Pests and Diseases of Turf: Monitoring and Management Tools

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Today's Discussion

- How the industry has changed over the past 10 years
- Key steps in reducing pest damage in landscaped systems
- The pest triangle and its role in pest management
- Biology and epidemiology of select lawn pests
- Importance of monitoring and techniques to use: old and new
- Use of integrated and alternative management practices
- Involving your client in the process

Since the 2009 Cosmetic Pesticide Ban…

- Pest management has had to change due to ban on pesticide use
  - Weed management
    - Hasn't changed as dramatically (Fiesta)
  - Disease management
    - Never been a major issue in lawncare
  - Insect management
    - Likely the most affected

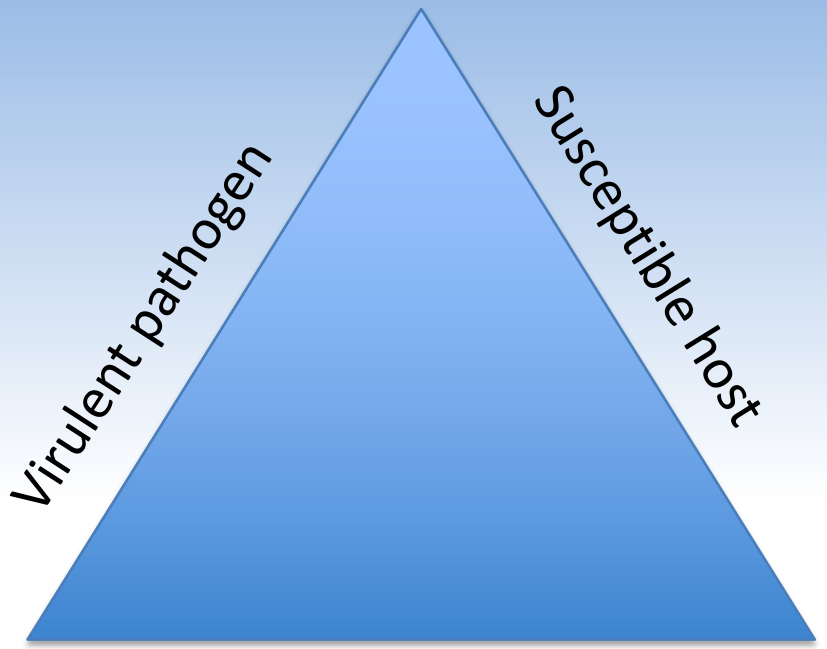
Key elements in reducing pest damage in landscaped areas

- Understanding pest biology
  - Duration of a pest's life cycle
  - Accurate identification
  - What conditions lead to presence of specific pests
  - When pests are likely to be most vulnerable
- Early diagnosis
  - Alternative practices most effective at low pest pressure
  - Need time for non-traditional practices to work
  - Making use of monitoring technology

Key elements in reducing pest damage in landscaped areas

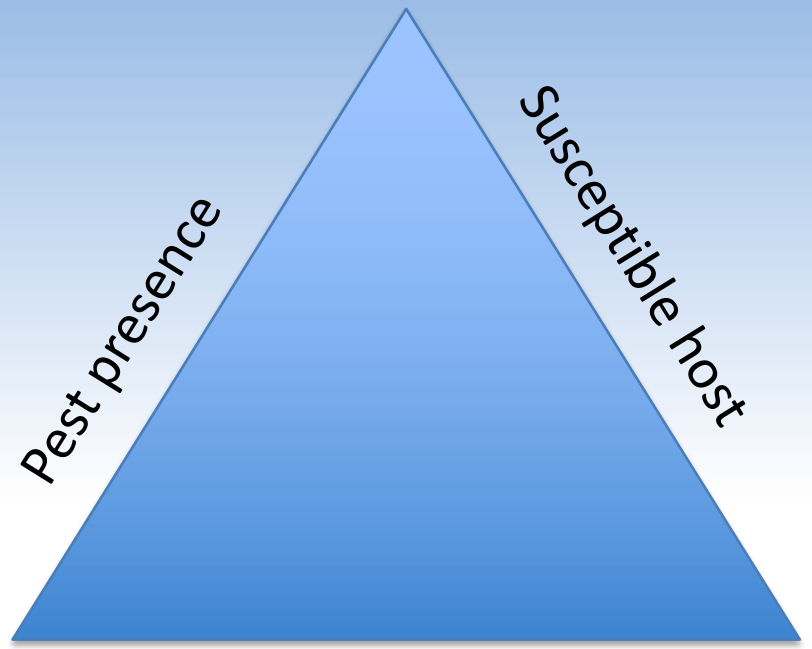
- Being open to various management methods
  - Cultural and some physical practices already being used
  - What about incorporating more biological control options?
  - All are more successful when used together
- Involving the client
  - Homeowner is primary lawncare operator for most of the season
  - Educating client on long-term plan is critical for success

Using the disease triangle to manage pests



All three must be present simultaneously for disease to occur

Pest Triangle



What we know about the pest triangle

- All three elements must be present simultaneously for pest damage to occur
- We almost always have the pest present
- We almost always have the susceptible host present
  - Can force shifts of species populations to resistant or tolerant species
  - Can alter management practices to reduce susceptibility

What we know about the pest triangle

- Conducive environment fluctuates the most and is affected by:
  - Regional weather
  - Microclimate conditions
  - Management practices
  - As turfgrass managers, can affect this side of the triangle significantly

- **The greater the volume of the triangle, the greater the potential for pest damage**
  - Goal is to reduce the triangle volume through integrated practices

Understanding pest biology

Diseases of interest

- Rust
- Snow moulds
- Necrotic ring spot

Insects of interest

- Grubs
- European crane fly
- Bluegrass billbug
- Hairy chinch bug

Rust (*Uromyces* and *Puccinia* spp)

- Fungal disease of mostly lawn, athletic field and lower maintenance turf
- All cool-season turf susceptible
- Especially problematic on PRG
- Most rust fungi need an alternate host to complete their cycle
  - Woody shrubs and herbaceous ornamentals
  - Not as critical for turfgrass rust species

Rusts – Life Cycle

- Multiple cycles of infection occur
- Fungus moves from host to host through production of numerous spores – UREDOSPORES
  - Held in rust-coloured pustules
  - May hold up to 50K spores
- Dissemination through air, water, turf equipment, shoes, etc.

Source: https://extension.umd.edu/hgic/topics/rust-lawns

Rusts – Factors favouring development

- Host susceptibility
  - Low N fertility
  - Excess shade
  - Drought stress
  - Infrequent mowing
  - Excessively low HOC
- Conducive environmental conditions
  - Prolonged leaf wetness
  - See spore germination in cool, moist conditions (15-25^{o}C)
  - See greatest symptom development (post-infection) in hot, dry conditions

Rust - Management

- Increase fertility, especially N
- Prune surrounding trees
- Reduce prolonged leaf moisture
  - Adjust irrigation timing
- Mow regularly and remove clippings when spores are present

Snow moulds

- Refers to a group of diseases that thrive in cooler weather
  - Grey snow mould (*Typhula incarnata* and *T. ishikariensis*)
  - Pink snow mould (aka Microdochium patch – *Microdochium nivale*)
- Both diseases occur mostly under snow or leaf litter cover
  - Microdochium patch can occur in the absence of cover
- All cool-season turf is susceptible to both

Grey snow mould

- May see sporocarps in the late fall/early winter prior to snowfall
- Sclerotia may also be present in the thatch
- Tend to see large patches throughout turf
- Generally not very severe and turf often recovers

Courtesy D. Smith

Source: Compendium of Turfgrass Diseases, 3rd Ed.

