

# BIOLOGICAL CONTROL STRATEGY FOR GREENHOUSE BELL PEPPERS PRODUCTION



## GLOBAL HORTICULTURAL INC. CONTROL AGENTS FOR GREENHOUSE BELL PEPPERS

PEST	BCA	PRODUCT	RATE		TIMING	COMMENTS
			m <sup>2</sup>	ft <sup>2</sup>		
<b>Thrips, Western Flower Thrips (<i>Frankliniella occidentalis</i>) &amp; others</b>  Note: <i>Amblyseius cucumeris</i> will also help in controlling spider mites and broad mites. <i>A. cucumeris</i> can be used year round.	<i>Amblyseius cucumeris</i>	<i>Cucumeris</i> stick sachets	1 sachet per plant		At transplanting at propagator.	
		<i>Cucumeris</i> hook sachets	1 sachet per 3 plants		Hang the sachet on the plant 18-25 cm (6-8 inches) from the top.	Hang sachets between the crop. Avoid hanging them in direct sunlight or close to heating pipes.
		<i>Cucumeris</i> loose	150-200	15-20	Release directly after planting. Curative --> 400 / m <sup>2</sup> every week in areas with high thrips numbers.	Distribute evenly over leaf canopy. Use the larger leaves.
	<i>Orius insidiosus</i>	<i>Orius</i> adults	0.5-1	0.05-0.1	Release 4 consecutive weekly introductions, starting at the end of February under natural day length. Curative --> rates can be much higher depending on thrips pressure.	NOTE: <i>Orius</i> egg laying capacity can be boosted by introducing <i>Ephepstia</i> eggs weekly during the first 4-6 weeks of establishment.
<b>Aphids - smaller species: Green peach aphid, Cotton melon aphid, Tobacco aphid (<i>Aphis gossypii</i>, <i>Myzus persicae</i>, <i>Myzus nicotianae</i>)</b>	<i>Aphidius colemani</i>	<i>Colemani</i> adults / mummies	0.25-1	0.025-0.1	Release weekly. Curative --> 1 / m <sup>2</sup> weekly until control of aphids has been achieved.	Use in combination with banker plants.
	<i>Rhopalosiphum padi</i>	Aphid banker plants	Minimum 1 / acre (2.5 / ha)		Initial introduction is 2 banker plants per acre followed by 1 per acre every 2 weeks.	Consistent releases and maintaining the banker plants are key to success.
	<i>Aphidoletes aphidimyza</i>	<i>Aphidoletes</i> pupae	1	0.1	Release at first signs of aphids. Release weekly until control of aphids has been achieved.	Be aware of diapause between Mid-October and beginning of March.
	<i>Chrysoperla spp.</i>	<i>Chrysoperla</i> larvae	10-20	1-2	Release in hotspots of aphids. Works as a quick knock down.	
	<i>Hippodamia convergens</i>	<i>Hippodamia</i> adults	10-20	1-2	Release in hotspots of aphids. Works as a quick knock down.	
<b>Aphids - larger species: Potato aphid, Foxglove aphid (<i>Macrosiphum euphorbiae</i>, <i>Aulacorthum solani</i>)</b>	<i>Aphidius ervi</i>	<i>Ervi</i> adults / mummies	0.25-1	0.025-0.1	Release weekly. Curative --> 1 / m <sup>2</sup> weekly until control of aphids has been achieved.	
	<i>Aphidoletes aphidimyza</i>	<i>Aphidoletes</i> pupae	1	0.1	Release at first signs of aphids. Release weekly until control of aphids has been achieved.	Be aware of diapause between Mid-October and beginning of March.
	<i>Chrysoperla spp.</i>	<i>Chrysoperla</i> larvae	10-20	1-2	Release in hotspots of aphids. Works as a quick knock down.	
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<b>Two-spotted spider mites (<i>Tetranychus urticae</i>)</b>  Note: <i>Amblyseius andersoni</i> / <i>Amblyseius californicus</i> will also help in controlling broad mites. <i>P. persimilis</i> , <i>A. andersoni</i> and <i>A. californicus</i> can be used year round.	<i>Amblyseius andersoni</i> or <i>Amblyseius californicus</i>	<i>Andersoni</i> / <i>californicus</i> sachets	1 sachet per 3-6 plants		Can be released as loose application but best results are achieved with sachets early in the season. Repeat introduction with heavy infestations.	Hang sachets between the crop. Avoid hanging them in direct sunlight or close to heating pipes.  Distribute evenly over leaf canopy. Use the larger leaves.
		<i>Andersoni</i> / <i>californicus</i> loose	6-10	0.6-1		
	<i>Phytoseiulus persimilis</i>	<i>Phytoseiulus</i> loose	10-20	1-2	Start when first spider mites are detected. Repeat weekly for 3-4 weeks until <i>P. persimilis</i> is established and mites are controlled.  Curative --> 100-150 / m <sup>2</sup> in and around hotspots.	Turn the bottle slowly during use for a more even distribution of the mites. Sprinkle material on the larger leaves in the center of the plant and avoid introduction in bright sunlight.
	<i>Stethorus punctillum</i>	<i>Stethorus</i> adults	In hotspots		Release in hotspots of spider mites.	<i>Delphastus</i> requires high numbers of spider mites.
<b>Broad mites (<i>Polyphagotarsonemus latus</i>)</b>  <i>Amblyseius cucumeris</i> and other <i>Amblyseius spp.</i> are excellent in controlling broad mites.	<i>Amblyseius cucumeris</i>	<i>Cucumeris</i> sachets	1	0.1	See thrips strategy. Broad mites are rare to find these days due to the pro-active strategies that are implemented for thrips. If you discover broad mites, release <i>Amblyseius cucumeris</i> in and around the hotspot.	Distribute evenly over leaf canopy. Use the larger leaves.
		<i>Cucumeris</i> loose	200	20	Release every 1-2 weeks in and around the hotspots.  Curative --> 300-400 / m <sup>2</sup> .	
<b>Caterpillars / loopers (<i>Trichoplusia ni</i> and other species)</b>	<i>Podisus maculiventris</i>	<i>Podisus</i> nymphs	0.05	0.005	Release weekly a few containers starting early in the crop until establishment.	If hotspots with loopers occur, focus releases on hotspots. The nymphs develop better in the presence of prey.
	<i>Orius insidiosus</i>	<i>Orius</i> adults	As thrips strategy		An established <i>Orius</i> population can be a significant contributor to looper control as they prey on moth eggs. Avoid interference from systemic crop protection products that harm <i>Orius</i> by focussing on aphid control using BCAs.	
	<i>Bacillus thuringiensis</i>	N/A	Follow label instructions		Little to no negative effect on other BCAs.	
<b>Whitefly Greenhouse whitefly (<i>Trialeurodes vaporariorum</i>) Silverleaf whitefly (<i>Bemisia tabaci</i>)</b>	<i>Amblyseius swirskii</i>	<i>Swirskii</i> hook sachets	1 sachet per 3-6 plants		Start at first signs of whitefly. Release once when whitefly has been observed. Curative --> introduce every 2 weeks in and around hotspots until whitefly is controlled.	Hang sachets between the crop. Avoid hanging them in direct sunlight or close to heating pipes.  Distribute evenly over leaf canopy. Use the larger leaves.
		<i>Swirskii</i> loose	100-150	10-15	Start at first signs of whitefly. Curative --> 300-400 / m <sup>2</sup> . Introduce every 2 weeks in and around hotspots until whitefly is controlled.	

