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Central New York Dairy, Livestock and Field Crops

Quarterly Newsletter

IN THIS ISSUE

Cattle Are Part of the Climate Solution

By Margaret Quaassdorff, Dairy Management Specialist, Northwestern New York Dairy, Livestock & Field Crops Team

Net zero has been a topic that has been heating up in the dairy industry and in society overall. Both Dr. Frank Mitloehner and Dr. Sara Place made excellent presentations during our February 2022 two-day virtual conference "Net Zero for NY Dairy", hosted by Cornell Cooperative Extension, PRO-DAIRY and Cornell CALS. Resources for NY dairy producers as well as speaker presentations are available for viewing: https://cornell.box.com/v/NetZeroNYDairy.

Dr. Mitloehner (Professor and Air Quality Extension Specialist, UC-Davis) presented on "Livestock and Climate" and gave the audience great insight into "rethinking methane". To recap some of the key points of his presentation, methane (CH_4) is a greenhouse gas (GHG) emitted from various sources including fossil extraction, wetlands, manure lagoons, and ruminant animals. Traditionally when measuring methane's impact on the climate, it is done so by comparing it to carbon dioxide (CO_2), the most abundant GHG in the atmosphere. The way that the two have been compared, using CO_2 equivalents does not reflect the way that they contribute to climate warming.

Current standards set by a metric called GWP100 (global warming potential 100) in 1990, say that 1 molecule of CH_4 is equal to 28 molecules of CO_2 over 100 years. However, GWP100 simply measures methane's CO_2 equivalents and overlooks how methane behaves. Methane, as it turns out, lives in the atmosphere for approximately 12 years versus carbon dioxide's 1000 years. This is why methane is considered to have much less warming power after it is emitted versus CO_2.

GWP* (GWP star) is a new metric out of the University of Oxford that assesses how an emission of a short-lived GHG affects temperature. It accounts for methane's short lifespan, including its atmospheric removal. Moving forward, this should be the metric to replace GWP100 which overestimates methane's warming impact of constant herds by a factor of 4, and overlooks its ability to induce cooling when CH_4 emissions are reduced. As highlighted in the white paper, Pathway to Climate Neutrality for U.S. Beef and Dairy Cattle Production, by Drs. Place and Mitloehner, "the U.S. cattle industries should set emissions reductions goals and targets on a basis of achieving net zero warming defined as 0 CO_2 warming equivalent emissions, rather than net zero as defined by 0 CO_2 equivalent emissions."

Methane from cattle is considered part of the biogenic carbon cycle. The carbon from CO_2 captured by plants during photosynthesis as carbohydrates, can be consumed as feed by the cow, and released as methane via eructation (burping) during rumination or in the manure. After 12 years in the atmosphere, that methane is again oxidized and broken down again to CO_2 that is pulled by the plants, which the cow eats. This is a very different travel path than carbon coming from fossil fuels which are not part of this cycle. Dr. Mitloehner suggests that if we were to keep our herd size constant, the amount of methane produced and destroyed balance each other out, meaning no additional warming.

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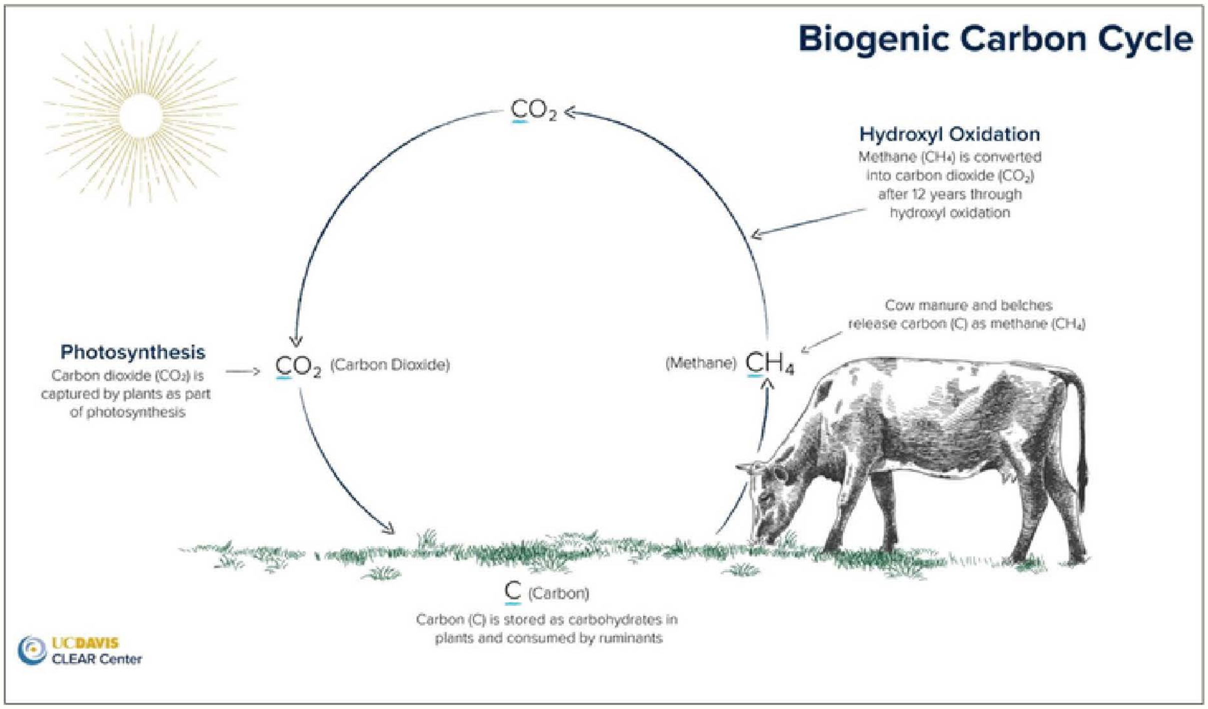
This is because methane is considered a flow gas (emitted and destroyed) versus carbon dioxide, which is considered a stock gas continuously accumulating in the atmosphere. Furthermore, if we reduce methane from cattle with feed additives, digesters, with soil health practices in our cropping systems it is possible to generate short-term cooling. Methane reduction of 25% has been accomplished in California via manure management changes. Though every mitigation strategy may not be feasible to every farm, the industry as a whole is looked to by the Paris Agreement to be partners in limiting global warming to less than 2 degrees Celsius (UNFCCC, 2021). Details, definitions, and more information can be found on the White Paper: *Pathway to Climate Neutrality for U.S. Beef and Dairy Cattle Production* as well as on the CLEAR Center website: https://clear.ucdavis.edu/news/climate-neutrality

From Dr. Place's presentation she reiterates that climate neutrality for dairy cattle production nationwide is likely possible and technically feasible. Both scientists agree it will require new innovations and making sure that the sustainability of our farms, including economic viability, is a focus. Both beef and dairy cattle produce a critical source of nutrition for people. In addition, in striving for net zero warming, their contribution to sustainability as ruminants that optimize land use, upcycle human by-products, and produce natural fertilizer, as well as generate infrastructure that supports communities is not to be taken lightly.



https://clear.ucdavis.edu/explainers/biogenic-carbon-cycle-and-cattle

Planning and Managing Permanent Vegetation Under Solar Arrays

By Joe Lawrence, PRO-DAIRY Forage Systems Specialist and the CCE Ag-Solar Program Work Team

Note from Erik A. Smith: The installation of solar arrays on productive agricultural land will remain a controversial subject as long as the practice continues. Many traditional agricultural operations would be extremely difficult or impossible to conduct on the land in the future. But with proper planning and stewardship by land owners and managers, a solar installation does not have to spell the end of that land's productivity altogether. So if you already have an array or if an array may be in your land's future, here is some guidance from PRO-DAIRY's Joe Lawrence on managing permanent vegetation (forage, pasture) under solar arrays.