Microdochium patch

- Smaller patches than with GSM
- See fluffy, white mycelium
  - Often turns pink in the presence of UV light due to presence of large number of spores
- Can be more severe and require longer recovery than with GSM

Courtesy S. Jordan

Source: Compendium of Turfgrass Diseases, 3rd Ed.

Snow moulds – Factors favouring development

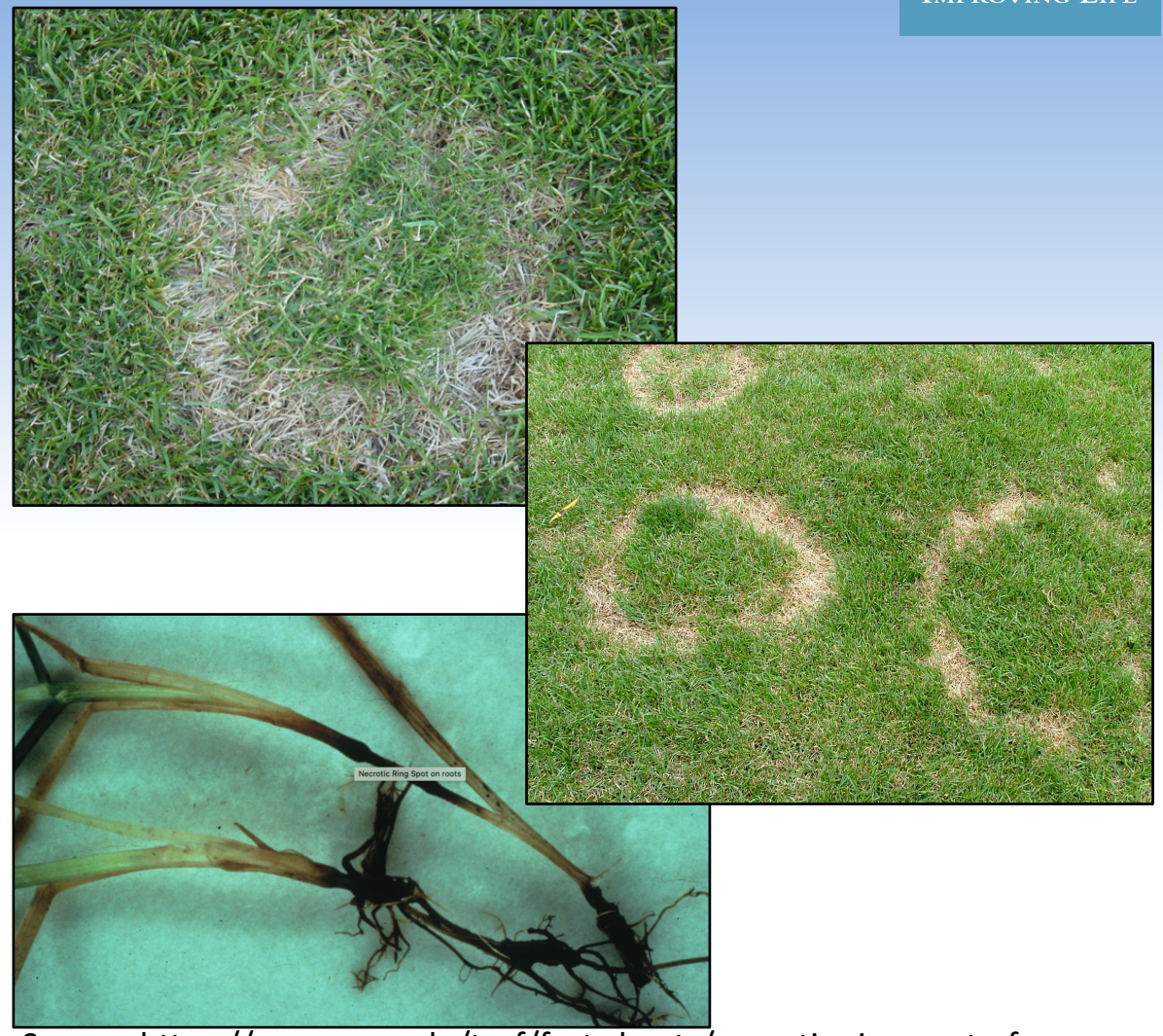
- Host susceptibility
  - High N fertility (GSM and MP)
  - Slow-growing and weakened
  - Certain species are more susceptible
    - TF and PRG for both GSM and MP
- Conducive environmental conditions
  - Excess thatch (GSM)
  - Snow or leaf litter cover (mostly GSM)
  - Alkaline soil (> 7.0) (MP)
  - Cool, wet conditions (< 15C) for MP
  - Extended shade for MP
  - Extended period at or just above freezing for GSM

Snow moulds - Management

- Avoid quick-release forms of N in the fall
- Gather fallen leaves and remove from lawn
- Reduce soil compaction in the fall
- Mow frequently and at the appropriate height up until dormancy
- Reduce thatch levels
- Rake up matted grass in the spring to speed recovery

Necrotic ring spot (*Ophiosphaerella korrae*)

- Fungal root disease of primarily KBG
  - Also see on ABG, rough bluegrass and creeping red fescue
- Like many root diseases, fungus is active in spring and fall, but symptoms present in the summer
- Leads to small patches that enlarge and become rings as center of patch recovers
- Can often see blackened roots and rhizomes



Source: https://ag.umass.edu/turf/fact-sheets/necrotic-ring-spot-of-poa-species

NRS – Factors favouring development

- Host susceptibility
  - Turf species
    - KBG is most susceptible; PRG is resistant
  - Drought stress
    - Enhances symptom development
  - Compromised roots
    - Compacted soils
    - Excess thatch
- Conducive environmental conditions
  - Cool and wet conditions favour the pathogen
    - Hot and dry conditions favour symptom development
  - Wide soil pH range (5 to 8)
  - Tend to see in younger stands
    - See a decline over time

NRS - Management

- Reduce thatch and soil compaction
- Improve drainage
- Monitor irrigation
- Adequate fertility
  - Avoid excess N
- Transition to higher percentage of PRG

White Grubs

European chafer (*Amphimallon majale*)

May/June beetle (*Phyllophaga* spp.)