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<p>Note: If <i>Amblyseius swirskii</i> is released for whitefly it will also help in controlling thrips. <i>A. swirskii</i> requires minimum temperatures of 20°C (68°F).</p>	<i>Encarsia formosa</i> & <i>Eretmocerus eremicus</i>	<i>Encarsia</i> / <i>Eretmocerus</i> mix	5-10	0.5-1	Start at first signs of whitefly. Release every week until whitefly is controlled. Curative --> min. 10 / m <sup>2</sup> every week until whitefly is controlled.	Optimal introduction method for wasps are blister packs. Keep blister packs (cards) out of direct sunlight and open release flap on the back.
	<i>Delphastus catalinae</i>	<i>Delphastus</i> adults	In hotspots		Release in hotspots of whitefly.	<i>Delphastus</i> requires high numbers of whitefly.
<b>Fungus gnats &amp; shore flies (<i>Bradysia spp.</i> &amp; <i>Scatella spp.</i>) in pepper crops grown in organic or soil media</b>	<i>Stratiolaelaps scimitus</i> ( <i>Hypoaspis miles</i> )	<i>Stratiolaelaps</i> loose	100	10	Apply at sticking / seeding and transplanting.	If applied at rooting stage, a second application should be half rate at transplanting.
	<i>Dalotia coriaria</i> ( <i>Atheta coriaria</i> )	<i>Dalotia</i> adults / larvae	2	0.2	Apply at sticking / seeding and transplanting.	If applied at rooting stage, a second application should be half rate at transplanting.
	<i>Steinernema feltiae</i> & <i>Steinernema carpocapsae</i>	<i>Steinernema feltiae</i> / <i>carpocapsae</i> sponge	20,000	2,000	Apply at sticking and repeat twice during rooting stage. Re-apply after transplanting.	Correct application is critical for efficacy. Make sure solution is agitated, fine filters are removed and pressure is kept low.