Bioline Biological Control Agents: Natural and Effective Products for Integrated Crop Management Programs
Bioline™ biological control agents from Syngenta are high-quality products containing natural, beneficial insects and mites for use in integrated crop management (ICM) programs to control pests. Available in a variety of unique packaging options, Bioline offers customized delivery systems to ensure beneficial insects and mites will be highly effective. Bioline biological control agents are ideal for greenhouse vegetable, fruit and ornamental growers who need to control insects resistant to chemical pesticides and who want to diversify their pest control strategy. The Syngenta approach to ICM combines all aspects of crop inputs, including integrated pest management, to achieve the needs of the producer and consumer.

### BIOLOGICAL CONTROL AGENTS

**Amblyline™ cal** biological control agent contains the predatory mite Amblyseius californicus to help control spider mites.
- **Active in high temperature and low humidity conditions.**
- Feeds on the common red or two-spotted spider mite (Tetranychus urticae) and the carmine mite (Tetranychus cinnabarinus).
- Will also feed on pollen, which allows it to survive longer in the crop.
- Disperses quickly over the crop and actively feeds on thrips larvae.
- Feeds only on the smallest larva and cannot attack larger larvae or adults.
- Best used early to prevent thrips establishment.

**Amblyline™ ca** biological control agent contains the predatory mite Amblyseius cucumeris, which is an important tool for helping to control Western Flower Thrips (Frankliniella occidentalis).
- Very mobile and will distribute uniformly throughout the crop, typically harbor within the top 0.4-1 cm of soil.
- Adult mites are able to persist for long periods of time even in the absence of food.
- Can be released under benches, if loose soil is present, where fungus gnats populations may thrive.
- Available in innovative blister pack release system, a patented delivery system for improved emergence and establishment.
- Eastern Flower Thrips (Frankliniella pennsylvaniae).
- Available in innovative blister pack release system, a patented delivery system for improved emergence and establishment.

**Amblyline™** biological control agent contains the predatory mite Amblyseius andersoni to help control a range of mite pests such as red or two-spotted spider mites, fruit-tree red spider mites and russet mites.
- Best used as a preventive treatment for spider mite and other mite pests.
- Active at lower temperatures (43ºF/6ºC), allowing it to be introduced earlier in the growing season.

**Eretline™ e** biological control agent contains the hymenopterous parasite Eretmocerus ervinicus to help control both greenhouse whitefly (Trialeurodes vaporariorum) and sweetpotato whitefly (Bemisia tabaci) larvae.
- Robust performance at high temperatures, even above 86°F/30°C.
- Excellent host-finding behavior.
- Available in innovative blister pack release system, a patented delivery system for improved emergence and establishment.
- Very mobile and will distribute uniformly throughout the crop, typically harbor within the top 0.4-1 cm of soil.
- Adult mites are able to persist for long periods of time even in the absence of food.
- Can be released under benches, if loose soil is present, where fungus gnats populations may thrive.
- Robust performance at high temperatures, even above 86°F/30°C.
- Excellent host-finding behavior.
- Available in innovative blister pack release system, a patented delivery system for improved emergence and establishment.

**Phytoline™ p** biological control agent contains the predatory mite Phytoseiulus persimilis, a well-known predator of the red or two-spotted spider mite (Tetranychus urticae).
- Feeds voraciously on adults and eggs of the red or two-spotted spider mite; also feeds on the carmine mite (Tetranychus cinnabarinus) and on some species of *Diaspididae*.
- Effective in wet temperature range (40-90°F/4-32°C), and performs well in humid conditions.
- Produced in the USA.

**Amblyline™ ca** biological control agent contains the predatory mite Amblyseius californicus to help control Western Flower Thrips (Frankliniella occidentalis).
- Disperses quickly over the crop and actively feeds on thrips larvae.
- Feeds only on the smallest larva and cannot attack larger larvae or adults.
- Best used early to prevent thrips establishment.