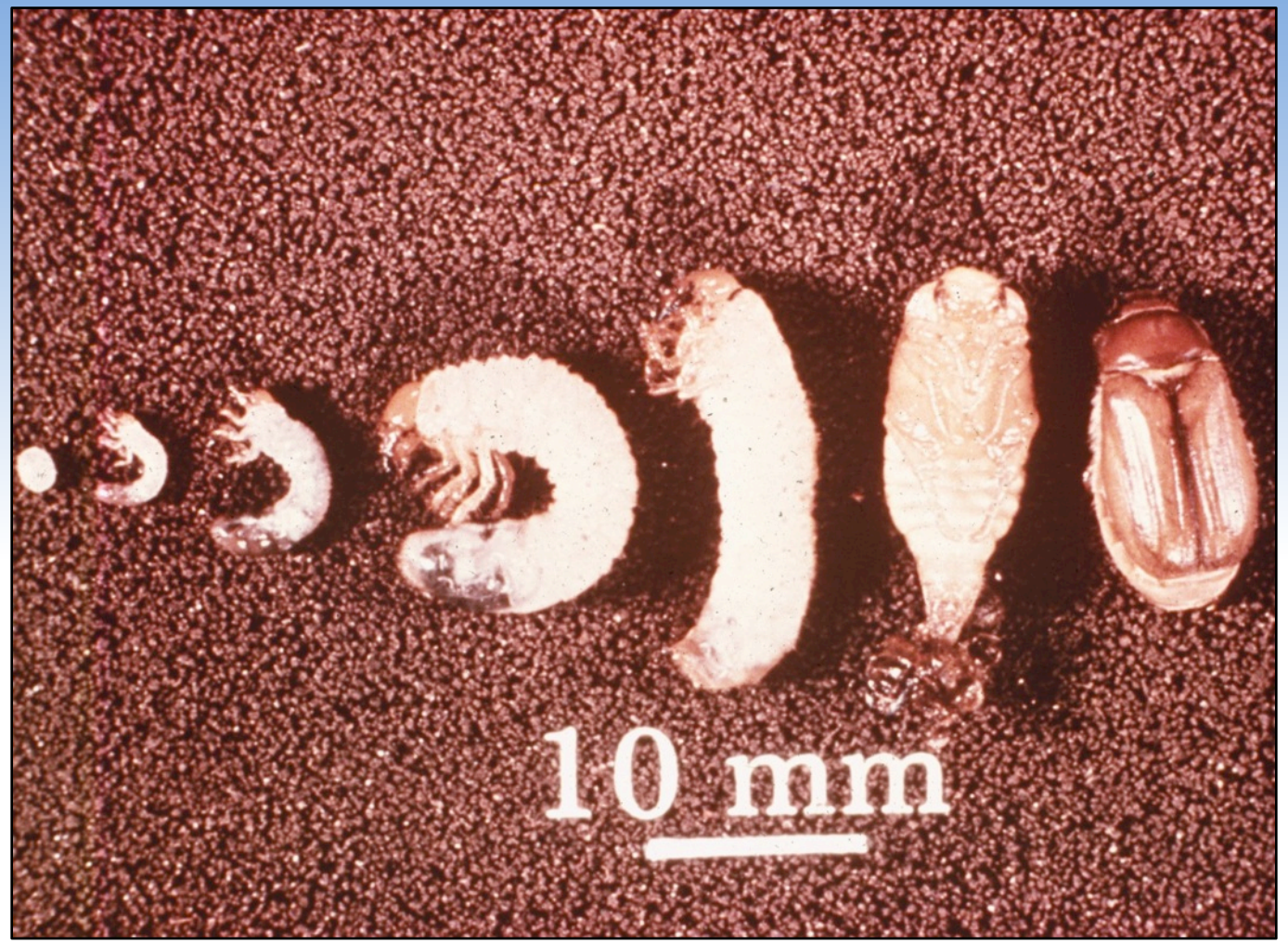
Japanese beetle (*Popilia japonica*)

Source of photos: http://www.omafra.gov.on.ca/english/crops/facts/08-023w.htm

General characteristics

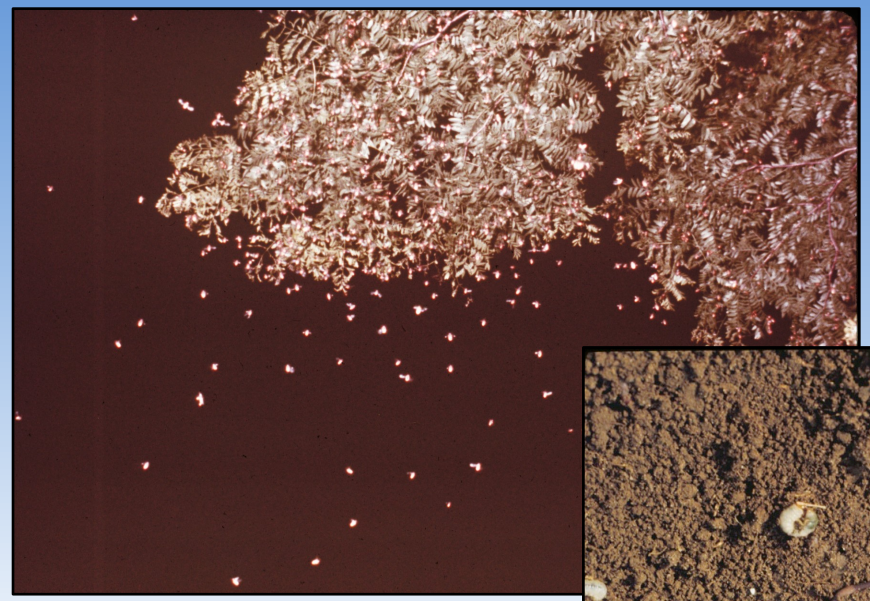
- Order Coleoptera
  - Family Scarabaeidae
- Complete metamorphosis
  - 4-stage and include pupation
- Most widespread and destructive of insect pests on turf (cool-season)
- Juveniles (called grubs) and are the damaging phase
- Life cycles are similar
  - M/J Beetle an exception
  - Some variation in length of time

Life cycle



Host plants, feeding and symptoms

- Attack all cool-season grasses
  - Turf and pasture systems
  - Also attack weed grasses, broad-leaved weeds, nursery crops
- Extremely damaging to cool-season turf
- Grubs feed at **roots near surface**
  - Wilting
  - Thinning
  - Irregular dead patches



Photos courtesy M. Sears

Source: https://www.canr.msu.edu/news/how_to_choose_and_when_to_apply_grub_control_products_for_your_lawn

Greatest damage often from secondary feeding

Source: https://www.spring-green.com/tag/skunk-damage/

Factors favouring pest damage

- Host susceptibility
  - Low fertility
  - Compacted soils
  - Excess drought
  - Excess thatch
- Conducive environmental conditions
  - Excess soil moisture during mating and oviposition
    - Rarely see Japanese beetle in arid regions

Grubs - Management

- Soil moisture important
  - Vertical movement based on soil moisture
  - Eggs need moisture
  - *Avoid watering during peak beetle activity*
- Irrigation once infested masks symptoms
- Balanced fertility
  - In fall, promotes recovery
  - In spring, high N encourages shoot growth
- No resistant cultivars of cool-season grasses known

Biological control

- Promote growth of natural enemies
  - Ground beetles, ants, parasitic wasps, etc.
  - Parasitic insects keep populations down more in Europe
- Application of entomopathogenic nematodes
  - Must ensure you choose the proper ones specific to these pests

Physical Control

- Pheromone traps

Managing damage from secondary feeders

- Research at University of Wisconsin looked at effects of biosolids (Milorganite) on feeding by vertebrate pests
  - Skunks and racoons are believed to be deterred by human odours
  - Use of human waste fertilizer could potentially reduce damage due to smell of product
- Current research at U of G suggests these products could sustain turfgrass growth as well

