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BotaniGard® and Biocompatibility

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Biocompatible refers to the ability of a pesticide to be safely used with biologicals (beneficial insects and mites). Koppert's side effects guide classifies side effect on beneficials in two ways; reduction of control capacity and persistence. For instance, DDVP® would likely be classed as a 4 for all biologicals, but only has a 1-2 day residual. We consider it "biocompatible" because it can be used to clean up a situation and biologicals can be immediately reintroduced with no side effect. Something like Spinosad®, while being less harmful than DDVP on many biologicals, has a residual period of at least two weeks. It is not as compatible due to the wait of 2-3 weeks before introduction of biologicals.

Biologicals can be generally broken down into these categories: Predatory bugs, predatory mites, parasites and gall midges.

Below is the side effects guide developed by Koppert:

- **1** Harmless < 25% reduction
- **2** Slightly harmful 25 - 50% reduction
- **3** Moderately harmful 50 - 75% reduction
- **4** Very harmful > 75% reduction
- **?** Effect/persistence unknown (Persistence is indicated in number of **weeks!** (Spinosad, Avid®, Enstar®, etc.)

More harsh materials, such as Thiodan®, which are listed as 3 or 4 and with a long residual (8-16 weeks), have no compatibility whatsoever. They are used only at the end of a bioprogram when there are no plans to go back to biologicals. A truly biocompatible pesticide such as Distance® can be used directly over top of a bioprogram with minimal disruption. **BotaniGard®** fits into this class for the majority of beneficials. BotaniGard is an excellent 'transition' material for growers moving from a traditional chemistry program to a biological program as it prevents the pests from developing until the chemical residue has dissipated sufficiently to be safe for beneficials.

BotaniGard is an excellent application over top of a bioprogram to reduce population down to more manageable levels for the biologicals.

Thrips programs are often based almost entirely on predatory mites. Thrips are controlled, on some crops, primarily with predatory mites (*Swirskii*, *Cucumeris*, etc.) which only target the first instar. BotaniGard is the only option to control thrips without damaging the beneficials if inadequate predatory mites are present and a portion of the thrips population develops past the first instar. Predatory mites and BotaniGard work synergistically as the predator mites attack the harder to contact 1st instar, BotaniGard targets the adults and larger instars which can be easier to contact on some crops.



Whitefly programs include *A. swirskii* and parasites in various crops. An example is cut gerbera where *A. swirskii* is used to control eggs and 1st larval stage in conjunction with parasites (*Encarsia* and *Eretmocerus*) used to control second and third larval stage. When hotspots develop, BotaniGard is sprayed over top of the biologicals and works synergistically. It is generally harmless to beneficials while targeting the remaining unparasitized whiteflies. When whiteflies are parasitized, their outer casing becomes a shield for the parasite which is further protected by its own pupal case.

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Parasitized (*Encarsia formosa*) whitefly pupae will have a blackened appearance and the yellowish ones contain ERCAL (*Eretmocerus eremicus*). BotaniGard will kill the majority of surrounding unparasitized pupae. Under close inspection, exit holes can be seen where healthy parasites have hatched. These healthy parasites may then target any whitefly scale missed by the BotaniGard treatment. Because whiteflies reproduce quickly on cut Gerbera, and contact is more difficult due to dense growth, combining BotaniGard with beneficials has proven extremely powerful. Similar strategies have been tried in the past with soft chemicals like Distance, but

resistance develops too quickly for it to be part of a long term program. BotaniGard has been successfully intergraded into long term biological control programs.

Aphid control programs are often very similar to the whitefly programs. Once a large number of aphids are parasitized, BotaniGard can be sprayed over top to control hot spots or regain balance with minimal disruption of the parasites protected inside the aphid "mummies".



BotaniGard is also very effective in bridging the residual period from products such as Avid or Conserve into a biological program. For example, an Avid application would be done for thrips then weekly sprays with BotaniGard to keep the population under control until it is safe to reintroduce biologicals (no more Avid residue).

BotaniGard may decrease **predatory bug** populations, (i.e. *Orius* spp., *Delphastus* spp., and *Aphidamia* spp.) often used to clean up hot spots. The grower would have the choice between using BotaniGard on the hot spot, or predatory bugs. *Orius* is used in peppers where it is introduced between weeks 8-12 and establishes in the crop for the remainder of the year. Prior to *Orius* introduction only predatory mites are used, so BotaniGard can be used until first *Orius* introductions. Predatory bugs in general are not used on a wide scale in most crops, other than peppers where *Orius* has a long history of use due to its ability to reproduce on pepper pollen. BotaniGard would likely be rated a 3 or 4 for predatory bugs with 0 residual on the "side effects" scale.

BotaniGard has minimal or no deleterious effect on **Predatory mites** (*Amblyseius* species, *Hypoaspis* species, and *Phytoseilus persimilis*) with the possible exception of *Phytoseilus persimilis*, for which we have no supporting data. Most other predatory mites used are *Amblyseius* species. BotaniGard would be rated a 1 for predatory mites with 0 residual on the "side effects" scale.

Parasites fly through the crop and lay eggs directly into the pest, which then develop inside their host until emerging as adults. Parasite adult numbers may be slightly reduced by BotaniGard applications (*Encarsia formosa*, *Eretmocerus eremicus*, *Aphidius* species, *Diglyphusisae*, etc.). Population reductions can be minimized by waiting until a large portion of the pest is already parasitized. Newly emerging parasites, which are protected from the BotaniGard application by the dead pest casing, should make up for any adults which may be affected. BotaniGard would likely be rated a 2 for parasites with 0 residual on the "side effects" scale. As mentioned earlier, the combination of BotaniGard with a well established parasite population can provide very powerful control against whitefly and aphids.

Gall midges (*Feltiella acarisuga*, *Aphidoletes aphidimyza*) fly through the crop and lay their eggs in spots of prey. The eggs then hatch and the larvae eat the pest. We do not have enough experience yet, but potentially BotaniGard could reduce midge numbers as they are very exposed.