Cucumber

General Information

The most common pest problems of cucumber crops are, in order of importance, spider mite, thrips and whitefly. Other common pests are aphids, cucumber beetle, loopers and Lygus. Over the last 10 years, cucumber production changed dramatically in many ways. Due to many reasons such as disease pressure, fruit quality and production demands, most cucumber greenhouses are now growing three crops a year. This has pros and cons for biological control. It allows growers to do a good clean up between crops to lower pest pressure, but at the same time it does not work favourably for some Biological Control Agents (BCA) that need a long time to become established in the crop. Key to a successful pest control program in cucumber is an integrated approach combining BCA's as a first line of defence for the most common pest problems with pesticides against pests currently not controlled by BCA's. Other important keys are an early preventive introduction of BCA's and a good monitoring system.

Scouting and Monitoring

As cucumber plants are excellent host plants for most common greenhouse pests, scouting needs to be done on a regular and consistent basis (weekly on the same day) to monitor pest and BCA populations. An excellent tool for monitoring Whitefly, Thrips, fungus gnat and shorefly populations is the use of sticky cards. Biobest suggests using 25 sticky cards per hectare (=10 cards/acre = 1 card/400m^2 = 1 card/4000ft^2), which should be inspected once a week. Identify, count and record the number of pests and BCA's found on cards. All counts (and observations) can be recorded on the Biobest 'Scout-Sheet' or on other scouting and monitoring sheets. Some pests do not show up on sticky cards because they do not fly. Two spotted spider mite and aphids are a good example. Therefore, plants should also be inspected weekly; we suggest inspecting double the number of sticky cards (minimum 50 plants per ha = 20 plants per acre); if any pests and BCA's are found on plants, identify and record observations.

Pests, Biological Control Agents (BCA) & Control Strategy

Spider mites:

Two-spotted spider mite (TSSM, *Tetranychus urticae*) is the main pest problem that can cause major production loss in cucumber. A characteristic of TSSM that makes its control difficult is that TSSM enter hibernation in the fall; at that stage, they can easily be recognized by their orange to orange-red colour. Hibernating TSSM walk off plants to hide in the greenhouse structure in places like cracks and crevices. As soon as temperatures are favourable (spring), spider mites slowly come out of hibernation and move to the nearest cucumber plants. Because over-wintering TSSM are difficult to kill with clean-up products, we recommend lowering the TSSM population by using chemical corrections or BCA's before they begin to hibernate. This is important in order to start the next crop with the lowest possible pressure.

As soon as the first spider mites are discovered, we suggest introducing Phytoseiulus-System, which contains the predatory mite *Phytoseiulus persimilis*, the most commonly used and most successful BCA against TSSM. Another tool and excellent BCA that can be used, especially in hotspots, is Feltiella-System, which contains the predatory midge *Feltiella acarisuga*. For any developing hotspots, a combination of extra Phytoseiulus-System and Feltiella-System can be introduced curatively on plants surrounding the hotspot. Because TSSM thrive under dryer and warmer conditions, it is important to closely monitor the balance between the populations of BCA's versus the spider mites in the plant canopy. In some conditions, it might be necessary to substitute the Phytoseiulus-System with the Californicus-System (contains the predatory mite *Amblyseius californicus*). *Phytoseiulus persimilis* provides an excellent control in cool and humid conditions (<25^{o}C; >65% RH), but might not show up in the upper canopy during hot and dry conditions; *Amblyseius californicus* tolerates heat and dryness better than *Phytoseiulus*. (Introduction rates: Tables 1 and 2).

Thrips

The western flower thrips *Franklinella occidentalis* is the most common thrips species in cucumber crops. The best line of defence against thrips is to begin a biological program as early in the crop as possible. If thrips are present in the greenhouse at planting, first instar larva of thrips could be crawling out of the egg within one week after planting; first instar thrips larva is the stage causing most of the damage. The basis of thrips control in cucumber is to prevent the larva from reaching adulthood, which is too large to succumb to attacks by the BCA's contained in the Amblyseius-System (predatory mite *Amblyseius cucumeris*) and Swirskii-System (predatory mite *Amblyseius swirskii*), the two main products used against thrips. Starting with the second larval stage, it becomes difficult to control thrips because other thrips predators do not fit well into a cucumber production system.