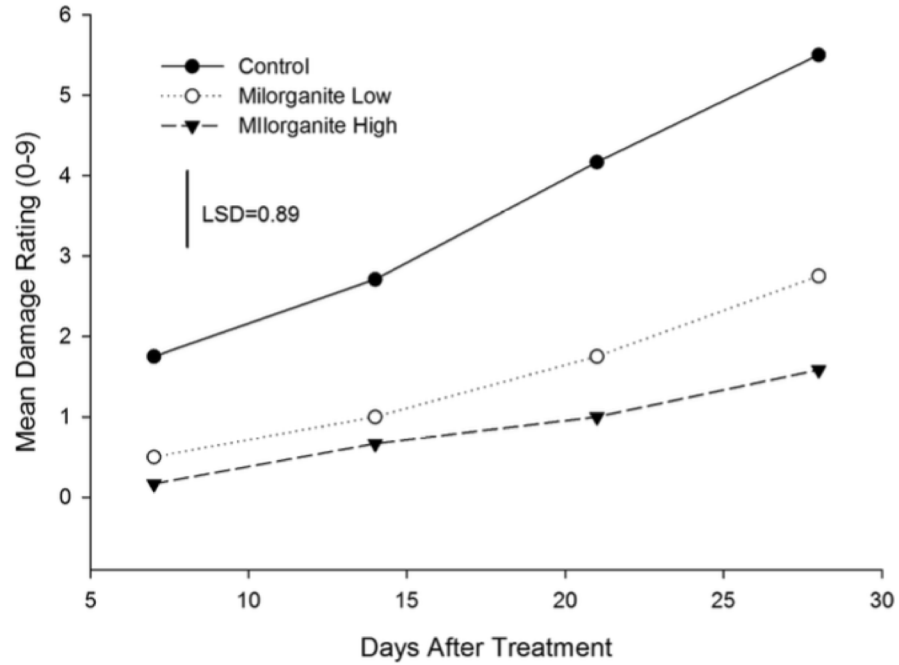


Fig. 1. Mean damage rating of plots treated with Milorganite at nitrogen rates of 16.1 or 48.8 kg ha^{-1} compared with a nontreated control. Data are pooled across both sites.

Williamson and Obear, 2017. Int. Turfgrass Soc. Res. J. 13:524–526

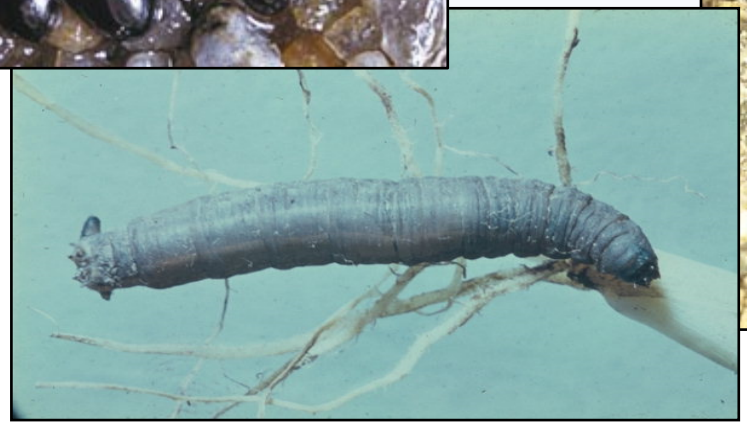
European crane fly

(*Tipula paludosa/T. oleracea*)

Adult crane fly

Source:https://www.canr.msu.edu

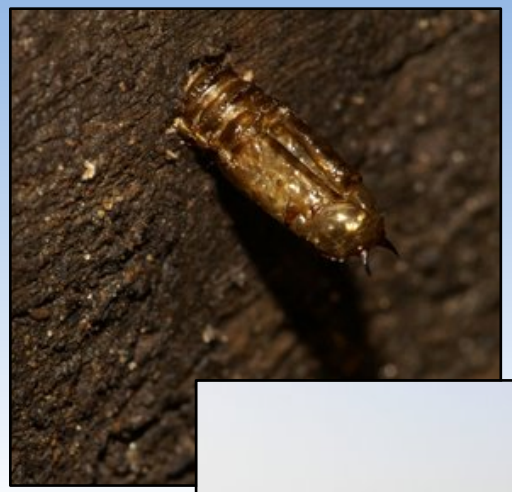
Eggs



Larvae

Life Cycle

- One generation per year
- Eggs laid in clusters of 200-300
  - Laid under soil surface
- Egg hatch →11-15 days
  - Larvae feed on roots, rhizomes and foliage
- Overwinter as large (3rd instar) larvae
- Pupation in July – mid-August
  - Pupal case may protrude from ground



Photos: P. Charbonneau

Feeding and Damage

- Larvae feed below ground during the day
  - May come up and feed on leaves and stems at night
- Damage appears as chlorotic patches and bare areas

Source:http://www.omafra.gov.on.ca/english/crops/facts/13-023.htm

ECF - Management

- Sensitive to desiccation
  - Monitor for adult activity
  - Withhold irrigation during egg laying
- Endophytic grasses may reduce foliar feeding
- Trapping of adults using light traps

Bluegrass billbug (*Sphenophorus parvulus*)

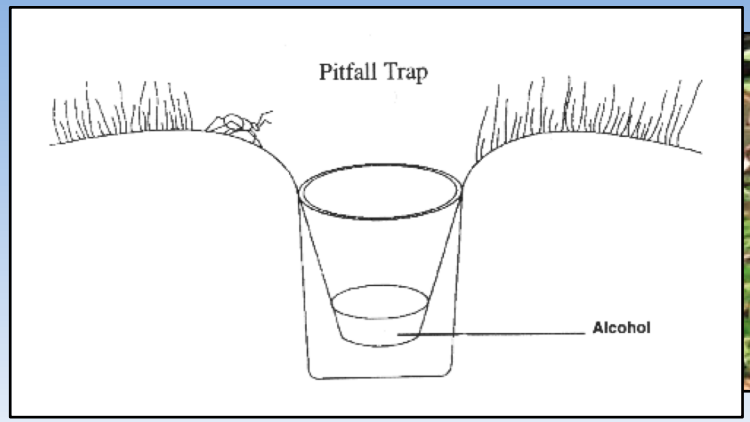
Life Cycle

- One generation per year (Complete metamorphosis)
- Overwinter as adults
- Five larval instars
- Females can lay up to 200 eggs in their lifetime
- Larvae feed on stems but more mature larvae move down to crown area and feed just above
  - Do the most damage

Typical symptoms

Source: https://www.mygardengeek.com/what-to-do-in-the-aftermath/

Monitoring for bluegrass billbug



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Bluegrass billbug - Management

- Overseed or renovate to less susceptible species and cultivars
  - Look for BB-resistant KBG cultivars
  - Endophyte-enhanced species will be less damaged
- Decrease thatch levels
- Keep turf stand moist and healthy
  - Heavily infested stands will not improve with irrigation
- Encourage natural antagonism by *Beauveria* fungus and entompathogenic nematodes
  - Increasing soil moisture

Hairy Chinch Bug (*Blissus leucopterus hirtus*)

Source: http://www.omafra.gov.on.ca/english/crops/facts/08-019.htm

Life Cycle

- Incomplete metamorphosis
- One to two generations per year in Canada
  - Two per year in most of their range
- Overwinter as adults in nearby landscape shrubs/beds
  - Spring – move to turf and mate ~ 2 weeks
- Oviposition in leaf sheaths or thatch
  - Mid-April to May
    - Lasts 2-3 weeks and female lays 20-30 eggs per day
- First nymphs pierce grass stems and suck sap
- Mature in late July/early August

Hairy Chinch Bug Life Stages

egg 1st 2nd 3rd 4th 5th short winged adult normal winged adult

nymphal instars

Credit: David Shetlar, The Ohio State University, Bugwood.org.