Proper planning for the use of land within a solar array is critical to a successful project. Options exist from very low maintenance management of ground cover to more intensive agricultural production systems. Even with low maintenance systems, pre-planning has numerous benefits for the landowner, project operator and environment. Benefits can include protecting the soil, improved pollinator habitat and livestock (primarily sheep) grazing performance and reduced maintenance cost for the solar operator.

In observing recent installations of solar arrays, the pre-construction field conditions vary greatly. It is apparent that planning for desired vegetative cover post-construction needs to start when the site is selected and implemented in conjunction with the construction of the solar array. This article will cover considerations for the successful establishment and maintenance of perennial ground cover options. The information is presented from the perspective of the Northeastern United States but may have applicability to other regions.

Existing Site Conditions

Managed Agricultural Land

Perennial Forage – When the proposed solar array location is in a perennial hay or pasture setting with good management, it is likely that less work will be needed but it still depends on desired outcomes after the project

How will the site be managed post-construction?

- Are the plant species present conducive to mowing?
  - Some forage species may become hard to manage if mowing frequency is low.
- Are the species present desirable for sheep grazing?
  - Fields heavy in legumes may be too “rich” for some livestock.
- Are the species present desirable for pollinators?
  - Several forage crops can serve as food for pollinators but may not provide the optimum selection.

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Row Crops – a row crop field offers a clean slate for establishing perennial cover under the panels; however, can also create challenges with weeds. Row crop fields can contain significant weed seed banks which can present significant challenges when left unchecked as these weeds can take a foothold.

- Annual weeds- allowing annual weeds to establish and produce seed during the planning and construction process can lead to significant increases in the weed seed bank and create weed management challenges for years to come.
- Perennial weeds – perennial weeds tend to be very hardy, once established, and allowing them to establish during the planning and construction process will require a significant effort to permanently remove them.

Un-Managed or Idle Agricultural Land

Solar development is encouraged on marginal or idle agricultural land, in these scenarios significant encroachment of undesirable plants may have already occurred. Again, the post-construction management plan will impact how this is evaluated but the following should be considered.

- Is existing vegetation considered invasive or pose other challenges to sitemanagement?
- Invasive species or undesirable aggressive species should be managed prior toconstruction.
- Will the existing vegetation cause challenges for mowing?
- Will the growth habits of the existing vegetation interfere with solar infrastructure?
- Is existing vegetation toxic or otherwise not palatable to livestock?
- Are herbicide tolerant weeds present?
    - These should not be permitted to go to seed.

Resource: Restoring Perennial Hay Fields, Agronomy Factsheet #109:
http://nmsp.cals.cornell.edu/publications/factsheets/factsheet109.pdf

Pre-Construction Actions

In many cases management of undesirable plants will face less hurdles before the construction of the solar array.

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Control Existing Vegetation

- Mowing – if time permits prior to the start of construction, frequent mowing can reduce the presence of some weed species and encourage the growth of more desirable species.
- Herbicides – Herbicides can be an effective control option for undesirable plant species. Care must be taken to assure that products are used in accordance with their label and steps are taken to avoid herbicide resistance development.
- Tillage – tillage can effectively terminate numerous types of plants but may not be successful in controlling species with creeping root systems or the ability to regrow from existing plant parts.

*Note: Tillage may lead to additional germination from the soil seed bank so planning should include follow-up measures to control newly emerged weeds after initial tillage.

Recourse: Weed Control in Grass Hay:
https://nydairyadmin.cce.cornell.edu/uploads/doc_872.pdf

Establishment of New Vegetation

- Standard practices of solar installation limit the impact on current ground cover, though conditions such as excessive rainfall during construction can increase soil disturbance. In cases where complete renovation of the vegetation is needed, it may be much more feasible to complete this prior to construction. Followed by necessary repairs after construction.
- Prepare a proper seedbed / use appropriate equipment (seed to soil contact is critical for germination and establishment. Resource: Grass Seeding and Establishment:
  http://www.forages.org/files/gis/GIS5_Grass_Seeding_and_Establishment.pdf
    - No-till – If the field conditions are smooth a properly set up no-till drill can provide a successful establishment without the need for tillage. Some control of existing vegetation may be necessary to allow newly seeded plants to establish. Resource: Improve Pastures and Hay Fields by Overseeding Perennial Forage Grasses and Legumes:
      https://nydairyadmin.cce.cornell.edu/uploads/doc_914.pdf

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- Broadcast seeding
  - Existing Stand – success is marginal as proper seed to soil contact is variable.
    - Note: frost seeding is the practice of broadcasting seed onto the soil surface in the early spring and utilizing the natural freeze/thaw cycle of the soil to aid in improving seed to soil contact. This practice is known to improve success, though results are still variable.
    - Resource: March is Frost Seeding Time!: https://nwnyteam.cce.cornell.edu/submission.php?id=515&crumb=grazing%7C4
  - Prepared Seedbed
    - Broadcasting onto a prepared seedbed can improve the likelihood of success but is still risky compared to seeding with a grain drill.
    - Requires very well-prepared seedbed and packing following the seeding.

Fertility Management

- Weeds are opportunistic and often thrive where soil fertility is poor. Regardless of intended management/use of the vegetation post-construction, addressing low fertility levels prior to construction will result in a much higher likelihood of successful establishment and long-term viability. The starting point for managing soil fertility is to measure the current status of the soil through a soil test. Recourse: Agronomy Fact Sheet #1: Soil Sampling for Field Crops: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet1.pdf
- The management of soil acidity (pH) is the backbone of a soil fertility program and should be addressed prior to other nutrient requirements. The native soil pH of a location is influenced the soil type and parent material (bedrock) at the location. The ideal pH range for most field crops is between 6.0 and 7.0. Resource: Agronomy Fact Sheet #5: Soil pH for Field Crops: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet5.pdf
- While there are occurrences where the pH can be too high, in most scenarios if the pH is out of the desired range, it is low. Lime is used to raise pH levels. Resource: Agronomy Fact Sheet #7 Liming Materials: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet7.pdf
- Once adjustments to soil pH are made, attention should be given to other information provided on the soil test related to the status of macro-nutrients needs by field crops. Resource: Agronomy Fact Sheet #75: Basics of Fertilizer Management: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet75.pdf

Agronomy Fact Sheet #17: Nutrient Management for Pastures: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet17.pdf

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Plant Species Selection

To date, the most common plans for vegetation management under solar arrays are mechanical control (mowing), grazing sheep, and pollinator habitat, or a combination of these three. In almost every scenario a mixture of different plant species will provide more desirable outcomes than a monoculture. Mixtures provide diversity in growth habits with a number of benefits, including;

Growth throughout the season

- Spring growth
- Tolerance of Summer Heat
- Fall growth

Success in micro-climates

Mixtures increase the chance that certain species will fill niches within a field

- Wet or dry soil conditions
- Shade
- Variability in soil fertility

Pest Tolerance

Mixtures decrease the likelihood that a pest will overwhelm the field.

