Biological Control Agents (BCAs):
Field Strawberry Insect Management

BCA Insect Control					
Pest	**BCA**	**Rate (Units/m²)**	**Rate (Units/ft²)**	**Release strategy**	**Application Notes**
Thrips Western flower thrips (*Frankliniella occidentalis);* Chili thrips *(Scirtothrips dorsalis);* and other species Note: *A. swirskii* can interfere with aphid control by predation on *Aphidoletes aphidimyza*	*Amblyseius cucumeris*	100	10	Apply sachets at propagation and again at transplanting into field. Continue applying every 4 weeks until flowers are present. Or broadcast weekly in propagation and finished bed until flowers are present.	Release evenly on the crop area. A battery-operated blower can be used for better coverage and to save time.
		1 stick sachet per linear meter			Ensure the sachets are in contact with plant foliage for better results. Effective on Broad mite also.
	Amblyseius swirskii	50	5	Apply sachets at propagation and again at transplanting into field. Or broadcast weekly in propagation and finished bed until flowers are present.	In areas where temperatures are consistently > 75 °F (24 °C) replace *Amblyseius cucumeris* with *Amblyseius swirskii,* which will feed upon whitefly eggs also. (Summer growing)
		1 stick sachet per linear meter			
	Orius insidiosus[4]	5 - 10	0.5 – 1.0	Release for 4 weeks consecutively with blossoms present; additional release may be required.	Utilize Pepper or *Lobularia* banker plants to allow an earlier and better establishment of Orius. Be aware of reproductive diapause until March 1. Note: Orius in an established population will also support the control of TSSM and Lepidoptera eggs.
	Stratiolaelaps scimitus (=Hypoaspis miles)	100	10	Release after transplanting to field.	Release full rate onto field. Both species can be mixed and applied together.
	Dalotia coriaria (=Atheta coriaria)	2	0.2		
	Steinernema feltiae (NemaShield)	250K - 300K	25K - 30K	Apply to transplants prior to planting in the field.	Ensure constant agitation/aeration of the suspension during application. Remove filters and keep a low pressure for best results. This product is also effective for control of fungus gnats.

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Two-Spotted Spider Mites (TSSM) *(Tetranychus urticae)*	*Phytoseiulus persimilis*	6 – 8	0.6 – 0.8	Release when first spider mites are detected. For best results, continue releasing for 4 weeks to establish population.	Consider using indicator plants (bush beans) for TSSM monitoring. In some strawberry crops, TSSM is assumed to be present immediately. In this case, start with *Phytoseiulus* introduction immediately after transplanting.
	Amblyseius californicus	6 – 8	0.6 - 0.8		Can be released preventatively or used in higher heat and lower humidity situations.
	Amblyseius andersoni	6 – 8	0.6 - 0.8	Broadcast weekly until established or introduce 1 sachet per 2 linear meters	Can be used preventatively and in cooler climates.
Aphids (small species) Cotton/Melon aphid (*Aphis gossypii);* Green peach aphid (*Myzus persicae);* *M. nicotianae*	*Aphidius colemani*	0.25 – 1.0	0.025 – 0.1	Release every week for 3-4 weeks in combination with Aphid banker plants until observing parasitism.	Release at least once per week. Can be complemented with aphid banker plants.
	Aphidoletes aphidimyza[1,2]	1	0.1	Release weekly upon aphid detection. Continue until control is achieved.	Start at first sign of aphid presence. Diapause occurs between October and early March. Keep carrier lightly humid to ensure *A. aphidimyza* emergence.
	Aphid Banker plants *(Rhopalosiphum padi + Aphidius colemani)*	minimum 2.5 plants/ha	minimum 1 plant/acre	Have banker plants established prior to strawberry plants arriving, then introduce every other week.	Place 2 units per acre at the beginning of the crop cycle, then introduce 1 per acre (2.5 ha) every other week. Note: Best results are achieved when banker plants are on drip irrigation system or drip tape, same as the crop.
	Chrysoperla spp. larvae	10 – 20	1 - 2	Use mainly as a hot spot control strategy.	Best for a quick knock-down effect on hot spots.
Aphids (large species) Potato aphid (*Macrosiphum euphorbiae*); Fox Glove aphid (*Aulacorthum solani*); Strawberry aphid (*Chaetospihon fragaefolii*)	*Aphidius ervi*	0.25 – 1	0.025 - 0.1	Release on a weekly basis.	Use as a strategy when large aphid species are detected in the crop.
	Aphelinus abdominalis	0.5 – 2	0.05 - 0.2	Alternate with *Aphidius* species.	Release this species when low parasitism is achieved with *A. ervi,* or if hyperparasitism is confirmed on aphid populations.
	Aphidoletes aphidimyza[1,2]	1	0.1	Release weekly upon aphid detection. Continue until control is achieved	Keep as part of the aphid biocontrol strategy until control is achieved.
	Chrysoperla spp. larvae	10 – 20	1 - 2	Use mainly as a hot spot control strategy.	Best for a quick knock-down effect on hot spots.