Hairy Chinch Bug Damage

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Conditions favouring pest damage

- Host susceptibility
  - Turfgrass species
    - KBG is very susceptible
    - Evidence suggests PRG, TF less susceptible due to fungal endophytes
  - Weakened turf will be more damaged
- Conducive environmental conditions
  - Hot and dry conditions
    - HCB is irritated by water
  - Nearby landscape plants
    - Overwintering sites
  - Excess thatch layer
    - Egg laying and overwintering site

HCB - Management

- Thatch reduction is KEY
- Irrigation during dry periods
  - Drowning nymphs
  - Encourage bio-control with fungal antagonists
  - Can be difficult with watering restrictions
- Use of endophyte-enhanced turfgrasses
- Keep turfgrass healthy

Biological control

Predator - Big eyed bug

Fungal parasite – *Beauveria bassiana*

Monitoring for Turf Pests

- A critical part of pest management
- Should be done regularly and consistently
- Collecting data is only part of the process
  - Recording and analyzing the information is equally important
- Not just looking for pests and symptoms
  - Weather conditions
  - Microclimate conditions
  - Making note of recent activities and management practices

Monitoring for Diseases

- Mostly visual observation
  - Of symptoms and of **environmental conditions**
- Can look for predictive models for some specific diseases
  - Most of these are developed for golf course diseases
    - Dollar spot
    - Brown patch
  - Usually based on temperatures and moisture
  - Repeated observation of same location may allow for your own type of predictive modeling
- Use GPS to mark where symptoms are observed

Monitoring for Insect Pests

- Also visual observation but of the pests themselves
- More tools are available for insect monitoring
- Plant phenology
  - Using plants in bloom to predict when insects will become active

EC Pupation at full bloom of Vanhoutte spirea (*Spiraea vanhouttei*)

- EC Peak adult flight at full bloom of common catalpa (*Catalpa bignonioides*)

Growing Degree Days

- Cumulative Heat Units
  - How much heat has accumulated based on daily temperatures over time

$$\sum \left(\frac{T_{max} + T_{min}}{2} \right) - T_{base}$$

  - Can find lists of known pests and the range of heat units that lead to each stage in their life cycle

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Example of GDD chart for various turfgrass pests

Michigan State University GDD Model for Turfgrass		
Annual Bluegrass Flowering	GDD_{22}	1500-2450
Embark Timer	GDD_{22}	680-1050
Primo/Proxy Timer	GDD_{32}	220-501
Crabgrass Germination (peak)	GDD_{50}	200-600
Japanese Beetle Emergence	GDD_{50}	950-2150
Black Turfgrass Ataenius (egg laying)	GDD_{50}	150-1200

Source: http://gsrpdf.lib.msu.edu/ticpdf.py?file=/article/skorulski-getting-8-23-13.pdf

GPS (Global Positioning System) and GIS (Geographical Information System)

- Using GPS coordinates to mark location of pests and symptoms
  - Allows for year-to-year comparisons
  - Allows multiple people to make observations
- Using GIS to map observations
  - Lets you see patterns within and between sites

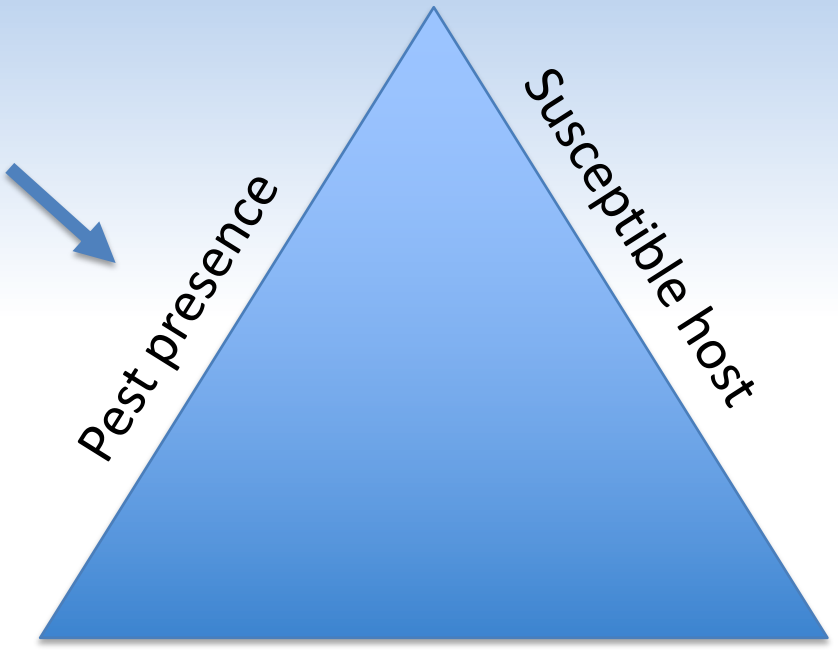
Pest Management and the Pest Triangle…

- In Ontario, alternative management is the only option for pest management of landscaped areas
  - Still see use of chemicals for weed management (and sometimes for insects?)
- The use of combined practices is the best way to combat pests

- Remember: Pest management goal as a turfgrass manager is to reduce the volume of the pest triangle as much as possible