Diversity for pollinators and livestock

- Offer pollinators different food sources at different points in season.
- Improve source of nutrients for livestock and reduce risk of overconsumption.

Low Maintenance Ground Cover

Ground cover is important for environmental and solar productivity needs, and it is important to recognize that low maintenance does not equal no-maintenance. All solar arrays require vegetation management to prevent vegetation from affecting the solar system. The plant species present will impact the frequency, ease, and cost of managing this vegetation. Characteristics of common plant species for permanent ground cover in the northeast can be found in Appendix A.

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Pollinator Habitat

Intentional use of targeted plant species will enhance the positive impacts of a solar array for pollinators. When pollinator habitat is a primary goal, planning for these goals in the pre-construction phase will improve success in meeting these goals. Resource: Pollinator-Friendly Solar Photovoltaic, University of Mass.: https://ag.umass.edu/clean-energy/services/pollinator-friendly-solar-pv-for-massachusetts

Pasture Management

The performance of ruminant animals on pasture can be impacted by the plant species present and management of the pasture area. A mix of desirable plant species can improve animal growth and health as well as consistency of the feed source throughout different stages of the growing season. Resource: Solar Grazing: https://blogs.cornell.edu/grazing/

Emerging Agrivoltaics

The prospects exist for hay harvest and cultivation of other crops within a solar array; however, these options will require additional planning and modifications to the installation that will necessitate further planning and negotiation with the developer.

- Spacing of panel rows
- Placement of related infrastructure
  - Electrical wires connecting panel rows, energy conversion equipment, etc.
- Height of panels
- Ability to adjust panel angle
- Resources:
  - Mass.: https://ag.umass.edu/clean-energy/research-initiatives/dual-use-solar-agriculture
  - Fraunhofer Institute: https://www.ise.fraunhofer.de/en/key-topics/integrated-photovoltaics/agrivoltaics.html
  - Rutgers U.: https://ecocomplex.rutgers.edu/agrivoltaics-research.html
  - Minnesota-Morris: https://wcroc.cfans.umn.edu/people/brad-heins

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Other Considerations

Pre-mixed seed – Certain pre-mixed seed options may contain undesirable species; it is important to check seed labels closely and consult with local advisors to assure there are no concerns regarding aggressiveness or suitability of species present in a seed pre-mix.

- Be wary of inexpensive seed mixes.
- Avoid plants considered non-native or known to be overly aggressive once established.
- Fescue grasses containing Endophytes – Older varieties of Tall Fescue contain endophytes* and are still found in some low-quality seed mixtures. Improved Fescue varieties are novel endophyte or endophyte free which makes them safe for animal consumption. Selecting these modern varieties is strongly recommended in any scenario but especially if there is ever a possibility of grazing or hay harvest from the location.

* Endophyte fungus live within plant and can cause health and performance problems in livestock.

Reeds Canarygrass containing alkaloids – in many areas, historic stands of Reeds Canarygrass are likely to contain high alkaloid levels which can decrease palatability and cause health problems in livestock when consumed in high levels. Improved varieties of forage Reeds Canary grass found on the market today are low alkaloid varieties.
Consideration: if historic stands of Reeds Canarygrass are present on the site, it is advised to terminate the vegetation and plant new improved varieties, particularly if grazing or hay production is a goal for the location.

Post-Construction Considerations

Repair following Construction Activities

- Follow Plant Species Considerations presented above
  - Match new seeding to existing stand
  - Avoid Monocultures
- Assure soil surface remediation and seedbed preparation is adequate
  - Removal of rocks or other debris
  - Smooth soil surface
    - Successful seeding establishment
    - Ease of future management

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Stand Maintenance

- Monitor for Weeds
  - Proper management through mowing and grazing will generally minimize the encroachment of weeds.
  - Mowing is a tool for controlling weeds as well as preventing these weeds from producing more seed. When pollinator or other wildlife habitat is a goal of the project, mowing frequency will need to be managed to balance these goals.
- Monitor Soil Fertility
  - Soil Fertility issues should be corrected prior to establishment (see above)
  - Removal of plant material
    - When plant material is removed (grazed, hay harvest) nutrients are also removed. Overtime this can deplete soil fertility. Fields with low soil fertility will limit the productivity of desirable plant species and increase weed encroachment.
    - The depletion of nutrients will be slower under grazing management, as some nutrients are returned to the soil by the animals but will still occur over time.
    - When vegetation is removed, it will be necessary to monitor and potentially replace nutrients to maintain a healthy stand of desirable vegetation.
  - No removal of plant material
    - When vegetation is mowed and left on-site the nutrients are returned to the soil and little management should be needed (assuming adequate initial fertility).

Through considerations of the topics presented here a landowner should be well on their way to successful and proper planning for the management of land within a solar array.

Appendix A

Plant Characteristics for Ground Cover and Management of Common Northeast Perennial Crops

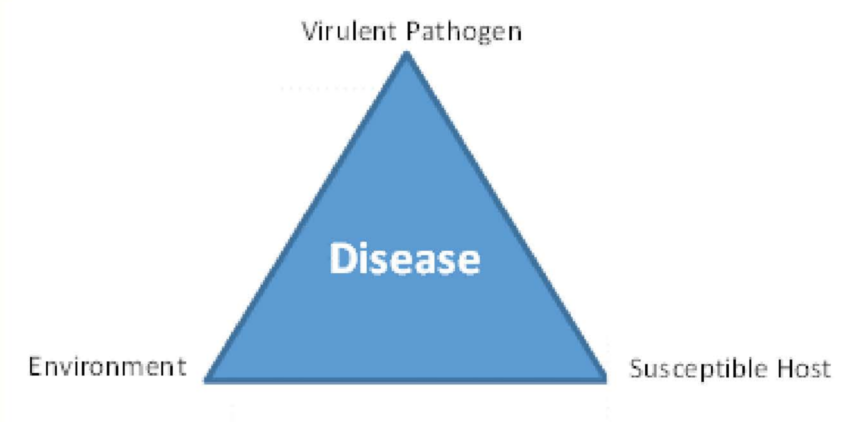
	Ease of Establishment	Persistence	Tolerates Wet Soils	Drought Tolerance	Tolerates Low pH	Relative Height	Risk of Lodging[1]
Common Cool Season Grasses							
Reeds Canarygrass	Low	High	High	High	Moderate	Tall	Moderate
Orchardgrass	High	Moderate	Low	Moderate	Moderate	Moderate	Low
Bromegrass	Moderate	High[2]	Moderate	Low	Moderate	Tall	Moderate
Forage Fescues[3]	Low	High	High	Moderate	Moderate	Moderate	Moderate
Conservation Fescues[4]	Low	High	High	High	Moderate	Short	Low
Timothy	High	Moderate	Low	Low	Moderate	Moderate	Low
Kentucky Bluegrass	Moderate	Moderate	Moderate	Low	Moderate	Short	Low
Ryegrass	High	Low	Moderate	Low	Moderate	Moderate	Moderate
Common Legumes							
Alfalfa	Moderate	Moderate	Low	High	Low	Moderate	Moderate
Red Clover	High	Moderate[5]	Moderate	Low	Moderate	Moderate	High
White Clover	Moderate	High	Moderate	Low	Moderate	Short	Low
Alsike Clover[6]	Moderate	Moderate	Moderate	Low	Moderate	Short	Low
Birdsfoot Trefoil	Low	Moderate	High	Moderate	High	Moderate	High
Hairy Vetch	Moderate	Moderate	Moderate	Moderate	Moderate	Short[7]	High

[1] Lodging can significantly increase the difficulty of mowing.
[2] Persistence is high with a low mowing frequency but will not tolerate intensive mowing.
[3] The most common forage fescues are Tall and Meadow. These varieties have been selected for forage quality and tolerance to harvest. If intended for livestock feed, select novel endophyte or endophyte free varieties.
[4] Fescue grass (Creeping Red, Hard) in this category are selected for low maintenance characteristics, can generally persist in poorer soil environments and are often shade tolerant. Neither are tolerant of harvesting nor well suited for livestock.
[5] Red Clover is relatively short lived; however, is highly effective at reseeding itself when allowed to go to seed.
[6] Do not feed to horses.
[7] Hairy Vetch will climb in a vine like manner. This can create challenges for mowing and may pose a risk of entangling solar infrastructure.

