Ministry of Agriculture and Food

Gummy Stem Blight of Greenhouse Cucumber

June 2024

Gummy stem blight (GSB) is caused by the fungus *Didymella bryoniae* (asexual state as *Phoma cucurbitacearum* or *Ascochyta cucumis*) and previously known as *Mycosphaerella melonis*. The fungus is also known to infect cucurbits, including cucumber, pumpkin, squash, watermelon, cantaloupe and many others. Under favourable climatic conditions, the pathogen can infect all parts, except roots, of the cucumber plant at all stages of plant development. Infection at fruit development often leads to internal fruit rot that may go unnoticed at harvest. This raises concern among growers because the inevitable post-harvest fruit decay at the grocer creates a poor image for the distributor (packing house) and grower.

Symptoms

Most infections occur through wounds at pruning sites or other injured sites although new growth, flowers and uninjured fruits may also be infected. Typically, symptoms of GSB begin to appear towards the latter part of the crop cycle due to cropping stress. For a crop planted in December/January, symptoms can occur in April/May and for a crop planting in June/July, symptoms can occur in September/October.

On seedlings - the fungus can be carried in seeds. Under favourable conditions, the pathogen can cause pre- and post-emergence death and damping-off of young seedlings.

On leaves - initial symptoms usually appear along the margin of the leaf as water-soaked areas surrounded by a yellow halo, and then extending into the leaf as V-shaped yellow-brown necrotic lesions (Figure 1A). These infections are usually triggered by guttation or where leaves at the top of the canopy are exposed to dripping water from condensation or over-head sprinklers.

On stems - tan coloured lesions develop at nodes where lateral shoots and leaves were pruned out or where cucumber fruits were harvested. These lesions become enlarged, developed into brown-black cankers, cracked and exude a characteristic amber red coloured gummy sap (Figure IB). In addition, basal stem splitting/cracking caused by root pressure can also be subjected to infection. Cankers at the stem-base may enlarge and girdle the stem, causing wilt and eventual death of the plant. Plants that are propagated under cool climate (i.e. below 23°C) often have fleshy thick basal stems that are more prone to infection.

On Fruit - fruit can be infected at the stem-end or the flower-end before harvest. Pre-harvest infections appear as soft black-green lesions with shrunken tissues externally on fruit surface (Figure 2). Internal fruit rot is identified by a subtle tapering of the flower-end of the fruit (Figure 2). Pre-harvest internal fruit rot is not always noticeable because the fungal growth is restricted by an active resistance mechanism in the fruit. After harvest, this mechanism is no longer active and thus the fungus continues to spread. Internal fruit rot is characterized by yellowing and eventual rotting of the fruit (Figure 2). As the disease progresses, the fungus produces numerous spores within the black fruiting bodies on the infected tissue. Spores are usually produced within 4 days of initial infection, and they soon begin a new cycle of secondary infections.

Other diseases that can be mistaken for GSB are black rot, caused by *Phomopsis cucurbitae*, and botrytis rot. Black rot lesions need to be examined under a microscope to confirm the causal agent. Plant infected with *Botrytis* will produce grey, fluffy mycelia under high humidity.

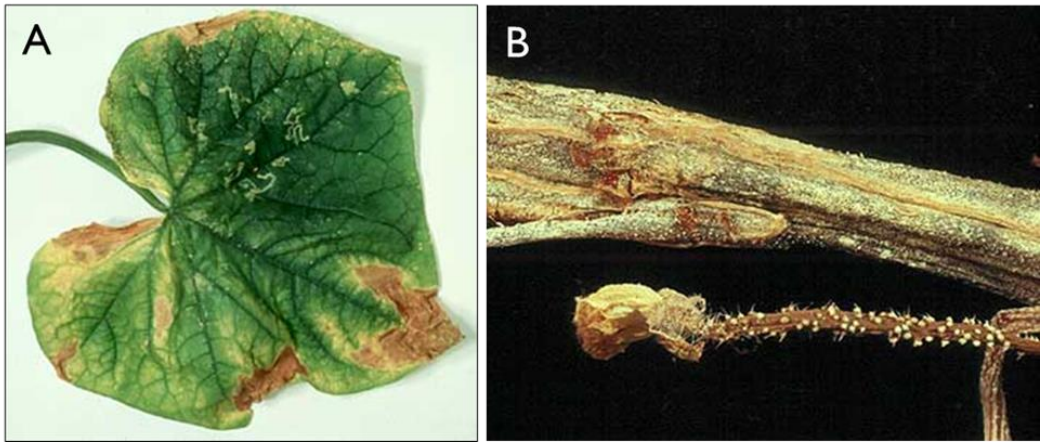

Figure 1. Gummy stem blight infection showing V-shaped lesions on a cucumber leaf (A), and tan-coloured lesions with black pinpoint spore-producing structures on a stem (B).