Effect on pest: Chemical control

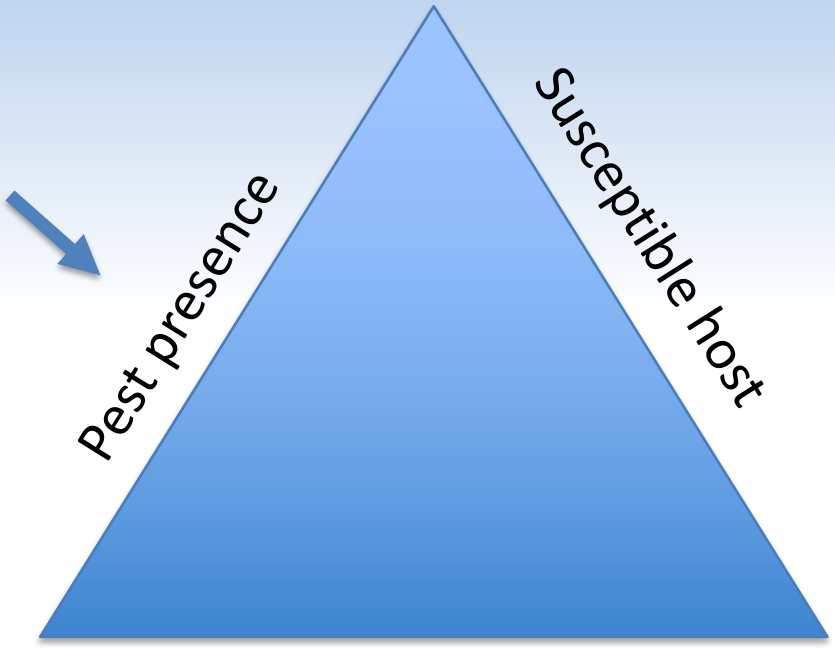
Chemical Control: Direct Effect



- Direct destruction of pathogen or pest by chemical means

Effect on pest: Physical practices

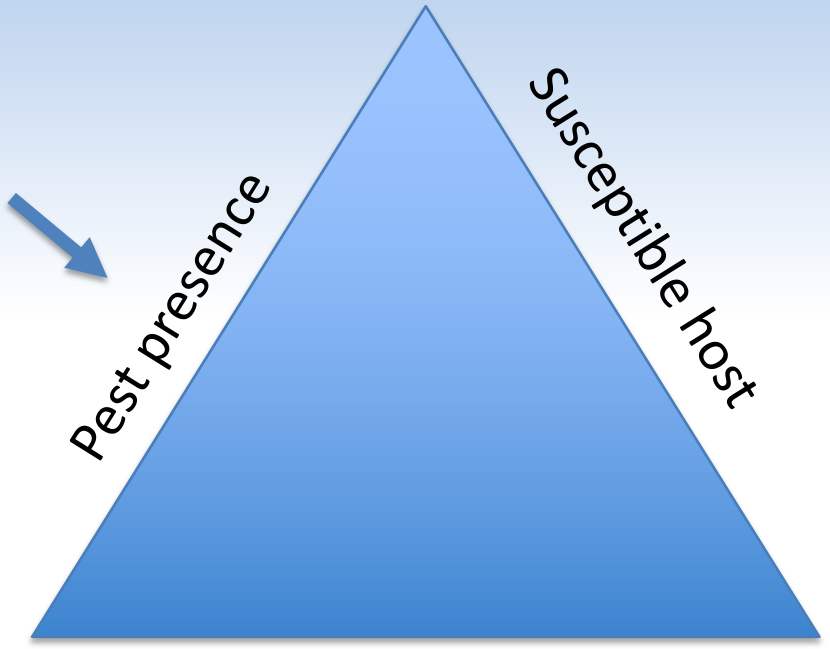
Physical Control: Direct Effect



- Direct removal of pest or pathogen by physical or mechanical means

Effect on pest: Direct Biological control

Biological Control: Direct Effect

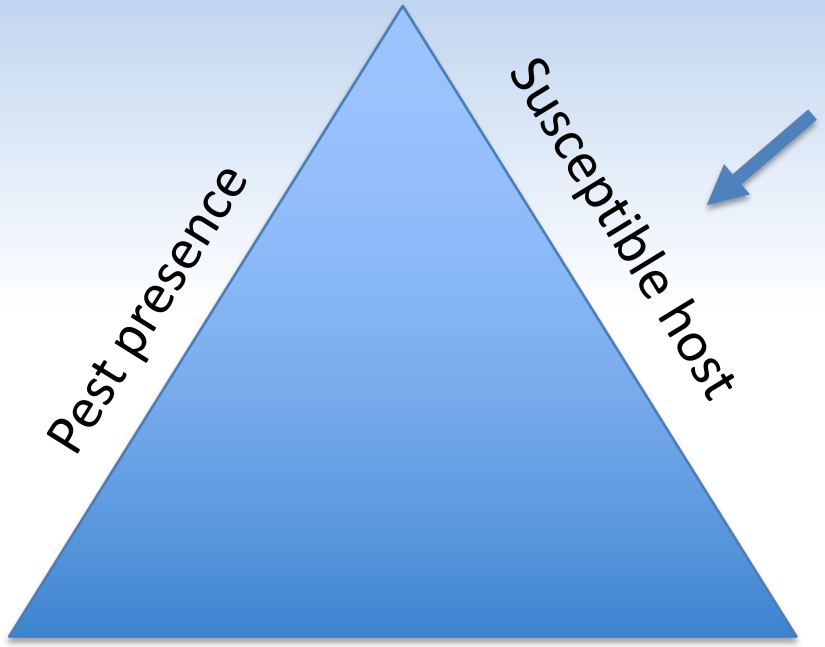


- Adding or enhancing live organisms that specifically parasitize pathogen or pest
- Antagonists that produce antibiotics
- Antagonists that directly compete for space and nutrients with pest