Protecting Your Flock From Disease

by Roxanne Newton, Eastern Alliance for Production Katahdins (EAPK) Communications Committee

Disease Triangle diagram:



Disease is present in every flock and can reside in the animals, soil, air, and water. Producers don't often talk about illnesses affecting their sheep because they don't want the stigma of disease to reflect negatively on their flock. But producers shouldn't have to deal with the problem alone. Let's accept the fact that disease is inevitable, remove the stigma, and learn how we can prevent or mitigate disease transmission in our flocks.

Disease is defined as "a condition of the living animal that impairs normal functioning and is typically manifested by distinguishing signs and symptoms." Unfortunately, sheep can't tell us how they feel or what symptoms they're experiencing so it often becomes a guessing game for both producers and their veterinarians. Since healthy sheep are resistant to many of the pathogens already present on their own farm, they often don't get clinically ill unless they are under stress. Previous exposure to these pathogens prepares the immune system to attack the disease in a timely manner.

Newly purchased animals can be 'asymptomatic carriers' of a disease your sheep have never been exposed to. This is why quarantining new animals is so important. Young lambs (and adults without previous exposure) are therefore more susceptible to novel diseases. In addition, stressors such as transportation, feed changes, weather events, weaning or lactation can weaken the immune system and increase susceptibility to infection.

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Climate change is impacting the occurrence and prevalence of infectious disease. Like humans, livestock are now being exposed to novel diseases or new strains of a common virus or bacteria. Diseases in sheep that were once limited to specific regions of the country or even to another continent are now spread more easily through the shipping of goods, the transporting of animals to and from sales and exhibitions, and by changes in global wind patterns. There is also an increased prevalence in cross-transmission of zoonotic diseases among different species of livestock. Vector-borne diseases, spread by mosquitos, midges, ticks, and fleas, are also on the rise due to the migration of disease-carrying insects to a more hospitable environment. Changes in farming practice, land use, and extreme weather patterns have also created new microenvironments that destroy beneficial plants and animals and allow harmful organisms to flourish, including disease-causing fungi and molds.

The Disease Triangle above illustrates how the transmission of disease is dependent on the interaction between a virulent pathogen, a susceptible host, and a favorable physical, chemical, or biological environment. Interruption or manipulation of any part can significantly reduce further development and transmission of disease.

Since diseases can spread rapidly, implementing good biosecurity practices, protecting susceptible animals or just altering the environment can help to mitigate the spread of infections. Some management practices that can help reduce disease transmission include:

1. Inspect and quarantine new animals for at least 30 days before comingling.
2. Isolate and treat animals with obvious signs of disease: limping, nasal discharge, fever, cough, scours, abscesses, or skin/oral lesions.
3. Test new animals for communicable disease such as Ovine Progressive Pneumonia (OPP), Caseous Lymphadenitis (CL), or Johne's disease.
4. Restrict access to wet pastures, stagnant water, moldy feed/hay. Avoid grazing sheep on pastures with high levels of parasite larvae. Lung worm and meningeal worm are more common in wet or wooded areas frequented by deer.
5. Vaccinate against Clostridial diseases and Tetanus. Consider vaccinating against abortion diseases (Chlamydia, Vibriosis), bacterial pneumonia (Pasteurella/Mannheimia), and/or sore mouth (Contagious Ecthyma).
6. Reduce stress during pregnancy, lactation, weaning, and transport.
7. Provide good nutrition, good minerals, and a clean, fresh water source.
8. Improve soil and forage health. Manage or eliminate poisonous plants/weeds.

The majority of infectious diseases are introduced by newly purchased animals and are then spread throughout the flock because the animal was not adequately quarantined. It is important to note that 75% of diseases are also transmissible to humans. Wear gloves when handling sick animals, disinfect equipment, and properly dispose of any contaminated instruments, needles, syringes, and bandages. Not all diseases can be avoided, but reducing the likelihood of transmission, protecting susceptible animals, and improving environmental conditions can significantly reduce risk.

Seed Corn Maggot, Stand Losses and the Need for Insecticide Seed Treatments

By Elson J. Shields, Entomology, Cornell University, Ithaca, NY

Seed corn maggot, Delia platura, (SCM) is the primary NY pest attacking large-seeded crops during germination. These crops include corn, soybean and edible beans. One of the difficulties in managing this pest is the unpredictability of the infestations, the lack of an insecticide rescue option, short NY growing seasons restricting the options of replanting and the high cost of replanting. The high cost of replanting includes both the cost of replanting and the reduced yield due to the short growing season.

SCM adult flies, looking similar to small house flies, are attracted to fields with high organic matter and lay their eggs in zones of high organic matter. In NY, the frequent use of animal manures and cover crops known as green manure crops increases the attractiveness of the fields to SCM. In these situations, stand losses can exceed 50% due to the attractiveness of the organic matter, resulting in a high level of eggs being laid in the field, before the field is planted. After the field is planted, the germinating seeds are surrounded with SCM larvae feeding on the organic matter. Newly hatched larvae feed on this organic matter and if they encounter germinating seeds, the larvae also attack and feed on the germinating seeds, a source of higher nutrition than organic matter. The short and cool NY growing season encourages growers to plant their crops as early as possible to be able to harvest profitable yields. This early planting of seeds into cold soils results in slow and delayed emergence which increases the window of vulnerability to SCM damage. Depending on planting date and soil temperatures, the window of vulnerability for corn to SCM attack is 1-4 weeks.

This is an unusual insect crop pest because it is not attracted to the plant, but to the high organic environment and secondarily attacks the germinating seeds. With the soil conservation movement promoting adoption of cover crops to 1) protect the valuable soil resource from erosion losses, 2) improve the quality of the agricultural soils, 3) sequester atmospheric carbon to counter climate change, the organic levels of the fields rise significantly and become more attractive to SCM, since they are attracted to the organic matter in the soil, not the crop planted. The current increased adoption of cover crops to rebuild and protect the soil resource has been successful due to the widespread usage of insecticide treated seed for the past two decades. Prior to the widespread use of insecticide seed treatments in the 1990's, efforts to get farmers to adopt cover crops was a widespread failure due to stand losses from SCM.

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Under NY growing conditions, measurable yield losses in corn start to occur between 10-20% stand losses. The magnitude of the yield loss is dependent on the corn variety, degree-day maturity requirements and the subsequent growing conditions which influences the ability of the undamaged plants to compensate for the missing plants. Due to the short growing season in NY, the decision to replant the field is seldom a viable option due to the additional expense of replanting (ca. $130/ac) and the yield reductions associated with shorter season corn variety required to be planted for maturity to be completed before killing temperatures in the fall. Typically, if the surviving corn stand has less than a 40% stand loss, the resulting yield loss is less costly than the combined cost of replanting and yield reduction associated with late planting.

