must also consider where the pest is found and target sprays accordingly. For example, whiteflies can infest the underside of poinsettia leaves, so un-less you are using a systemic or translaminar product, this is where sprays must be placed.

If spot spraying, consider the spray equipment and the material being used. Many insecticides like Avid have repellent properties that may actually promote the spread of an infestation by agitating the resident pest population and causing it to move from treated to adjacent host plants. Too much agitation of the foliage during spraying can also cause this sort of dispersion. Research done in Europe shows the spread of Western flower thrips can actually increase within an agitated greenhouse crop. Work done in the United States suggests high-pressure sprayers can help disperse fungus gnat adults. If spot treating, think about selecting a product and application method that minimizes this sort of effect, and treat a wide enough buffer zone around infested areas.

Reapplication

Given the limited range of activity, persistence, and residual activity of many of these products, reapplications are often required to suppress an infestation over a growing season. This raises two important issues. Firs when should you re-apply? Regular scouting and record-keeping after spraying will provide valuable information on how well a treatment has performed, and when another application needs to be made, optimizing the treatment timing. Secondly, what should you use for the second treatment? For products such as soaps and oils, repeated applications may be problematic because of the build-up of spray residues on the
leaves, but their use throughout a growing season is not restricted. For some of the newer biorationals such a Conserve and Distance (pyriproxyfen), the manufacturers mandate no more
than two to three consecutive applications of these products be made in an cropping cycle to delay the development of resistance.

The IGR buprofezin has been used successfully control whiteflies in Europe for many years, and was the weapon of choice in many programs because of its compatibility with natural enemies. Unfortunately, many whitefly populations in Europe are now resistant to this product, making buprofezin no longer a valid control option in many countries.

If ever there has been a lesson that we frequently ignore, it is that insects will become resistant, and resistance will develop more rapidly the more often we use the same product. It is essential to treat these new products with care, to ensure their prolonged usefulness in the greenhouse. To accomplish this, use pesticide rotations that incorporate different classes of insecticides with different modes of action.

Mixing Biorationals

Tank-mixing some products such as soaps, oils, or neem-based products with other insecticides is beneficial against certain pests. But because environmental factors and varietal and plant growth stage may affect phytotoxic expression, phytotoxicity should be assessed before treating large numbers of plants.

For fungal products such as BotaniGard, Mycotech's reference data sheets show compatibility with most biorational insecticides like Azatin, Avid, soaps, oils, and IGRs. There is also considerable compatibility with chemical fungicides, and tank-mixing is possible with biorational fungicides such as Phyton 27 and Cleary's 3336. Fungal use may be integrated with many other products, but applications need to be made several days before or after fungicides have been used.

Fungicides are also compatible with most predators and parasitoids, although the oils used in the emulsifiable formulations are initially repellent to some natural enemies such as whitefly parasitoids. Thus, formulation choice is important, depending on the crop, pest, and overall crop management program. The biofungicide RootShield also has proven to be compatible with many fungicides, insecticides, and growth regulators, and to date appears to have no adverse effects on natural enemies.

Bacillus thuringiensis (e.g., Gnatrol and Dipel) is compatible with most crop protection products, and has few or no adverse effects against a range of predators and parasitoids. Nematodes, which are primarily used for fungus gnat control, are also very compatible with biorational pesticides.

Biorationals And Beneficials

Compared to traditional pesticides, biorationals are generally much "softer" on natural enemies. Soaps, horticultural oils, and IGRs may have some negative impact on beneficials when applied as foliar sprays that directly contact the natural enemy, but these effects are short-lived due to their limited residual activity.

Koppert's adult Macrolophus, Encarsia, and Diglyphus are susceptible to neem products, and bees may be adversely affected. Neem products may be safe for Orius, Aphidius, and predatory mites. Similarly, there has been considerable debate about the safety of Conserve for natural enemies, which in itself highlights some of the difficulties associated with trying to assess compatibility.