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Whiteflies Greenhouse Whitefly (*Trialeurodes vaporariorum*); Sweet Potato Whitefly (*Bemisia tabaci*) For whitefly control in Strawberries, the wasps *Encarsia formosa* and *Eretmocerus eremicus* will provide good control.	*Encarsia formosa*	3 – 6	0.3 – 0.6	Start releasing after first whiteflies are detected and continue weekly	Maintain releases every week until achieving control. A combination of both species can be used for better results. Note: *Encarsia* is not very effective for controlling *Bemisia tabaci*.
	Eretmocerus eremicus				
	Dicyphus hesperus[3]	3-4 per Mullein plant per week for 8 weeks		Introduce Mullein plants at 40 per acre. Apply *Ephestia* eggs weekly during establishment.	This generalist predator feeds on eggs, larvae, and pupae of whitefly. Also feed on aphids, thrips (including *Echinothrips americanus),* moth eggs and various species of mites.
	Amblyseius swirskii	1 sachet per linear meter		Sachets are preferred release method.	Release evenly in the area or apply with a battery-operated blower. ***A. swirskii* will also help control thrips larvae but requires consistent temperatures > 75 °F (24 °C) for best results.**
		100 when loose	10 when loose	For loose broadcasting, repeat weekly.	
Fungus gnats (*Bradysia* spp.) and **Shore flies** (*Scatella* spp.)	*Stratiolaelaps scimitus (Hypoaspis miles)*	100	10	Release first in propagation, then repeat after transplanting to other containers or field.	Release full rate during propagation. Release half rate after transplanting if full rate is used during propagation. Both species can be mixed and applied together.
	Dalotia coriaria (Atheta coriaria)	2	0.2		
	Steinernema feltiae (NemaShield)	250K – 300K	25K - 30K	Apply during propagation.	Ensure a constant agitation/aeration of the suspension during application. Remove filters and keep a low pressure for best results. This product is also effective for the control of thrips.

NOTES:

[1] *Aphidoletes aphidimyza* is highly susceptible to the use of any sulfur products; sulfur should be avoided when using this species.

[2] *Aphidoletes* mate at dusk. If lights are utilized in the greenhouse, it is better to allow the natural sunset, and wait to turn on lights later, at 2 or 3 am. To avoid reproductive diapause (between October and early March), extend daylength to 12 hours. Nymphal stages must develop under long days; otherwise, the adult will not be able to lay eggs.

[3] Use of a generalist predator such as *Dicyphus hesperus* helps act as a biocontrol stabilizer.

[4] Planting habitat plants of *Lobularia* is an excellent method to attract Syrphid flies and other beneficial insects, as well as providing a food source for Orius.

Lygus bugs can also be a problem pest in Strawberry production. Currently there are no known specific BCAs for controlling this pest. Practical experience has shown that established populations of generalist predators such as *Orius*, *Dicyphus* and *Podisus* will help to maintain this pest problem below threshold levels.

Refer to our guide on "Utilizing Dips: Clean up incoming plant material" for more details on how to use other products to reduce the risks of 'hitch hikers' on your young plant material coming in through the door. Contact your Biological Control Advisor or Biological Solutions Advisor for additional information.

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