2021-2022 Field Study in Aurora, NY (2 growing seasons)
A two-year study was conducted to examine the impact of SCM and the necessity of insecticide seed treatments on 1) corn grown under continuous corn culture with minimal organic matter and 2) corn following a green manure cover crop with high organic matter.

Experimental design:

The continuous corn site had been planted to corn for 7 years prior to the 2021 growing season. Previous corn crops had been harvested as grain and soil tillage was restricted to spring chisel plowing. Crop residue was moderate, typical of the minimum tillage of commercial corn production focused on reducing soil losses from erosion. Planting in 2021 and 2022 utilized a 4-row no-till planter.

The cover crop site was planted to red clover in 2020 and the clover crop was retained as a green manure crop. Prior to planting the cover crop site to corn, the clover was mowed, liquid dairy manure was applied to the surface and the soil was chisel plowed in 2021 and moldboard plowed in 2022 to prepare the seed bed for planting. Planting in 2021 and 2022 utilized a 4-row no-till planter.

Each area was planted on a weekly basis yielding 6 different sequential planting dates in 2021 and 5 different sequential planting dates in 2022. In 2021, wet spring soil conditions delayed the first planting until the second week of May and in 2022, the first planting coincided with the first week of May. Each row of the 4-row planter contained a different treatment and the plots for each planting date were comprised of a single planter pass in the continuous corn and two planter passes in the cover crop site. The following treatments were planted as single rows within each planter pass. 1)conventional corn (non-Bt-RW) with no seed applied insecticide, 2) conventional corn (non-Bt-RW) with seed applied insecticide, 3) Bt-RW corn with no seed applied insecticide and 4) Bt-RW corn with seed applied insecticide. Each planting date was replicated four times at each location. Data collected included stand counts after the plants were V3-4 growth stage and excavation of the missing plants to document the reason for the missing plant.

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Results:

Continuous corn site:

At the continuous corn site in 2021, the experimental design allowed 24 planting pairs (corn type x presence/absence of seed applied insecticide) for comparison and analysis. Fourteen of the 24 planting pairs (58%) suffered stand losses in the untreated seed row from seed corn maggot ranging from 2% to 66% stand loss compared to the insecticide-seed treated row. If the 10% stand loss/yield loss threshold is used, then nine of the 24 planting pairs (38%) indicated economic yield losses in the non-seed applied insecticide treatments. If 14% stand loss/yield loss threshold is used, then eight of the 24 pairs (33%) indicated economic yield losses in the non-seed applied insecticide treatments. If the 20% stand loss threshold is used, then six of 24 (25%) planting pairs indicate economic losses in the non-seed applied insecticide treatments. Four of the planting pairs had greater than 40% stand losses (10%) in the non-seed applied insecticide treatments.

Averaging across all planting dates and treatments, insecticide untreated seeds had stands reduced 30.6% which translates to a significant economic yield loss.

In 2022, the experimental design allowed 20 planting pairs (corn type x presence/absence of seed applied insecticide) for comparison and analysis. Seventeen of the 20 planting pairs (85%) suffered stand losses in the untreated seed row from seed corn maggot ranging from 4% to 66% stand loss compared to the insecticide-seed treated row.

If the 10% stand loss/yield loss threshold is used, then 13 of the 20 planting pairs (65%) indicated economic yield losses in the non-seed applied insecticide treatments. If 14% stand loss/yield loss threshold is used, then 10 of the 20 pairs (50%) indicated economic yield losses in the non-seed applied insecticide treatments. If the 20% stand loss threshold is used, then eight of 20 (40%) planting pairs indicated economic losses in the non-seed applied insecticide treatments. Five of the 20 planting pairs had greater than 40% stand losses (25%) in the non-seed applied insecticide treatments.

Averaging across all planting dates and treatments, insecticide untreated seeds had stands reduced 21.1% which translates to a significant economic yield loss.

Combining the two growing seasons, 62% of the non-insecticide treated seed plantings suffered a 10% or greater stand loss from SCM. A 14% or greater stand loss was recorded in 42% of the non-insecticide treated seed plantings and 33% of the plantings suffered a 20% or greater stand loss from SCM. Stand losses exceeding 40% were recorded from 18% of the plantings.

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Corn following cover crop site:

In the 2021 corn following cover crop site, the experimental design allowed 24 planting pairs (corn type x presence/absence of seed applied insecticide) for comparison and analysis. Sixteen of the 24 planting pairs (66%) suffered stand losses in the untreated seed row from seed corn maggot ranging from 2% to 62% stand loss. If the 10% stand loss/yield loss threshold is used, then 13 of the 24 planting pairs (54%) indicated economic yield losses in the non-seed applied insecticide treatments. If 14% stand loss/yield loss threshold is used, then nine of the 24 pairs (38%) indicated economic yield losses in the non-seed applied insecticide treatments. If the 20% stand loss threshold is used, then seven of 24 (29%) planting pairs indicate economic losses in the non-seed applied insecticide treatments. Five of the planting pairs (21%) had greater than 40% stand losses in the non-seed applied insecticide treatments.

Averaging across all planting dates and treatments, insecticide untreated seeds had stands reduced 24.4% which translates to a significant economic yield loss.

In the 2022 corn following cover crop site, the experimental design allowed 20 planting pairs (corn type x presence/absence of seed applied insecticide) for comparison and analysis. Seventeen of the 20 planting pairs (85%) suffered stand losses in the untreated seed row from seed corn maggot ranging from 7% to 52% stand loss. If the 10% stand loss/yield loss threshold is used, then 15 of the 20 planting pairs (75%) indicated economic yield losses in the non-seed applied insecticide treatments. If 14% stand loss/yield loss threshold is used, then 14 of the 20 pairs (70%) indicated economic yield losses in the non-seed applied insecticide treatments. If the 20% stand loss threshold is used, then 10 of 20 (50%) planting pairs indicate economic losses in the non-seed applied insecticide treatments. Three of the planting pairs (15%) had greater than 40% stand losses in the non-seed applied insecticide treatments.

Averaging across all planting dates and treatments, insecticide untreated seeds had stands reduced 21.6% which translates to a significant economic yield loss.

Combining the two growing seasons, 65% of the non-insecticide treated seed plantings suffered a 10% or greater stand loss from SCM. A 14% or greater stand loss was recorded in 54% of the non-insecticide treated seed plantings and 40% of the plantings suffered a 20% or greater stand loss from SCM. Stand losses exceeding 40% were recorded from 18% of the plantings.

Discussion

Under NY growing conditions during 2021 and 2022, if a farmer decides or is forced to plant corn without an effective insecticide seed treatment, 36% of his fields will suffer a greater than 20% stand loss and significant economic loss. Continuous corn fields will suffer a lesser, but significant level (33%) than corn following a green manure/cover crop (40%).

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Many corn agronomist experts believe that yield begins to be impacted at 10-14% stand loss and all corn agronomists agree that significant and measurable yield loss occurs at 20% stand loss. Corn silage is a critical forage to support NYS dairy industry and is more valuable per acre than grain production.

The following values were estimated for 2021 from three different regions of NY. These values were estimated by regional experts.