**Amblyline™** biological control agent contains the ectoparasitic wasp *Dipteryx sisaea* that specializes in attacking the larval stages of leafminer (*Liriomyza sp.* and *Phytomyza sp.*).
- Adult wasp paralyzes leafminer larva with its sting, and lays eggs next to the paralyzed leafminer that hatches and feeds on it.
- *Dipteryx* life cycle is faster than leafminers’, which enables quicker establishment.

**Encarline™ f** biological control agent contains the hymenopterous parasite Encarsia formosa which controls greenhouse whitefly (Trialeurodes vaporariorum) larvae.
- Best used preventively before the first whiteflies are seen to avoid whitefly establishment.
- Parasitism easy to detect when black-colored scales appear.
- Adult mites are able to persist for long periods of time even in the absence of food.
- Can be released under benches, if loose soil is present, where fungus gnats populations may thrive.
- Available in innovative blister pack release system, a patented delivery system for improved emergence and establishment.

**Phytoline™ m** biological control agent contains *Hypoponus miles*, a soil-dwelling predatory mite to control fungus gnats larvae and thrips pupe that drop from the plant.
- Very mobile and will distribute uniformly throughout the crop, typically harbor within the top 0.4-1 cm of soil.
- Adult mites are able to persist for long periods of time even in the absence of food.
- Can be released under benches, if loose soil is present, where fungus gnats populations may thrive.

**Phytoline™** biological control agent contains the hymenopterous parasite *Dipteryx sisaea* that specializes in attacking the larval stages of leafminer (*Liriomyza sp.* and *Phytomyza sp.*).
- Adult wasp paralyzes leafminer larva with its sting, and lays eggs next to the paralyzed leafminer that hatches and feeds on it.
- *Dipteryx* life cycle is faster than leafminers’, which enables quicker establishment.

**Swirskiline™** biological control agent contains the predatory mite Amblyseius swirskii to help control spider mites.
- Best released between March and September to avoid pupal diapause, unless supplemental lighting is used.
- Will also parasitize the following species: Myzus sp., *Stinkon sp.*, *Schizaphis sp.*, *Rhodaphus sp.* and *Athripsosiphum sp.*
- Adult mites are able to persist for long periods of time even in the absence of food.
- Can be released under benches, if loose soil is present, where fungus gnats populations may thrive.
- Available in innovative blister pack release system, a patented delivery system for improved emergence and establishment.

**Aphidoline™** a biological control agent contains the midge Aphidoletes aphidimyza whose larvae feed on more than 60 different species of aphid.
- Attacks aphids by biting the joints of the legs and injecting a toxin which paralyzes the aphid.
- Best released between March and September to avoid pupal diapause, unless supplemental lighting is used.
- Available in innovative blister pack release system, a patented delivery system for improved emergence and establishment.

**Aphidoline™** c biological control agent contains the braconid wasp *Aphidius colemani* that will sting and paralyze smaller aphids such as the melon or cotton aphid (*Aphis gossypii*), peach aphid (Myzus persicae) and tobacco aphid (Myzus nicotianae).
- Prevents aphid populations from developing and reduces moderate populations to non-damaging levels.
- Adults begin to emerge in transit, ready for immediate release.
- Release beneficial wasps either early in the day (dawn) or late afternoon/early evening (dusk).

**Aphidline™** e biological control agent contains the braconid wasp *Aphidius ervi* that will sting and paralyze larger aphids such as the fogive aphid (*Aulacorthum solani*) and the potato aphid (Macrosiphum euphorbiae).
- Best released between March and September to avoid pupal diapause, unless supplemental lighting is used.
- Available in innovative blister pack release system, a patented delivery system for improved emergence and establishment.

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- Adults begin to emerge in transit, ready for immediate release.
- Release beneficial wasps either early in the day (dawn) or late afternoon/early evening (dusk).
The biological control agent mix contains mummies of two different wasps: Aphidius colemani and Aphidius ervi for broad-spectrum aphid control. Aphidius colemani is an ideal solution for growers who are unsure of which type of aphid is present in the crop.

- Customized mixture of parasites for broad-spectrum control of aphids in ornamental crops.
- Very active search behavior.
- Adults begin to emerge in transit, ready for immediate release.