We recommend to start a biological control program immediately after planting by introducing either the Amblyseius-Breeding-System or the Swirskii-System on every plant by placing a small pile of the product at the base of every plant (e.g. on every rockwool block). It is important to introduce on every plant since these predatory mites do not fly and there is no contact between plants at this early stage of the crop. These piles provides a environment suitable for the reproduction of the predatory mite for a duration of approximately four weeks, by which time plants have matured and are touching. The second introduction (and later introduction if necessary) of the predatory mites can be done using the sachet version of the Amblyseius-Breeding-System or Swirskii-Breeding-System, which will provide a release of the mites over four to six weeks. In case a hotspot of thrips develops, we recommend doing foliar application of the Steinernema-System, which contains the nematode *Steinernema feltiae*. (Introduction rates: Tables 1 and 2).

Whitefly:

Greenhouse whitefly (*Trialeurodes vaporariorum*) can be a very dominant pest problem in cucumber crops. High whitefly levels can seriously damage plants and affect production both in quantity and quality.

We suggest using the Eretmix-System, which contains the parasitic wasps *Encarsia formosa* and *Eretmocerus eremicus*, in combination with the Swirskii-System, which contains the predatory mite *Amblyseius swirskii*. Since greenhouse whitefly can get established very rapidly in a cucumber crop, the Eretmix-System provides control during the establishment period of the Swirskii-System. Furthermore, the combination of the Eretmix-System and Swirskii-System gives an excellent coverage of the control of whitefly eggs and larval stages. (Introduction rates: Table 1 and 2).

Aphids:

The most common aphid species found in cucumber are the green peach aphid and melon aphid (for detailed identification key, consult the 'Aphid Pest-Info Sheet'). Aphid population can develop very fast as they give birth to live young aphids (no eggs), which in return start to be reproductive very quickly as well. So, again, monitoring for aphids is very important. Often, when aphids are found in the crop, population has already reached a level that justifies an intervention with pesticides (spot treatment if possible).

Therefore, we recommend a preventive approach by introducing the Aphidius-System, which contains *Aphidius colemani*, a parasitic wasp of green peach and melon aphids, in combination with the 'Aphid Banker-Plant'. The 'Aphid Banker-Plant' consists of barley plants infested with cereal aphids, which can support a population of *A. colemani* but will not attack cucumber; in other words, it is an 'in-house rearing system of aphid enemies'. In case potato and/or foxglove aphids are found in the crop, we suggest using the Ervi-System and/or the Aphelinus-System, which contain the parasitic wasp *Aphidius ervi* and *Aphelinus abdominalis*, respectively. Another option is to use the Aphidoletes-System and/or the Chrysopa-System, which contains the midge *Aphidoletes aphidimyza* and the lacewing *Chrysopa rufilabris*; these two BCA's are generalist predators and can therefore be used against all aphid species. (Introduction rates: Table 1 and 2).

Fungus gnat and shore fly:

Fungus gnats can be a problem in propagation of young plants as well as at the planting stage of small plants but they can occasionally cause damage to older plants. Shore flies can also be a problem but they do not cause direct damage to plants. We suggest using the Hypoaspis-System, which contains the predatory mite *Hypoaspis miles*, as preventive measure against fungus gnats. We suggest to also introduce the Atheta-System, which contains the predatory rove beetle *Atheta coriaria*, as a preventive measure; this beetle will complement the work of the Hypoaspis-System in controlling fungus gnats but it will also

control shore flies. Usually one application soon after seeding and at planting is enough to establish a population and obtain control of fungus gnats and shoreflies. (Introduction rates: Table 1).

Cucumber beetle and Lygus:
Unfortunately there are no BCA's available to control the cucumber beetle or Lygus effectively. Therefore, these pest problems need to be addressed with selective pesticide when observed in the greenhouse. Please contact your Biobest or distributor's IPM consultant to discuss options.

Caterpillars and Loopers:
Caterpillars and loopers can be controlled with B.t.k. (*Bacillus thurgiensis* var. *kurstakii*) products as well as some pesticides that have no negative effect on the rest of the biological control system and/or BCA's used. There are some BCA's available commercially for use against caterpillars and loopers; if you are interested in learning more about these BCA's, please Biobest or distributor's IPM consultant.

Impact of pesticides on BCA's
- Pesticides (insecticides, nematicides, fungicides, etc.) can have short or long-term negative effects on one or more stages of the BCA's. Therefore, be careful if or when choosing pesticides to apply while using BCA's.
- If buying plants from an outside source, request a record of the pesticides applied on the plant material you are buying. Some pesticides with long-term residuals can have a negative impact on BCA's for many weeks after their application, even if pesticides were applied before the plant material is brought into your greenhouse. Ask your supplier of plant material to incorporate BCA's as much as possible in his pest management program.
- Effects of pesticides on BCA's are listed in the Biobest's publication "Side Effects Manual" or can be found on Biobest's website (www.biobest.ca);

Additional sources of information
- For detailed information on pests and BCA's mentioned above, consult the corresponding "Pest Info-Sheet" or "Beneficial Info-Sheet", which are all contained on the "Biobest Info-System" CD. To obtain a copy of any info-sheet or of the CD, please contact Biobest directly or a Biobest representative.