Region	Silage value (in field)	Representative Yield	Value/ac
NNY:	\$40/ton	17 tons/ac	\$680
CNY	\$38/ton	20 tons/ac	\$760
WNY:	\$47/ton	20 tons/ac	\$940

In all three regions, a one-ton silage loss per acre in yield equals eight-times the cost of the insecticide seed treatment. A one-ton reduction in silage is approximately 5% loss in yield which equals a \$40 loss per acre. In a typical 50 ac field, the economic impact is \$2,000. An insecticide seed treatment to prevent the stand loss related to this yield loss cost \$5/ac (\$250/50 ac). If the seed treatment protects as little as a 1% yield loss (\$8), the cost of the insecticide seed treatment is paid for. The economics of yield loss are staggering. For example, a 10% yield loss from SCM damage is estimated to be 2 tons of silage and valued at ~\$80. In a 50-acre field, a 10% yield loss has an economic impact of \$4,000.

Conclusions:

These 2021-22 research data indicate the level of potential and realistic economic losses by NY corn farmers, if seed applied insecticide is not available for use. It has been suggested that viable seed treatment insecticides are available to replace the currently utilized Neonic insecticides. However, NY field testing across multiple growing seasons has shown that all possible insecticide replacements are only 50% effective under field conditions, whereas the currently used neonic insecticides are more than 85% effective. It has also been suggested that SCM damaged fields could be simply replanted to recover from the SCM damage. However, replanting a field in NY with its short growing season is a double-edged economic risk. Replanting cost are estimated to be \$130/acre and the shorter season corn which is planted to achieve maturity before the fall killing frost is significantly lower yielding that the full season variety originally planted. Based on multiple years of NY data, if the surviving corn stand has less than a 40% stand loss, the resulting yield loss is less costly than the combined cost of replanting and yield reduction associated with late planting. Additionally, the conservation practices such as reduced tillage and planting cover crops to reduce erosion and runoff and increase sequestering of atmospheric carbon are not only encouraged, but also incentivized in NY State. It is important to understand that in the absence of these seed protectants, farmers may revert to planting fewer cover crops to avoid losses to SCM.

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Is the IPM approach feasible?

In short, the philosophy of IPM is to scout/monitor the field for insect pest populations and if the insect populations exceed a preset threshold, then take corrective action, often apply an insecticide. Will this strategy work on SCM in NY?

To begin with, it needs to be remembered that SCM is attracted to the high organic environment, not the crop and the adults often lay eggs in the high organic environment before any crop is planted. If a crop is never planted, the SCM larvae mature on the organic matter present in the field and complete their lifecycle. SCM larvae are organic matter feeders who will also attack germinating seeds if/when they encounter them.

1) Scouting for adults using sticky cards:

While the use of sticky cards to monitor adult SCM indicates the presence of the adults in the field, the correlation between adults on the sticky card and the number of eggs laid in the field is not well researched or correlated. Even in insect pest/crops where multiple research projects have been conducted over the past decades, the relationship between adults on a sticky card and immature insect stages attacking the crop is tenuous at best. Perhaps after years of research in NY, a reliable correlation can be established, but given the imprecise nature of predicting SCM insect infestations, this research is difficult to conduct successfully.

2)Delaying corn planting to miss the SCM adult flights:

In most farming operations in NY, the concept of delaying corn planting to windows where SCM adults are not present is not feasible. First off, SCM lay eggs in the high organic environment, not because the crop is planted. Thus, if eggs are going to be laid in the field, the eggs are laid prior to the delayed planting. When the corn seeds germinate, the SCM larvae are present and ready to attack the germinating seeds. Secondly, with the frequent rain delays during the spring planting season, farmers with multiple fields need to plant whenever the soil conditions are correct for planting. Otherwise, planting is delayed significantly and the impact of reduced yield from those delayed planting dates is costly.

3)Rescuing a corn planting if SCM exceeds threshold:

The concept of "rescuing" a corn planting from SCM without replanting the field is without merit. First off, the seedlings are killed by SCM and there is no technology to "bring them back to life". Secondly, there are no rescue insecticides which are effective.

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4)Replanting as a viable rescue from an economic SCM stand loss:

As previously stated, replanting a field in NY with its short growing season is a double-edged economic risk. Replanting cost are estimated to be $130/acre and the shorter season corn which is planted to achieve maturity before the fall killing frost is significantly lower yielding that the full season variety originally planted. Based on multiple years of NY data, if the surviving corn stand has less than a 40% stand loss, the resulting yield loss is less costly than the combined cost of replanting and yield reduction associated with late planting.

We thank NY Farm Viability Institute, Cornell CALS and Cornell Agricultural Experiment Station for their research support for this ongoing study focused on identifying alternative management strategies for SCM.

"CCE Regional Teams and the NYS Integrated Pest Management program are undertaking several multi-year studies into seed corn maggot population dynamics and the relative effectiveness of currently-available seed treatments (as a collaborator, I am conducting these studies on 12 farms in our region). With an uncertain future for neonicotinoid seed treatments in NY state, these studies will allow us to be as prepared as possible if and when we need to transition from neonicotinoid crop protectants." – Erik Smith

Soybean Cyst Nematode in Soybeans and Dry Beans

New Research and Renewed Sampling Efforts in 2022

by E. Smith, M. Zuefle, X. Wang, K. Wise, J. Degni, A. Gabriel, M. Hunter, J. Miller, K. O'Neil, M. Stanyard, G. Bergstrom. From CCE, NYSIPM, USDA - Agricultural Research Service, and Cornell University

Soybean cyst nematode (SCN) is a plant parasitic roundworm and is the most damaging pest of soybean crops worldwide. Yield losses can reach 30% before above-ground symptoms manifest, leaving growers unaware that they have an infestation until it's too late. With soybean prices the highest they've been in a decade, this translates to a loss of more than $13,000 per fifty acres in a field that would otherwise produce a yield of 55 bu/acre. We are only now beginning to understand the spread and damaging effect of SCN on dry bean crops, for which financial losses would almost certainly be greater due to their higher value.

In addition to legume crops, SCN can infest and reproduce on several weed species such as chickweed, purslane, clover, pokeweed, and common mullein. Overwintering SCN eggs hatch in spring when soil temperatures reach approximately 50°F (10°C). Females colonize roots to feed, eventually allowing the lower half of their bodies to protrude through the root wall and become visible as small white cysts (Figure 1). Eventually, the female dies and the cyst dries, hardens, and darkens in color, concealing up to 400 eggs. While we can expect at least three generations of SCN each growing season, these cysts can survive for years in the soil until the right conditions allow them to hatch. Because of their hardiness, longevity, and their relatively broad host range, once a field has been infested with SCN is it considered impossible to eradicate. SCN cysts can spread via wind, soil, water, tires and farm equipment, contaminated seeds or plants, and through birds or other animals.

FIGURE 1. SOYBEAN CYST NEMATODE CYSTS ON SOYBEAN ROOTS.
Photo: Craig Grau

This is an extremely hardy and pernicious pest, but populations can be managed using an integrated approach including scouting, soil sampling, host resistance, and crop rotation. The first step is of course scouting and identification using soil sampling.

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If SCN infestation is not known in a field, the roots of symptomatic plants (stunting or premature yellowing compared with the surrounding crop) may be inspected for cysts (Figure 1). Otherwise, soil samples should be collected near harvest or just after. Samples should be taken from the root zone in field entrances and sections of the field that showed stunting or premature yellowing/death compared with the surrounding crop (Figure 2). If a field is known to have an SCN infestation, soil samples should be taken across the field in a zig-zag or grid pattern because SCN infestations are unevenly distributed.