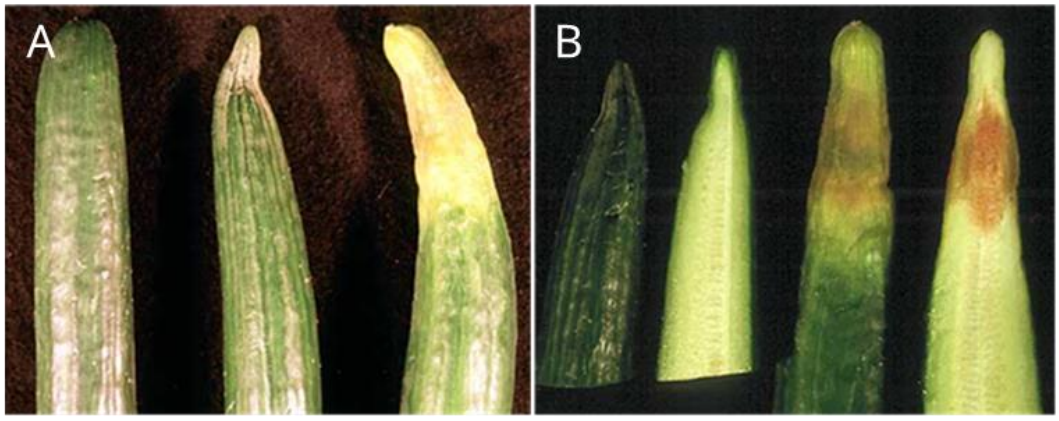

Figure 2. Healthy cucumber fruit on the left and two infected fruits on the right with tapering end due to internal fruit rot (A), and two cucumber fruits on the left with early symptoms of pre-harvest internal fruit rot, and two cucumber fruits on the right with the symptoms of post-harvest rot (B).

Spread

The pathogen can be seed-borne and, thus, can spread by infected seedlings/transplants. The inoculum of the pathogen can also come from other cucurbitaceous host plants and weeds and infected plant debris in and around the facility. The pathogen produces two types of spores: asexually produced pycniospores, and sexually produced ascospores. Both types of spores are short-lived once they are released into the environment. However, the pathogen can survive up to 2 years as chlamydospores or mycelium on undecomposed, dry plant debris.

There are two main methods of disease spread. Under humid conditions, 1) pycniospores are spread by splashing water droplets; a film of water on the plant surface is necessary for spore germination and infection, and 2) ascospores are released into the environment with air-currents in the evenings. These spores germinate in the evening condensation or guttation droplets and grow under low light conditions. High root pressure associated with excess watering and fluctuating transpiration due to weather changes promotes guttation. Wounded tissues are more susceptible to infection than intact tissues. Greenhouse practices such as overhead sprinkler irrigation, pruning and improper crop handling greatly influence the spread of the fungus. Spores can also be dispersed on pruning knives, wet hands and clothing.

Both pycniospores and ascospores start new infections by germinating on plant surfaces that are wet for an hour or more. If there is inadequate moisture, the spores may stay dormant and germinate when moisture becomes available. After spore germination, conditions of high relative humidity, low light and temperatures between 20-28°C promote the growth and spread of the fungus. Disease symptoms appear within 4 to 8 days of initial infection. As soon as the symptoms can be observed, the fungus will have begun to produce spores which will be invisibly spreading through the greenhouse.

Control

GSB is not easy to manage as greenhouse conditions are often favourable for disease development and spread, and there is constant occurrence of fresh wounds from pruning and harvesting that serve as new infection sites. There is no “silver bullet” approach for controlling gummy stem blight. Key strategies for disease management include good sanitation, thorough year-end cleanup, proper pruning and growing practices, multi-cropping and proper irrigation practices.

Prevention and Management

Keep plants dry through growing season and maintain an open canopy to increase air circulation.

Avoid root pressure increases to avoid stem split.

Monitor for disease symptoms starting from early crop development. Remove any suspected infected plant materials immediately from the greenhouse. Prune to leave clean breaks that

are flush to the stems. Avoid leaving stubs. Remove prunings from the greenhouse but be aware that removal will reduce the build-up of beneficial insect populations and adjust them accordingly. Avoid pruning during periods of cloudy/dark weather.

Keep disposal piles away from the greenhouse.

Disinfect pruning tools periodically with a 2-minute dip in 70% ethanol or a quick dip in an appropriate disinfectant (5% Virkon or 0.1 or 0.2 % Chemprocide), noncorrosive to metals. For disinfection and sanitation products and their use, please refer the ministry's factsheet on "Disinfection and Sanitation Practices".

Perform a good year-end cleanup.