Effect on pest: Indirect Biological control

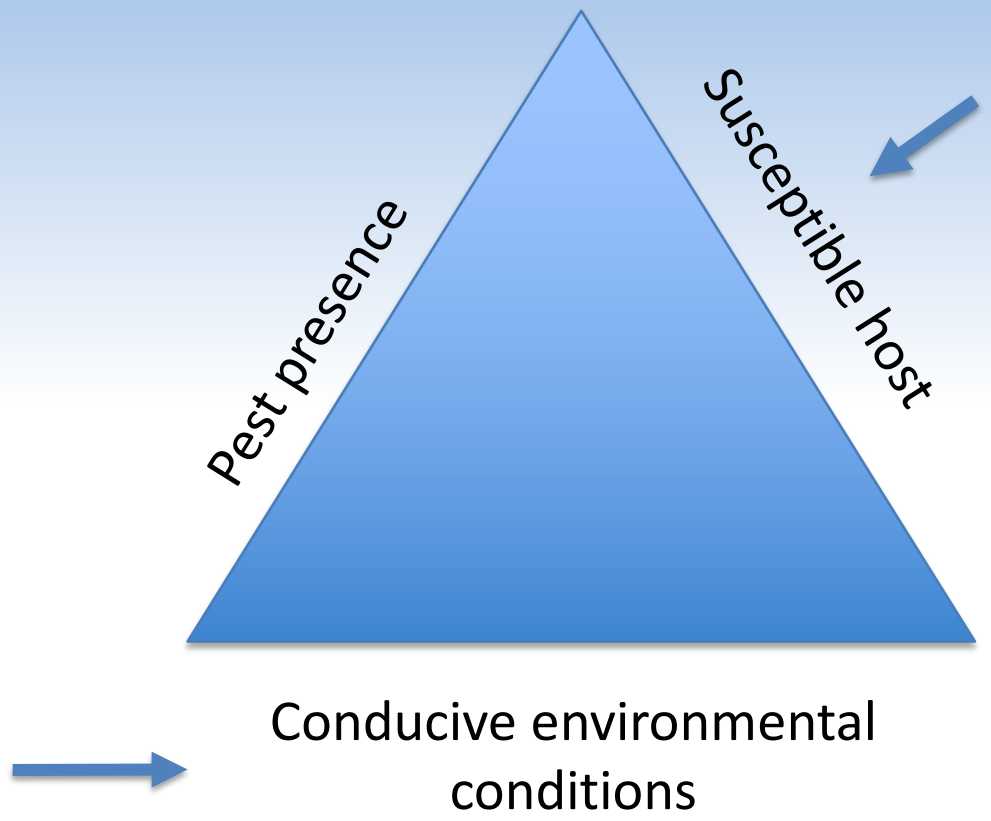
Biological Control: Indirect Effect

- Organisms that boost plant defenses



Effect on pest: Cultural practices

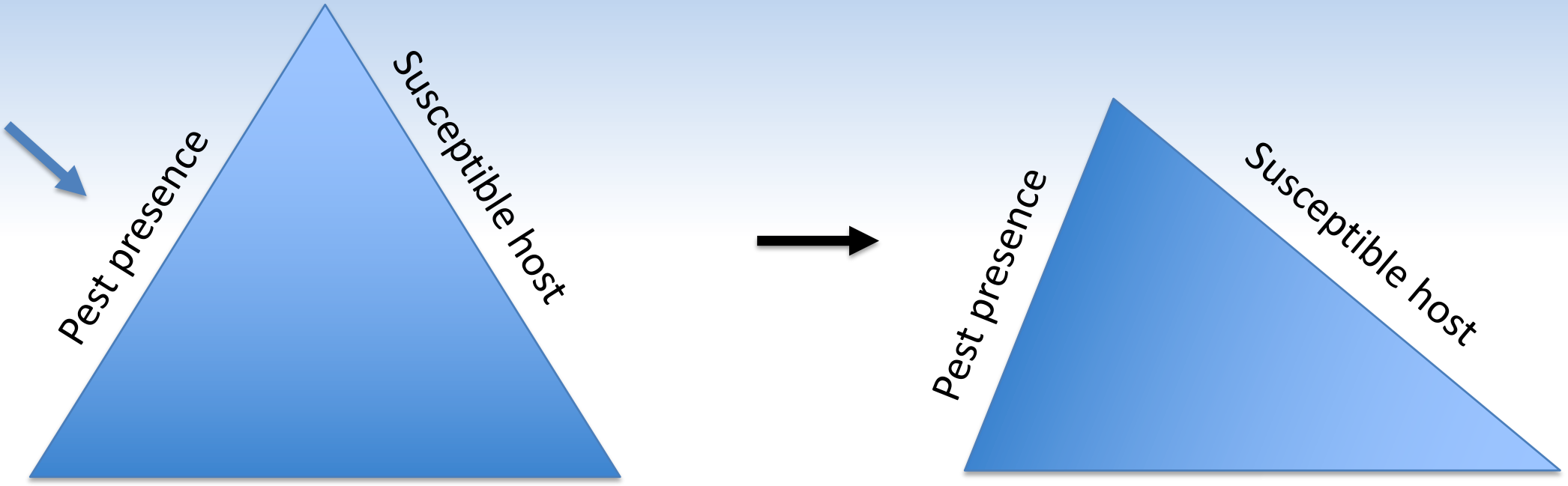
Cultural Practices: Indirect Effect



- Altering mowing, irrigation, and fertility
- Cultivation to improve soil conditions
- Thatch removal

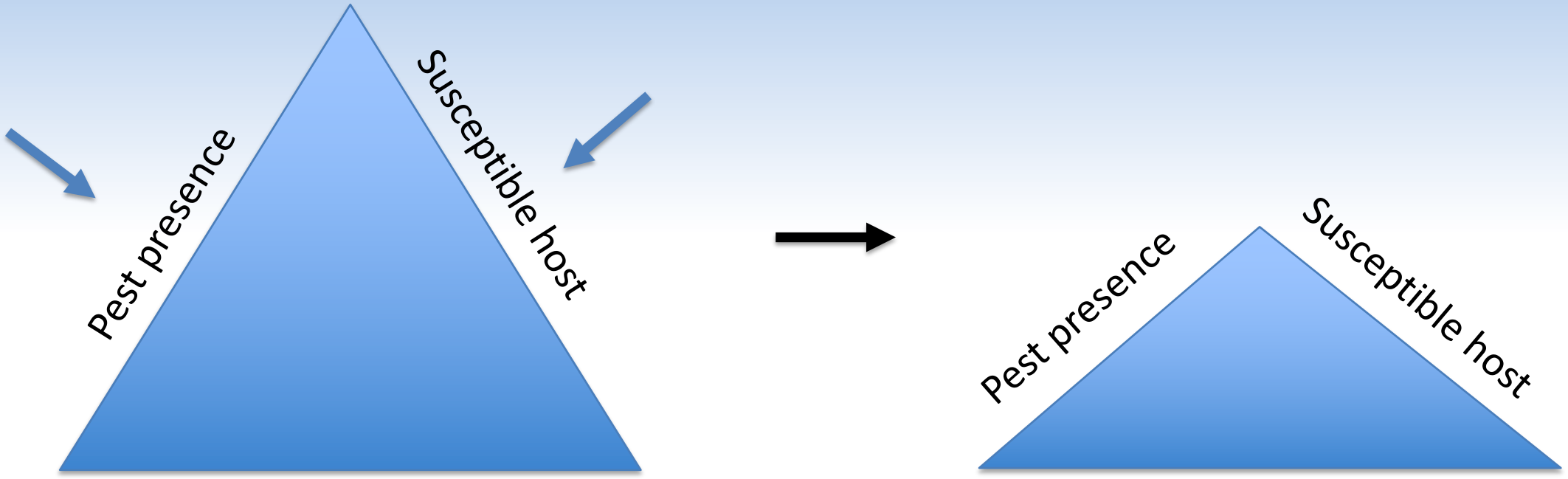
How these practices each affect pest potential

Practices aimed at reducing pest directly



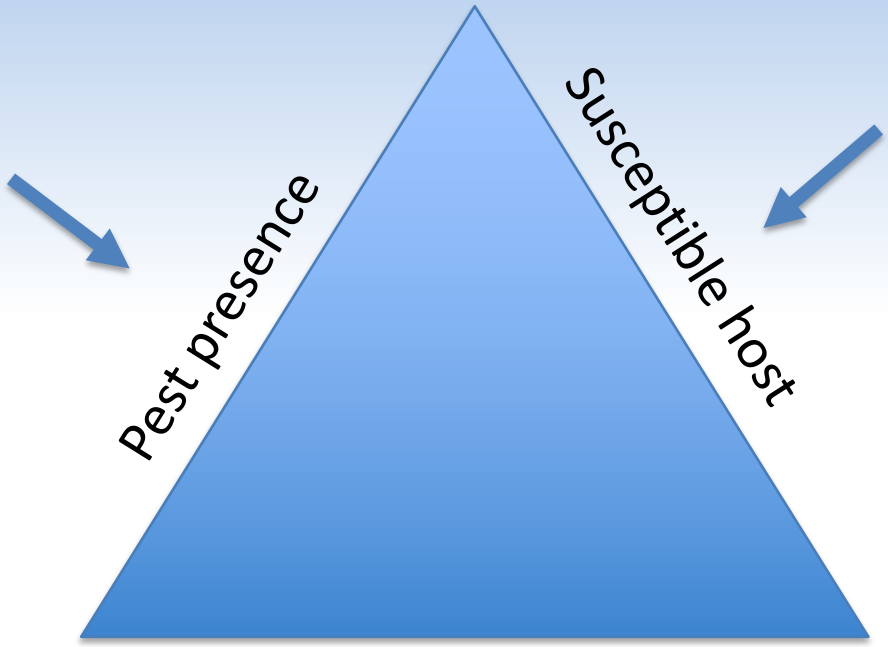
How these practices each affect pest potential