Figure 2. Soybeans infested with SCN drying down prematurely compared with the surrounding crop. Photo: Erik Smith

From 2017 to 2020, 134 soybean and dry bean fields in 42 counties were sampled for SCN, yielding positive samples in 30 counties (SCN+). In 2021, further testing revealed 6 more counties with infestations (Table 1, Figure 3).

Fields tested	Fields SCN+	Counties sampled	Counties SCN+	New SCN+ counties
98	30[a]	37	15	6[b]

a: Mostly low populations (<500 eggs/cup of soil). Moderate egg counts (500-10,000 eggs/cup) were found in Western NY, the North Country, and the Southern Tier (no geographic trend).
b: Broome, Genesee, Oneida, Schenectady (not previously sampled), Tioga, and Yates (not previously sampled).

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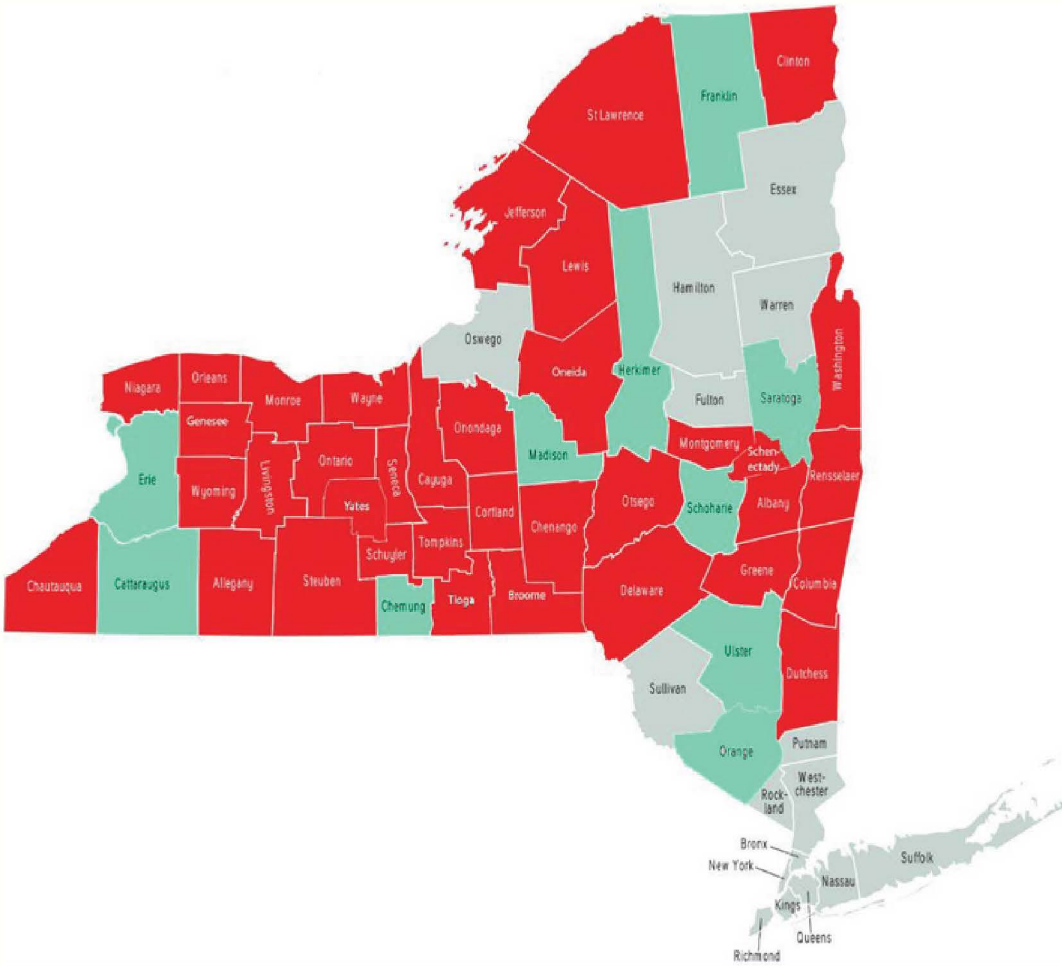

Figure 3. Counties with known infestations of soybean cyst nematode (red), counties that have been sampled but have not yielded positive samples (green), and counties that have not been sampled (gray).

To scout for damage and sample soil more efficiently, researchers from New York State IPM are investigating the effectiveness of using soil electrical conductivity (EC) mapping technology. Soil EC mapping can determine field distribution for many nematode species but has not been tested on SCN. Nematode population density, if present, has a strong positive correlation with the proportion of sand in the soil because of increased mobility in looser, sandier soils. EC measurements can be used to detect the variability in sand content in a field and thereby create a map of areas with higher likelihood of SCN. This map is then used to target soil sampling to those areas. Preliminary data collected in 2021 using an EC machine shows there is variation in SCN distribution within fields. Results from 2022 (funded by the NY Dry Bean Industry) will be used to seek additional funding to expand our mapping, and to utilize existing EC maps from growers of dry beans, soybeans, and snap beans to further validate this approach.

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While we have many SCN-resistant soybean varieties, the majority (>95%) are derived from a single resistant cultivar, PI 88788. The extensive use of this cultivar in soybean breeding has led to the emergence of SCN populations that can overcome PI 88788-type resistance. For example, recent SCN surveys conducted in major soybean producing states including Missouri and Minnesota all reported an increased level of adaptation to PI 88788-type resistance. In contrast with our current soybean varieties, SCN field populations exhibit great genetic diversity. During the fall of 2022, researchers from the USDA-ARS will be collecting soil samples to conduct a comprehensive study on SCN distribution, density, and virulence phenotypes across New York state. Regular monitoring of SCN densities and virulence phenotypes is essential for developing effective management plans based on the use of resistant cultivars.

With the current infestation levels in NY, crop rotation is our most valuable management tool. Rotating out of soybeans for even one year can reduce SCN populations by 50% or more. Continuing to rotate crops allows us to keep populations low, reducing the likelihood that growers will have to resort to more costly management strategies.

Please contact your local Cornell Cooperative Extension agent if you would like your field(s) to be sampled for SCN. This year, the NY Corn and Soybean Growers Association (NYCSGA) is providing funding for up to 75 soybean fields to be tested, while the NY Dry Bean Industry is funding EC mapping of three dry bean fields and nine soil samples per field (27 total samples). With continued scouting, soil sampling, and race-typing by Cornell University, USDA-ARS, and NYSIPM, New York’s soybean and dry bean growers are in position to continue making the best management decisions for this pest.

Advantages of Using Artificial Insemination

by Tasha Harris, WVU Extension Agent - Upshur County and Jesica Streets WVU Extension Agent - Tucker County

Swine AI Guidelines for Beginners

There are several advantages to using artificial insemination (AI) in swine operations. First, few to no boars are needed, therefore alleviating the cost of feed, housing and medical supplies for intact males. Second, it can save time and labor during breeding and farrowing season when coupled with estrus synchronization. Finally, with proper management, time commitment and skill, you can improve herd quality with access to genetically superior boars while maintaining biosecurity on the farm.

Detecting Estrus

The key to a successful AI program is detecting estrus (standing heat) in the gilt or sow. Females typically cycle every 21 days, but estrus cycles can vary. Cycles may range from every 16 to 25 days.