Miscellaneous
- Introduction rates of BCA's can be influenced by climate, season and location;
- Always use products as soon as possible after receipt. If storage is unavoidable, keep at recommended temperature (indicated on package) for the shortest amount of time possible;
- Always use products before the expiry date stated on the package;
- For additional information, please contact a Biobest supplier or technical advisor.

Biobest Canada Ltd., 2020 Fox Run Rd.; Leamington, ON, N8H 3V7, Canada. Tel.: (519) 322-2178; Fax (519) 322-1271; E-mail: info@biobest.ca; Website: www.biobest.ca

Table 1: Preventive introduction of BCA's against cucumber pests.

Pest	Product (BCA)	Introduction rate	Timing	Application
Thrips	Use first product if only thrips are present; use second product if both thrips and whitefly are present			
	Amblyseius-Breeding-System (*Amblyseius cucumeris*)	50 / block	Once, Immediately after planting	2.5ml pile on block
		1 sachet / 3 plants	Monthly, start when crop is 5ft tall	Hang sachets on leaf
	Swirskii- Breeding-System (*Amblyseius swirskii*)	50 / block	Once, Immediately after planting	2.5ml pile on block
		1 sachet / 6 plants	Every 2-3 weeks, start when crop is 5ft tall	Hang sachets on leaf
Whitefly	Use the following two products in combination.			
	Swirskii- Breeding-System (*Amblyseius swirskii*)	Introduction rates in thrips section above; do not repeat if already used for thrips control		
	Eretmix-System (*Encarsia formosa* & *Eretmocerus eremicus*)	1.5 / m^2	Weekly, start immediately after planting	Hang card on leaf
Small aphids	Use following two products in combination			
	Aphid Banker-System (barley plant with cereal aphid)	1 plant / acre	Every 2 weeks, start immediately after planting	Transplant in hanging basket and place in greenhouse
	Aphidius -System (*Aphidius colemani*)	250 / Banker-System	1 week after introduction of Banker-System	Sprinkle on Banker-System
Fungus gnat	Use following two products in combination			
	Hypoaspis-System (*Hypoaspis miles*)	100 / slab	Once, immediately after planting	5ml pile on slab
	Atheta-System (*Atheta coriaria*)	2 / m^2	Once, Immediately after planting	Pile on slab

N.B.: 1 m^2 = 10 ft^2.

h

Table 2: Curative introduction of BCA's against pests of cucumber.

Pest	Product (BCA)	Introduction rate	Timing	Application
Spider mite	Use first product; second product is optional			
	Phytoseiulus-System (*Phytoseiulus persimilis*)	3 -4 / m^2	3 introductions a week apart, start at first sign of TSSM	Sprinkle on plants (whole greenhouse)
		10 -20 / m^2	As necessary	Sprinkle on plants in hot spots
	Feltiella-System (*Feltiella acarisuga*)	250 / hot-spot	2 introductions a week apart	Open package in hot-spots
Thrips	Use at least one of the following two products			
	Swirskii- Breeding-System (*Amblyseius swirskii*)	1 sachet / plant	Once, at first sign of hot spot	Hang sachets on plants in hot spots
	Steinernema-System (*Steinernema feltiae*)	250000/ m^2	2 introductions a week apart	Spray on plants
Whitefly	Swirskii- Breeding-System (*Amblyseius swirskii*)	Introduction rates in thrips section above; do not repeat if already used for thrips control		
Small aphids	Aphidius -System (*Aphidius colemani*)	0.5 - 1 / m^2	At least 3 introductions a week apart	Sprinkle on plants in hot spots
Large aphids	Use at least one of the following two products			
	Ervi-System (*Aphidius ervi*)	0.5 - 2 / m^2	At least 3 introductions a week apart	Sprinkle on plants in hot spots
	Aphelinus-System (*Aphelinus abdominalis*)	0.5 - 2 / m^2	At least 3 introductions a week apart	Open package in hot spots
All aphids	Use at least one of the following two products			
	Aphidoletes-System (*Aphidoletes aphidimyza*)	0.5 - 1 /m^2	At least 3 introductions a week apart	Make piles of 250 Aphidoletes near hotspot
	Chrysopa-System (*Chrysopa carnea*)	500 / Acre	At least 3 introductions a week apart	Sprinkle on plants in hot spots

N.B.: 1 m^2 = 10 ft^2.