In general, when spray residues are dry there is a high degree of compatibility with honey bees and bumble bees, predatory bugs such as Orius, ladybeetles, and lacewings. Effects on predatory mites are less clear but appear to be more chronic, which can reduce longevity and fecundity, and adversely affect establishment.

Parasitic wasps are very sensitive and releases must be timed to prevent direct exposure to high levels on treated plants. Avid is very harmful to some predators and parasitoids, al-though
it affects some developmental stages more than others. Systemic insecticides such as Marathon and Endeavor are harmful to many predatory and parasitic species.

Koppert has compiled what is probably the best source of information on compatibility. This publication is in English and Dutch, with up-to-date in-formation available at ww.koppert.nl.

Biorational Availability

While alluding to many products in this article, the main purpose has been to highlight what it takes to use them effectively. Here is a list of some biorational products:

· Existing IGRs include Adept, Precision, Distance, Enstar II, Azatin XL, Neemazad, Ornazin, and Citation. Most have 12-hour REIs, but Azatin and Enstar II have four-hour REIs.
· Horticultural oils and soaps, and microbially-derived preparations, such as Avid and Conserve, are biorationals.
· The microbial biopesticides BotaniGard, and Bt products have a variety of trade names such as Dipel, Xentari, and Gnatrol to name a few.
· The borderline biorationals are Marathon and Endeavor.
· Registrations in the near future include Marathon look-alikes Acetamiprid and Flagship for aphid whiteflies, and mealybugs, and the IGR buprofezin (Applaud).
· For mites, Floramite, Ovation, Hexygon, and Pylon have been newly registered, or appear to be on the verge of registration for greenhouse ornamentals. They appear to be fairly compatible with most biologicals, although some precautions should be observed if predatory mites form part of an IPM program.
· Messenger is another interesting new product with a different mode of action. This has just been registered for use on ornamentals and other crops, and works by provoking a plant's natural defense mechanisms in a manner analogous to the way in which vaccines elicit an immune response in humans. The full range of crops and diseases against which this material might promote a defense response remains to be determined, but certainly the early results are encouraging, and it is very appropriate for an IPM program.
· Fungicides fitting the biorational, profile include Phyton 27, Cleary's 3336, and the biofungicides RootShield and PlantShield (T.harzianum), Rhapsody, and Serenade (Bacillus subtilis).

Pest Control Of The Future

Applied correctly, biorationals can provide excellent control of pests and diseases, and have a host of other positive attributes that surely make them the weapons of choice for the future. If not used properly or wisely, then control will be poor, and we will see many of the problems associated with the older-generation pesticides emerging.

Knowledge and product must be used together to make the right decisions and to obtain the high levels of control required in greenhouse crop production.

Biorationals and IPM

Here are some considerations when incorporating biorationals into a spray program:

· Think about your total pest management program. Ideally, the program should be thought through ahead of time.
· Early and accurate identification of pests (or diseases0, and the predominant life stages is vital.
· Biorationals are often only active against certain pests or life stages. Some products are preventative, not curative, and work on an "in-first" basis.
· Thorough coverage of foliage is essential, with sprays targeted at the pest. Many biorationals must directly contact the pest to be effective.

· Biorationals are often only active against specific life-stages, therefore repeat sprays may be necessary.
· Do not overuse products with the same chemistry. Use spray rotations.
· Even though most of these products are considered soft on natural enemies, still consider the choice of product and the timing of sprays/releases to minimize any negative interactions.

About the author: Michael Brownbridge is a professor of entomology, University of Vermont, Entomology Research Laboratory, Burlington, VT 054054400. Many thanks to Dick Lindquist Ohio State University), Dan Gilrein (Cornell Extension), and John Sanderson (Cornell University) for information on existing and upcoming biorational insecticides. Mention of a product in this article does not represent an endorsement by the author or the University of Vermont.