COVERCROP

VEGETABLE PRODUCTION TRAINING

Session 5

Cover crops for pest managment

DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

Outline

- **Cover Crops for Effective Crop Rotation and Pest Management**
  - Crop rotation
  - Nematode suppression
  - Weed control
  - Disease suppression
  - Effects on pests and beneficials

Crop Rotation

Clockwise from upper left: black oats, winter wheat, Austrian pea, mustard, crimson clover, cereal rye. Photos: Jackie Lee

- Important to avoid cover crop plantings which could be alternate hosts for the same diseases/insects you are trying to control

Crop Rotation

Mustard

Rye grass

Nematode Suppression

Root-knot nematode on lettuce. Source: apsnet.org

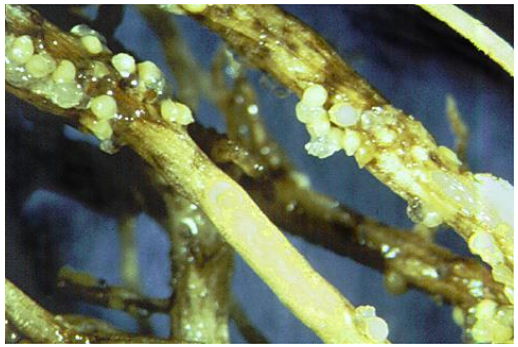
Severe forking in carrot caused by RKN. Source: apsnet.org

Cover crop plantings can be affective for nematode suppression, but do your research!!

- Non-Host = Starving out nematodes:
  - Root knot nematodes (RKN) can only survive for 1-2 years absent a suitable host
  - Cyst nematodes have long-term survival stages and are more difficult to control with the starving out method
  - In the case of RKN, utilize a non-host such as sorghum (Sudan grass) and avoid mustards/brassicas
- Make sure to have the correct cultivar – not all are equally effective
- Environmental factors can influence the effectiveness of RKN control, so year-to-year results may vary.
- If RKN levels are high, or the subsequent crop is highly susceptible, a multi-year rotation with non-hosts may be required

Nematode suppression

Close-up view of RNK. Source: apsnet.org



Soybean cyst nematode. Source: apsnet.org

- Bio fumigating nematodes
  - Brassicas/mustards release glucosinolates (bio fumigant) as they break down when cut and incorporated into the soil
  - Glucosinolate levels peak at different times for different species, so incorporation should be done as close to this peak time as possible
  - More useful for cyst nematodes
  - **Most brassicas/mustards are excellent hosts for RKN, so avoid if RKN is your primary issue**
- Avoid hairy vetch if soybean cyst nematode is present
- Other less-common nematodes can also cause issues (E.g. lesion/dagger/etc.)
  - Research compatibility of cover crop species if your soil test shows you have issues with these nematodes

Cover Crops as Hosts to Nematodes

			Host (+) or Poor/ Non-host (-) [2]					
Season	**Cover Crop Type**	**Cover Crop**	**Root Lesion**	**Root knot nematode**	**Dagger**	**Needle**	**Sting**	**Foliar Nematode**
Warm	Legume	Sun hemp [1]		–			–	
	Legume	Soybean		+				
	Legume	Cowpea [1] 'Iron clay'		–			+	
	Legume	Velvet Bean		–			–	
		Sesame		–				
		Marigold	–	–	–			
	Grass	Pearl, Millets [1]	–	–	+		+	
	Grass	Sorghum, Sudan [1]	–	–	+		+	
Inter	Brassicas	Canola/ Rapeseed		–	–			
Cool	Legume	Clovers		+				
	Legume	Vetches		+				
	Broadleaf	Buckwheat		+				
	Brassicas	Mustards [1]		–	–			
	Grass	Cereal Rye	–	–	–			
	Grass	Wheat	+	–				
	Grass	Black Oats [1]	–	–				

[1] *Be sure to select varieties that have resistance*

2 *Host and Non-host is a spectrum and the chart is based on best recommendations and likelihood for nematode population rebound following planting of the cover crop*

Weed Control

Cover crops can help suppress weeds through both physical and chemical means

- Physical control:
  - Outcompete weeds for nutrients, sunlight, and other resources
  - After termination, cover crop residues can prevent weed seed germination when left on the soil surface by blocking sunlight and affecting soil temperature/moisture.
  - These effects are highly species specific and favored by a high cover crop density
    - Grasses tend to produce the most biomass and result in the best weed suppression
    - Grasses alone, or mixed with legume/brassicas provides better weed control compared to legume/brassica monocultures

Mature plot of mustard relatively free of weeds (left) compared to heavy weed growth in a control plot. Photos: Jackie Lee

Weed control

- Bio-chemical control:
  - Brassica species and cereal rye produce allelopathic chemicals (nature's herbicides!) which inhibit growth or germination of nearby plants
    - These benefits in addition to physical control
  - Most effective on germinating seeds, seedlings, and young plants
  - Significantly slows weed growth and sometimes kills them outright
  - Allelopathic interactions are often species specific
    - Winter wheat/rye are quite active against pigweed, lambs quarter, purslane, crabgrass, and less so against ragweed, and morning glory (articles.extension.org)
    - Sunflower and some clover species suppress morning glory, and sorghum can inhibit purple nutsedge
    - Herbicide resistant palmer amaranth, a type of pigweed, is a major problem
      - Cereal rye/winter wheat provides good control (Wiggins et al., 2016)
- Cover crops may not always provide sufficient weed control by themselves, necessitating herbicide use for more persistent weeds

Disease suppression

Powdery mildew on watermelon

Anthracnose on watermelon

- Cover crops can help suppress disease, but the system is complex and not fully understood.
- Suppressive effects can vary greatly due to location, climate, environmental conditions, and differences in pathogens present. Each of these factors can affect disease susceptibility in crop plants.