Add in practices aimed at reducing host susceptibility

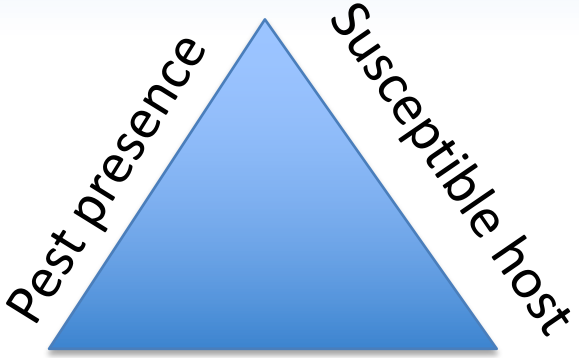


How these practices each affect pest potential

Add in practices aimed at reducing conducive environment for pest

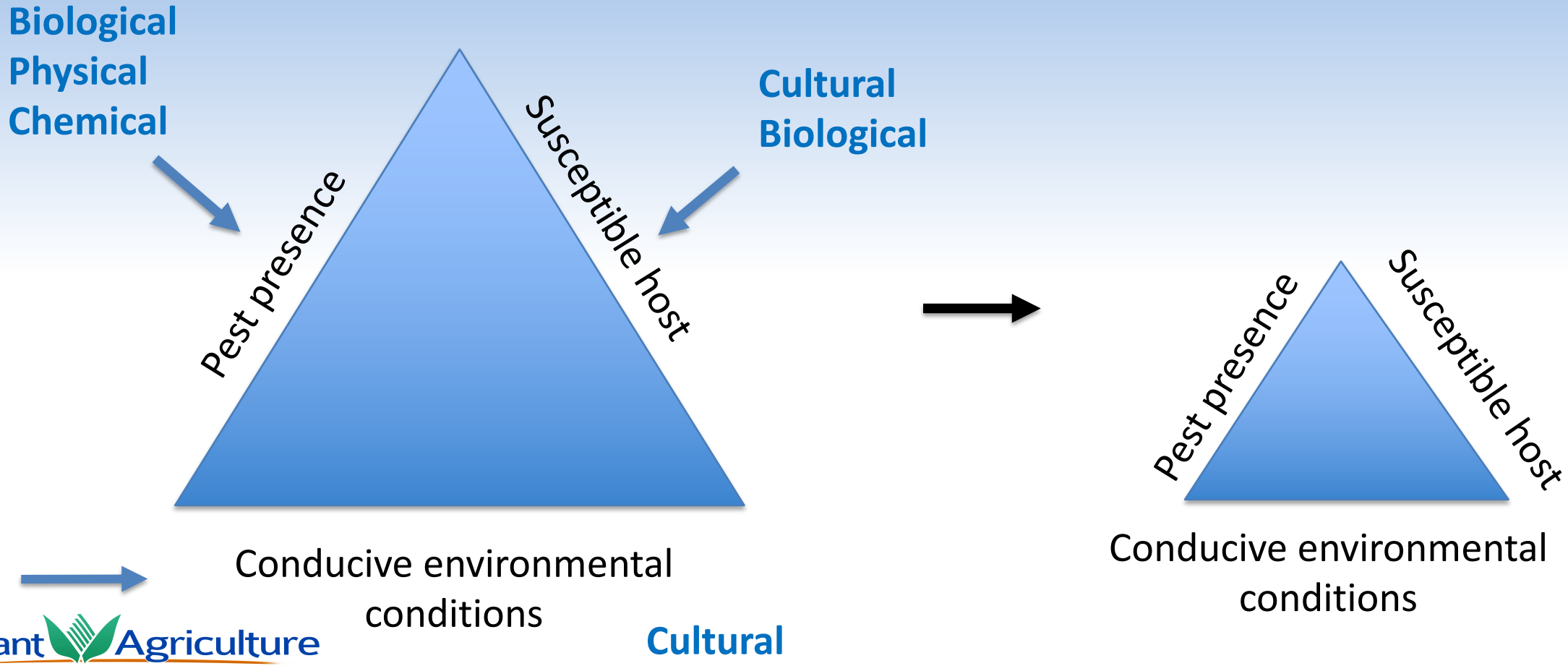


Conducive environmental conditions



Conducive environmental conditions

Ideal Situation



Final word about Biological control

- Seeing more research indicating that biological control may have some potential in turfgrass pest management

Potential of two entomopathogenic fungi, *Beauveria bassiana* and *Metarhizium anisopliae* (Coleoptera: Scarabaeidae), as biological control agents against the June beetle

Fedai Erler[1,2] and A. Ozgur Ates[3]

Dosage Response Mortality of Japanese Beetle, Masked Chafer, and June Beetle (Coleoptera: Scarabaeidae) Adults When Exposed to Experimental and Commercially Available Granules Containing *Metarhizium brunneum*

Robert W. Behle[1] and Erica J. Goett

Entomopathogenic nematode performance against *Popillia japonica* (Coleoptera: Scarabaeidae) in school athletic turf: Effects of traffic and soil properties

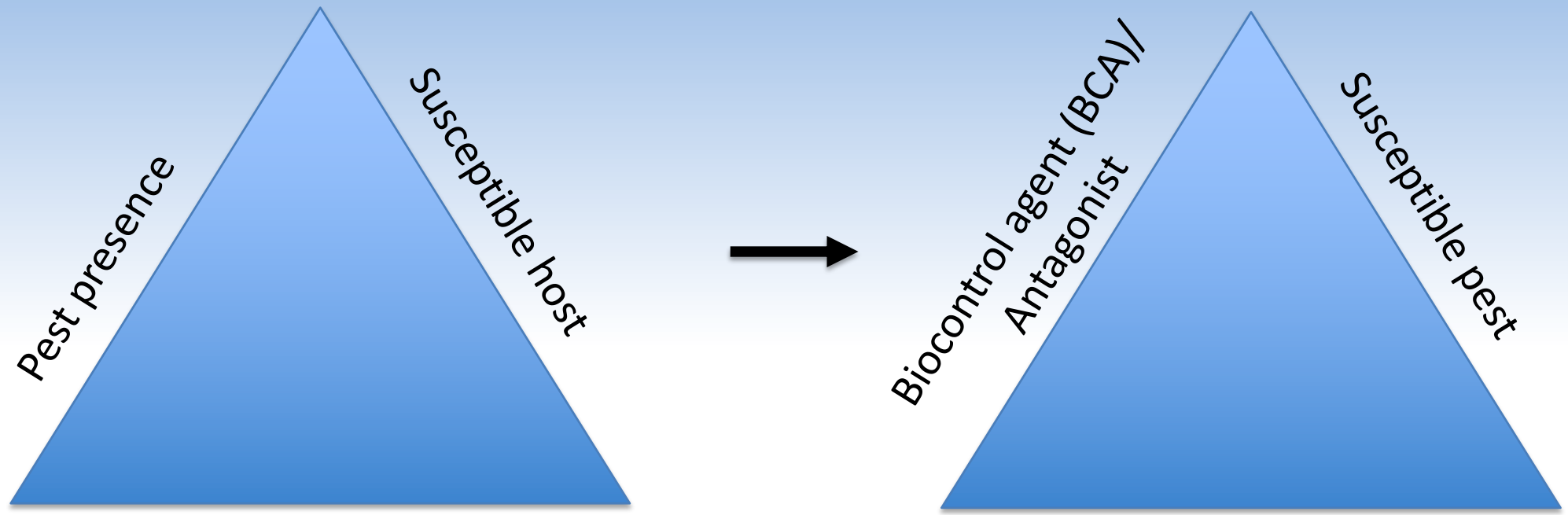
M.S. Helmberger[a,*], J.S. Thaler[b], E.J. Shields[b], K.G. Wickings[b]

[a] *Michigan State University, United States*
[b] *Cornell University, United States*

Why don’t we see more of it in turf?

- Expensive to purchase some of the products
- Inconsistent efficacy
- Takes more time and more knowledge to apply products properly
- Takes specific conditions to work properly…

The Biological Control Triangle



Conducive environmental conditions

Conducive environmental conditions (for BCA)

Making the BC Triangle work for you

- Much like the pest triangle, all three components must be present simultaneously for it to work
- Unlike the pest triangle, you want to INCREASE the volume of the triangle rather than reduce it
- Management practices can affect all sides

Managing turf to improve BC potential

- Irrigation and cultivation can create more favourable environment for antagonistic organisms
  - Most are fungi or other insects that often thrive in moist conditions
- Adding BCA to the soil can increase antagonist populations
- Cultural and physical practices aimed at reducing pest vigor make the pests more susceptible to attack
- Passive biological control can be as effective as active
  - **Altering the environment to encourage natural antagonism**

Remember to include your clients in your plan

- Pest management is not a part-time endeavor
- Monitoring, maintaining turf health, altering conditions to favour antagonism and not favour pests must be ongoing
- Let your clients in on your plans and explain why they need to be involved
  - Mowing practices
  - Irrigation (if allowed)

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