Aphidius ervi is a biological control agent mix containing the mummies of three different parasites: Aphelinus abdominalis, Aphidius colemani, and Aphidius ervi, which will attack multiple species of aphids.

- Targets more than 25 species of aphids.
- Ideal for use in mixed ornamental crops.
- Reduces the worry of making an incorrect species identification by releasing a three-way mixture of parasites.

**Phemerone**

- **Thripline™** ams. Pheromone contains the aggregation pheromone for Western Flower Thrips (Frankliniella occidentalis). The natural pheromone is produced by males of F. occidentalis and attracts both males and females into mating groups.
- Improves the sensitivity of monitoring traps for thrips, particularly at low levels of infestation or in easily-damaged crops.
- Enables growers to introduce additional control measures, such as Amblyline cu before thrips populations reach damaging levels.
- Highly recommended tool for resistance management in ICM programs.

**Chrysoline™** c. Biological control agent contains the second instar larvae of Chrysopa carnea. The larvae of Chrysopa carnea are predators of aphids and other pests before developing into adults.

- Young larvae with feeding potential on aphid populations.
- One larva can eat more than 200 aphids.
- Adults feed only on nectar and pollen and are not predatory.

**Exhibilne™** sf. Biological control agent contains the infective juvenile stages of the entomopathogenic nematode Steinernema feltiae to help control fungus gnat larvae, Western Flower Thrips and leafminers.

- Controls fungus gnat larvae (Bradysia spp.) that feed in growing media, Western Flower Thrips and leafminers that feed on plants.
- Up to six weeks of protection from fungus gnat larvae.
- Active at temperatures as low as 48°F/8°C, but minimum soil temperatures should be 57°F/14°C for the nematodes to work effectively.

**Online™** i. Biological control agent contains the predatory bug, Orius insidiosus that is a control for Western Flower Thrips (Frankliniella occidentalis).

- All mobile stages are voracious predators of Western Flower Thrips and will attack any developmental stage including adults.
- Will feed on pollen if prey populations are low, which allows it to survive longer in the crop.
- Often released as a follow-up treatment to Amblyline cu.

- Fast-moving predator with aggressive feeding behavior.
- Effective in a wide range of temperatures (54-95°F/12-35°C) as well as a wide range of humidity, light, irrigation and soil conditions.
- Each bag contains mixed life stages with adults, larvae, pupae and eggs providing a balanced population.

**Bioline Unique Release Systems**

When using biological control agents, it’s not just the insects that are important for a successful program. Packaging plays an important role to ensure biological control agents are properly stored and released into your plants. To meet growers’ needs and to help ensure the highest level of effectiveness, Syngenta Bioline has developed a series of unique packaging options. The packaging of Bioline products determines how beneficial insects are released and ultimately impacts how effectively they will control destructive insects. Different beneficial insects need to be packaged and released in different ways, depending on the insect, growers’ needs, crop size and conditions.

- **Breeding system** provides large numbers of mites over time, making preventative control possible with continuous emergence 24/7.
- **Original CRS** was developed by Syngenta Bioline.
- Also available as mini sachets (ideal for hanging baskets) and as the water-proof, patented Gemini sachet.
- **Resists overhead watering and acts as a distribution platform for the mites**.
- **Provides preventative control of damaging pests with continuous emergence 24/7**.
- **Available for Amblyline cu, Anderline aa and Swirskiline as**.

**Blister Pack**

- Novel delivery system for controlling whitely and aphids.
- Improved efficiency, ease of use and labor savings.
- Protects un-hatched cocoons from desiccation and predation.
- Available for Aphidiline a and Erelfine e.

**Controlled Release System (CRS) Sachets**

- Easy to distribute, which allows for more release points and better protection.
- Breeding system provides large numbers of mites over time, making preventative control possible with continuous emergence 24/7.
- Also available as mini sachets (ideal for hanging baskets) and as the water-proof, patented Gemini sachet.
- Original CRS was developed by Syngenta Bioline.
- Available for Amblyline cu, Anderline aa and Swirskiline as.