Cropping system

Single cropping of cucumber plants is productive only certain period of time under current crop management practices. Production from crops planted in January tends to decline in early July. Although several short periods of high production can still be achieved with pruning, the act of pruning increases the number of wounds on the plant. These wounds are located in the canopy where the relative humidity is quite high and, thus, provide ideal sites for infection by the pathogen. Another consideration is that the stem tissue begins to age in July, reducing its capability to resist disease infection and lesion expansion.

Double cropping (growing two crops per season) will result in more even production and higher quality fruit from July onward. Double cropping will extend deliveries until December, and the young crop will have few wounds which minimize the number of infection sites. Removal of the old crop before disease build-up will reduce the spore load during the fall cropping period.

Climate Management

Keep plants dry:

Avoid sudden changes in climate, especially relative humidity (RH). Target RH below 80%. Verify the RH and temperature readings by periodic calibration. Ensure their placement is near the active growing head.

Maintain minimum pipe to provide VPD >3 grams/m^3. Keep a narrow dead zone in the morning.

During March/April, maintain a minimum pipe temperature of 45°C. Increase temperature to reduce RH especially when it is raining. Decrease pipe temperature with increasing light. Increase the temperature slowly in the early morning at 1°C per hour and ensure tissue temperatures are at day-time targets before sunrise. Put a grow pipe in the canopy at a maximum of 50°C. Decrease pipe temperature with increasing light. Vent early with 1/2 inch minimum once outside temperatures reach 5-6°C. Do not over vent. Cold air coming into the greenhouse can promote GSB. Consider venting at night to avoid soft plants.

Avoid spraying pesticides in the evening, as plant surfaces may remain wet long enough to allow the fungus spores to germinate. If you must spray in the evening, turn up pipe heat after spraying.

Air Temperature	RH	Dewpoint Temperature
18°C	80%	14°C
18°C	90%	16°C
22°C	80%	18°C
22°C	90%	20°C

Avoid high root pressure:
Use higher EC levels (3.0) especially in the development of the plant to the wire. This encourages the development of stronger stem tissues which will be less prone to infection at leaf scars.

Do not water early in the morning. Start watering 2 hours after sunrise or later on cloudy mornings, and over drain by third or fourth drip turn. Extend day watering period as the days become longer. Do not water after midnight. Reduce irrigation under low fruit loads. Keep over drain to the third or fourth drip turn.

Uniform, regular pruning reduces problems with root pressure. Remove no more than 2 actively growing green leaves at one time.

Post-harvest handling
Store fruit at 10 to 12°C shortly after harvest

Crop-end Activities

At the end of each crop, remove all crop debris from the greenhouse. Pay close attention to wires and temperature sensors. Take debris off site, compost or bury it.

Clean/disinfect picking carts, machinery, totes, sprayers etc. at the end of each crop. Disinfest the structure (refer to the Crop Clean-up Factsheet) at the end of the fall crop. For selecting appropriate disinfectants and sanitation products and their use, please refer the factsheet on "Disinfection and Sanitation Practices".

Fungicides

Apply preventatively before the onset of disease or at the first sign of symptoms or under conditions favourable for GSB. Use fungicides (Table 1) from different chemical groups in rotation to avoid pathogen from developing resistance to a particular fungicide and to prolong fungicide efficacy.

Table 1. A summary of registered fungicides and label information. For more information refer to Health Canada's Pest Management Regulatory Agency website for fungicide label information. Please adhere to Product label instructions when using each chemical

Product	Active ingredient	Chemical or biological group	Mode of Action	REI[1] hrs	PHI[2] days	Application guidelines
Manzate	mancozeb	M	preventative	NA	NA	Use preventatively at 14-day interval.
Nova 40W	myclobutanil	3	preventative, locally systemic	until dry	2	Use preventatively at 14-day interval. Do not exceed 2 to 3 applications per crop cycle.
Pristine	boscalid & pyraclostrobin	7 & 11	preventative, locally systemic	until dry	0	Use preventatively at 7 to 14-day interval. Do not exceed 1 application per crop cycle.
Diplomat 5SC	polyoxin D	19	preventative	until dry	0	Use preventatively in rotation with other fungicides at 7 to 14-day interval. Do not exceed 1 application per crop cycle.
PreStop	*Gliocladium catenulatum*	biological	suppressive	4	0	Use preventatively before onset of disease or at first sign of symptoms. Apply at 3 to 4-week interval.
Rhapsody ASO	*Bacillus subtilis* QST 713	biological	suppressive	NA	0	Use preventatively before onset of disease or under low disease pressure at 7 to 10-day interval.

[1]PHI - pre-harvest interval [2]REI - re-entry interval NA – information is not available

For Further Information

Gummy Stem Blight - Cornell University
Gummy Stem Blight and Black Rot of Cucurbits - Ohio State University
Gummy Stem Blight - Cornell University
Gummy Stem Blight Images - Forestry Images.org

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