

## List of Biological Control Agents (BCAs) for Vegetable Farm Use in Singapore

Biological Control Agent (BCA) is a natural enemy, an antagonist, or competitor used for pest control – which offer farms an alternative to chemical pesticides for pest management. BCAs include fungi, bacteria, predatory insects, predatory mites, parasitoids and entomopathogenic nematodes that prey on and eliminate plant insects.

Predatory insects, predatory mites, parasitoids and entomopathogenic nematodes may be used for pest control in vegetable farms without having to engage the services of a Certified Pesticide Operator<sup>1</sup> (CPO). Bacteria- and fungi-type of BCAs must be registered as pesticide with SFA for use in farms producing vegetables or other food crops<sup>2</sup>. Farms must also engage a CPO to apply or supervise the application of these BCAs.

This table lists and provides guidance on the use of BCAs that are approved for import by NParks<sup>3</sup> and can be used in vegetable farms, supporting safe and sustainable pest management practices to enhance local production. If you wish to use any of the listed BCAs, you will need to apply for a permit from NParks to import from overseas.

Biological Control Agent	Type	Target Pests/Diseases	Preferred Growing Conditions
<i>Aphedius ervi</i>	Insects	Aphids (specifically pea aphid and foxglove aphid)	Prefers temperatures between 18-25 °C; works well in greenhouse and open-field crops
<i>Aphedius colemani</i>	Insects	Green peach aphid and cotton/melon aphid	Effective in temperatures between 20-30 °C; thrives in greenhouse environments
<i>Aphelinus abdominalis</i>	Insects	Potato aphid and other large aphid species	Effective in temperatures between 15-30 °C; suitable for greenhouse and field conditions
<i>Dacnusa sibirica</i>	Insects	Leaf miner larvae (Liriomyza species)	Optimal temperatures 20-25 °C; thrives in greenhouse environments
<i>Diadegma semiclausum</i>	Insects	Diamondback moth ( <i>Plutella xylostella</i> ) larvae	Prefers cooler temperatures of 18-25 °C; suitable for brassica crops
<i>Diglyphus isaea</i>	Insects	Leaf miners (Liriomyza species)	Optimal temperature 18-30 °C; prefers high humidity levels
<i>Diaeretiella rapae</i> (M'Intosh, 1855)	Insects	Aphids, particularly cabbage aphid and mustard aphid	Effective between 15-28 °C; works in open fields and greenhouses
<i>Encarsia formosa</i>	Insects	Greenhouse whitefly ( <i>Trialeurodes vaporariorum</i> )	Works best between 20-27 °C; used extensively in greenhouse environments
<i>Eretmocerus hayati</i>	Insects	Silverleaf whitefly ( <i>Bemisia tabaci</i> )	Effective between 22-30 °C; thrives in humid greenhouse conditions
<i>Eretmocerus warrae</i>	Insects	Silverleaf whitefly and greenhouse whitefly	Prefers temperatures of 22-32 °C; used in greenhouse and field settings

(1) For application of Certified Pesticide Operator, please refer to <https://www.sfa.gov.sg/farming/pesticides/certification-of-pesticides-operators>.

(2) Suppliers of BCAs that have not been registered with SFA as pesticide products can submit an application for pesticide registration via the SFA website at: <https://www.sfa.gov.sg/farming/pesticides/pesticide-registration>. The full list of registered pesticide products can be accessed at: <https://www.sfa.gov.sg/tools-and-resources/pesticides-search>

(3) To apply for import permit from NParks, visit the NParks website at <https://www.nparks.gov.sg/services/import-plant-plant-products/check-plant-health-requirements/biological-control-agents>.

## List of Biological Control Agents (BCAs) for Vegetable Farm Use in Singapore

Biological Control Agent	Type	Target Pests/Diseases	Preferred Growing Conditions
<i>Mallada signata</i>	Insects	Aphids, whiteflies, thrips, and small caterpillars	Prefers temperatures between 18-30 °C; suitable for both field and greenhouse
<i>Neoseiulus californicus</i>	Insects	Two-spotted spider mite and other pest mites	Effective in warm and humid conditions, 20-30 °C
<i>Orius sauteri</i>	Insects	Thrips, aphids, and whiteflies	Best at temperatures between 20-30 °C; thrives in greenhouse settings
<i>Phytoseiulus persimilis</i>	Insects	Two-spotted spider mite ( <i>Tetranychus urticae</i> )	Optimal temperature range 20-30 °C; high humidity required
<i>Plesiochrysa ramburi</i>	Insects	Aphids, thrips, and whiteflies	Prefers temperatures 18-28 °C; effective in field and greenhouse settings
<i>Stratiolaelaps scimitus</i>	Insects	Fungus gnat larvae, thrips pupae, and soil-dwelling pests	Effective in soil temperatures of 15-25 °C; thrives in moist environments
<i>Typhlodromalus lailae</i>	Insects	Thrips and small pest mites	Thrives in warm climates, 22-30 °C; used in greenhouse and field crops
<i>Typhlodromips montdorensis</i>	Insects	Thrips and whiteflies	Effective in warm conditions, 25-30 °C; works well in greenhouse settings
<i>Typhlodromips swirskii</i>	Insects	Thrips, whiteflies, and pest mites	Best in temperatures of 20-30 °C; thrives in protected cropping environments
<i>Orius tantillus</i>	Insects	Thrips, whiteflies, aphids, and small caterpillars	Prefers warm conditions, 22-32 °C; effective in field crops and greenhouses
<i>Heterorhabditis bacteriophora</i>	Nematode	Larvae of beetles, including white grubs and wireworms	Prefers moist soil environments; effective in temperatures between 20-30 °C
<i>Heterorhabditis indica</i>	Nematode	Larvae of beetles, including root weevils and chafer grubs	Prefers moist soil environments; effective in temperatures between 22-30 °C
<i>Steinernema carpocapsae</i>	Nematode	Larvae of crane flies, leatherjackets, and wireworms	Applied to moist soil where target larvae are active; effective in temperatures between 22-28 °C
<i>Steinernema feltiae</i>	Nematode	Fungus gnat larvae, thrips pupae, and other soil pests	Best applied to moist soil; effective at 10-25 °C

Let us know  
your thoughts



### Author

Fadhline Suhaimi is from the Agri-Tech & Food Innovation Dept of the Urban Food Solutions Division. Her research focus on Plant Health Biosecurity and Nutrient Management.

### References:

1. International Organisation for Biological Control (IOBC). Guidelines for the use of biological control agents, 2023, <https://www.iobc-global.org>
2. United States Department of Agriculture (USDA). Biological control of insects and weeds, 2023, <https://www.ars.usda.gov>
3. Heimpel GE, Mills NJ. Biological control: Ecology and applications. Cambridge: Cambridge University Press; 2017.
4. Hoddle MS, Van Driesche RG. Evaluation of biological control agents: A guide for greenhouse and field crops. Annu Rev Entomol. 2009;54(1):57-75, <https://doi.org/10.1146/annurev.ento.54.110807.090604>