**Bugline™**

- Unique patented delivery system for controlled release of predatory mites. Developed by Syngenta Bioline to help growers reduce labor by 75 percent versus sachets.
- Provides preventative control of damaging pests with continuous emergence 24/7.
- Resists overhead watering and acts as a distribution platform for the mites within the crop.
- Available in strips of 100 m (328') length, with six strips per case.
- Available for Amblyline cu, Anderline aa and Swirskiline as.
## BIOLINE BIOLOGICAL CONTROL AGENTS FOR WELL-ROUNDED, SUCCESSFUL ICM PROGRAMS

Today's growers are under increasing pressure to produce crops economically and sustainably. Growers should consider all aspects of production with an ICM approach. For pest and disease control, biological control agents should be integrated with physical and chemical controls to create an overall management system.

Compatibility between biological control agents and other plant protection products has to be carefully planned according to each grower or greenhouse's problematic pests, cropping systems and rotations. A comprehensive understanding of practices and conditions allows Syngenta to recommend a crop management system that yields desired grower results.

## COMPATIBILITY CHART FOR SYNGENTA BIOLINE™ BIOLOGICAL CONTROL AGENTS AND PLANT PROTECTION PRODUCTS

### Insecticides

<table>
<thead>
<tr>
<th>Product</th>
<th>Active Ingredient</th>
<th>Class</th>
<th>Population Effect</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avid®</td>
<td>Abamectin</td>
<td>1</td>
<td>0-25% reduction</td>
<td>Best used at the beginning or end of the crop. If used at the beginning, release beneficial insects 7-10 days after application.</td>
</tr>
<tr>
<td>Citation®</td>
<td>Cyromazine</td>
<td>2</td>
<td>26-50% reduction</td>
<td>Residual effect on Encarline f and Eretline e for 12 weeks; beneficials will have difficulty establishing during that period.</td>
</tr>
<tr>
<td>Endeavor®</td>
<td>Pymetrozine</td>
<td>3</td>
<td>51-75% reduction</td>
<td>Can have up to a 12 week residual effect; beneficials will have difficulty establishing during that period.</td>
</tr>
<tr>
<td>Flagship®</td>
<td>Thiabendazole</td>
<td>4</td>
<td>&gt;75% reduction</td>
<td></td>
</tr>
<tr>
<td>Scimitar® GC</td>
<td>Lambda-cyhalothrin</td>
<td></td>
<td></td>
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</tbody>
</table>

### Fungicides

<table>
<thead>
<tr>
<th>Product</th>
<th>Active Ingredient</th>
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<th>Population Effect</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banner Maxx®</td>
<td>Propiconazole</td>
<td>1</td>
<td>0-25% reduction</td>
<td>Best used at the beginning or end of the crop. If used at the beginning, release beneficial insects 7-10 days after application.</td>
</tr>
<tr>
<td>Diacrin®</td>
<td>Chlorothalonil</td>
<td>2</td>
<td>26-50% reduction</td>
<td>Residual effect on Encarline f and Eretline e for 12 weeks; beneficials will have difficulty establishing during that period.</td>
</tr>
<tr>
<td>Heritage®</td>
<td>Azoxystrobin</td>
<td>3</td>
<td>51-75% reduction</td>
<td>Can have up to a 12 week residual effect; beneficials will have difficulty establishing during that period.</td>
</tr>
<tr>
<td>Hurricane® WDG</td>
<td>Fludioxonil + Mefenoxam</td>
<td>4</td>
<td>&gt;75% reduction</td>
<td></td>
</tr>
<tr>
<td>Medallion®</td>
<td>Fludioxonil</td>
<td></td>
<td></td>
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<tr>
<td>Mecri®</td>
<td>Mandipropamid</td>
<td></td>
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</tr>
<tr>
<td>Paladin®</td>
<td>Cyprodinil + Fludioxonil</td>
<td>1</td>
<td>0-25% reduction</td>
<td>Best used at the beginning or end of the crop. If used at the beginning, release beneficial insects 7-10 days after application.</td>
</tr>
<tr>
<td>Subdue Maxx®</td>
<td>Mefenoxam</td>
<td></td>
<td></td>
<td></td>
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