Disease suppression

Possible modes of disease suppression:

- Cover crops produce a physical barrier that reduces rain splashing, thereby decreasing pathogen dispersal
- Increased soil microbial activity; can increase plant health, thereby reducing disease susceptibility
- Arbuscular mycorrhizal fungi interactions – some cover crops promote these fungal species which lead to beneficial interactions with the roots of crop plants, causing the crop to be less susceptible to certain diseases
- Many cover crop species (annual rye, red clover, hairy vetch, winter wheat, canola, etc.) can be colonized by the fungus *Trichoderma harzianum*
  - Suppresses *Pythium* and *Fusarium* spp. Cause important soil borne diseases in many vegetable crops including damping off
  - Allows carryover to subsequent crop (southernsare.org)
- Brassica species are known for their disease suppressive effects:
  - The result of the breakdown of naturally-occurring sulfur-containing compounds in the brassica crop residues
  - The breakdown results in compounds with fungicidal activity
- **Good in theory, but evidence is lacking and effects are highly crop-specific**

Cover crop effects on arthropod populations

- Cover crops can have many effects on arthropod populations:
  - Reduce pest insect/arthropod populations
  - Promote natural enemies & beneficials
  - Promote pollinator populations & diversity
  - Possible pest bridging issues?

Melon aphids

Squash bug

Cucumber beetle

Cover crop effects on arthropod populations

- Reduction in pest insect populations by disrupting their life cycles
  - These effects are varied, depending on the crop, its associated pests, and subsequent crops.
- Impact on beneficial insect/arthropod populations
  - Increase natural predators
    - Provide refuge and overwintering sites
    - Springtime habitat
    - Positively impacted by plant diversity

Predatory mite; Source: www.planetnatural.com

Cover crop effects on arthropod populations

- Examples of promoting beneficials/predators
  - Strip tilled cover crops help maintain predator insect populations, and lady beetles preferred legume cover crops (Tillman et al., 2004)
  - Cereal rye can support populations of lady beetles which are a major predator of aphids (Bugg et al., 1990).
  - Crimson clover can reduce Colorado potato beetle populations in eggplant (Hooks et al., 2013)
  - Many cover crops can support predatory mites which can help keep spider mites in check

Pollinator effects

Source: Paige Hickman

Source: bugwood.org

- Pollinator conservation is important due to global decline:
  - Habitat destruction
  - Pesticide use
  - Disease
  - Climate effects
- 35% of food crops are reliant on pollinator services, so having abundant pollinators present is desirable

Pollinator effects

- Winter planted flowering cover crops can provide an early-season food source for emerging pollinators
  - Can increase pollinator abundance for subsequent crops
  - Floral density is the primary factor affecting bee populations
  - Canola has the highest floral density compared to Austrian pea and crimson clover
  - Canola also supported the greatest bee diversity, likely due to flowering earlier than Austrian pea and crimson clover (Ellis and Barbercheck, 2015)

Source:www.albertafarmexpress.ca

Pest Bridging

- Cover crop effects on pest populations is not always positive
  - Cover crops can possibly serve as alternate hosts for pest insects
    - Overwintering sites for pests vs. beneficials
    - May increase pest populations and damage in subsequent crop
      - (Dunbar et al., 2016) found increased early-season lepidopteran pests and increased damage in cornfields previously planted with a cereal rye cover crop
    - Important to consider subsequent crops and insect-host plant interactions when choosing cover crop plantings
  - Can also serve as alternate hosts for plant pathogens if not managed properly

Take Home Message

- Important to avoid cover crop plantings which could be alternate hosts for the same diseases/insects you are trying to control
- Cover crops can provide habitat for beneficial insects and pollinators
- Cover crops can suppress diseases
- Cover crops can suppress nematodes but highly variety dependent

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Resources and Sources

- Managing cover crops profitabily (3rd Ed.): https://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition
- Baraibar, B., Hunter, M. C., Schipanski, M. E., Hamilton, A., & Mortensen, D. A. (2017). Weed suppression in cover crop monocultures and mixes. *Weed Science*, 1-13.
- Bugg, R. L., Phatak, S. C., & Dutcher, J. D. (1990). Insects associated with cool-season cover crops in southern Georgia: Implications for pest control in truck-farm and pecan agroecosystems. *Biological Agriculture & Horticulture*, 7, 17-45.
- Dunbar, M. W., O'Neal, M. E., & Gassmann, A. J. (2016). Increased risk of insect injury to corn following rye cover crop. *Journal of Economic Entomology*, *109*, 1691-1697.
- Ellis, K. E., & Barbercheck, M. E. (2015). Management of overwintering cover crops influences floral resources and visitation by native bees. *Environmental Entomology*, *44*, 999-1010.
- Hooks, C. R. R., Hinds, J., Zobel, E., & Patton, T. (2013). Impact of crimson clover dying mulch on two eggplant insect herbivores. *Journal of Applied Entomology*, *137*, 170-180.
- Tillman, G., Schomberg, H., Phatak, S., Mullinix, B., Lachnicht, S., Timper, P., & Olson, D. (2004). Influence of cover crops on insect pests and predators in conservation tillage cotton. *Journal of Economic Entomology*, *97*, 1217-1232.
- Wiggins, M. S., Hayes, R. M., and Steckel, L. E. (2016). Evaluating cover crops and herbicides for glyphosate-resistant Palmer Amaranth (*Amaranthus palmeri*) control in cotton. *Weed Technology*, 30, 415-422.