Signs of Estrus

- Swollen, red vulva
- Increased vocalizations
- Decreased appetite
- Pinning of ears
- Mucus discharge from vulva
- Restlessness
- Mounting other females or standing to be mounted

It is ideal to heat check females every 12 hours by using a mature boar or sex odor aerosol (boar spray). Depending on the facilities, either allow the boar in the area with the female(s) for direct contact or allow the boar to stand on the outside of the pen and allow each female to smell the boar. Once the female approaches the boar, apply pressure to her back by pushing or gently sitting on her to detect estrus. If she “locks” into position by becoming immobile and pins her ears erectly in a forward position, she is in standing heat. If the female is not in standing heat, she will attempt to escape when pressure is applied to her back. Gilts typically exhibit estrus for an average of 38 hours and sows for 53 hours. It can be very helpful to keep records of estrus cycles on each female to maximize conception rates.

Synchronizing Estrus Cycles in Females

Synchronizing your females can be beneficial for time and financial management during both breeding and farrowing. There are natural and synthetic methods to synchronize sows or gilts.

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Weaned Sows: Wean suckling piglets off sows all on the same day. It is suggested to wean piglets at three to four weeks of age. Sows will typically come into estrus four to seven days after weaning.

Prepubertal Gilts: Mature age for the reproductive tract in swine is around 160 days, but gilts typically don't start cycling until around 200 days. To start estrus in prepubertal gilts (160 to 180 days old), there are several methods.

Transport Method: Transporting gilts from one farm to another or mixing of prepubertal gilts can cause the onset estrus within five to seven days.

Boar Method: Exposing gilts to the sight, scent, sound and physical presence of a mature boar (over 12 months of age) for at least five to 10 minutes daily can cause estrus typically within 10 to 14 days. Most operations will use both the transport and boar methods to increase success of estrus in prepubertal gilts.

Using PG600: This pharmaceutical compound is a combination of two, naturally occurring hormones – equine chorionic gonadotropin (pregnant mare serum gonadotropin) and human chorionic gonadotropin. Gilts can show signs of estrus within five to 10 days after treatment. This method is often used with the boar method for best results. Typically, waiting to breed gilts until the second to third estrus cycle will maximize the number of ovulations and increase litter size.

Sows and Cycling Mature Gilts: Once females reach puberty and begin to exhibit normal estrous cycles, boar exposure and PG600 cannot be used to synchronize estrus due to a hormone called progesterone. Therefore, strategies for synchronizing estrus in mature sows and gilts need to create a situation in which the decrease or removal of progesterone occurs at the same time in all animals.

A synthetic product is approved and available on the market by the name of Matrix. Recently, similar products containing altrenogest have been approved and made available for use. Matrix is manufactured by the company Intervet/Merck Animal Health. Matrix can be used at any stage during a female's estrous cycle and is administered orally at 6.8 milliliters (15 milligrams altrenogest) per female daily for 14 days. Treat gilts on an individual animal basis by top-dressing Matrix on a portion of each gilt's daily feed allowance. To produce the desired synchronization of estrus in a group of gilts, treat all of the gilts daily for the same 14-day period. Typically, 85% to 90% of females treated with Matrix show signs of estrus within four to nine days – most often five to seven days after the last dose.

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Inseminating Gilts and Sows

Females should only be bred when in standing heat. Females need to be inseminated before ovulation; however, it is hard to detect exactly when a female will ovulate. Therefore, it is recommended to inseminate females twice during standing heat for higher conception rates and larger litter size. Sows typically stand longer than gilts, but it also can depend on genetic makeup, environmental factors and individual females.

Ovulation occurs at the end of the estrous cycle in both gilts and sows. Suggested guidelines for insemination in gilts is 12 hours after the first detection of estrus. A second insemination should follow 12 hours after the first. Sows should be inseminated 24 hours after the first detection of estrus and a second insemination should occur 12 hours later. If a female stands for three days, a third insemination may be beneficial for optimum timing of ovulation and success in conception.

Supplies Needed

- AI breeding rods
- Non-spermicidal lube
- Semen
- Scissors
- Rag or damp paper towel
- Mature boar or boar spray

There are several types of inexpensive, disposable AI breeding rods to choose from, such as foam-tipped, spiral and deep uterine. Choose which works best for your operation and preference.

Steps to Take

- Bring a boar to the female, place the boar in an adjacent pen and allow nose to nose contact. If a boar is not available, use boar spray and spray on the female's snout. "Acting" as a boar may be needed, such as pushing on her shoulders, sides and back.
- Check to see if the female is in standing heat by applying pressure to the females back. The "locked up" standing heat position will allow for the hormone oxytocin to be released, causing contractions of the uterus to transport semen into the uterus and oviduct.
- Clean the vulva with a rag or damp paper towel to prevent any debris from entering the reproductive tract.
- Lubricate the tip of the breeding rod with non-spermicidal lube or a few drops of the semen.
- Insert the breeding rod in the vulva at a slight upward angle, toward the female's back, to prevent the rod from going into the bladder.
- If using the spiral-style breeding rod, gently turn the rod counterclockwise while inserting it into the vagina and cervix. The tip of the rod will "lock" into the cervix. The rod is typically inserted 8 to 10 inches before reaching the cervix. To test for the locked position, twist the breeding rod counterclockwise and release it. The rod will rotate back clockwise about a quarter of a turn if the rod is locked in the cervix. If you are experiencing difficulty getting the rod to lock, reposition the rod and try again. Be patient.

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- If using a foam-tipped breeding rod, turning the rod counterclockwise is not necessary. Gently insert the foam tip the same way until you feel a "pop." The rod will catch in the folds of the cervix. To test for the locked position, gently pull back on the foam-tipped rod to ensure it is caught in the cervix. Typically, if you hit the bladder, there may be urine backflow, or the female will be uncomfortable and move around. If this happens, be sure to remove the breeding rod and use a new one.
- Once the rod is locked into the cervix, gently mix the semen bottle. Snip the end of the bottle and insert it to the end of the breeding rod. Gently squeeze the bottle of semen to start the flow into the cervix. The female may take in the semen herself due to the contractions of the uterus. Be patient, this process could take up to five minutes. Work with the female and apply gentle pressure to the bottle as needed. A small amount of semen backflow is normal at the vulva; however, if there is a good amount of backflow, stop and reposition the rod and try again.
- Once the bottle is empty, remove the spiral rod by gently pulling it out while turning it clockwise. The foam-tipped rods can just be gently pulled back out.
- Once the rod is removed, continue to apply pressure to the females back with a boar in close proximity or use the odor spray to allow for continued contractions.
- Repeat the procedure and use a new breeding rod for any consecutive inseminations on the female or other females.

After the final breeding, check for standing heat 12 and 24 hours later. If the female is no longer standing after 12 hours, the optimum timing was likely achieved. If she is still standing administer another dose of semen. If the female is still standing after 24 hours and no doses of semen are available, the optimum timing was likely missed. If only a single dose of semen was administered and the female is no longer standing after 12 hours, optimum timing was likely met.

Do not try to administer a second dose of semen if not standing, this could have adverse effects on the breeding. Be sure to heat check on the females' next estrous cycle dates. Recordkeeping is vital for a successful management plan. Keep records on breeding dates, estrous cycles, due dates, boars used, etc.

Proper Semen Handling

Proper handling and storage of semen is crucial to keep the quality of semen and conception rate high. Boar semen can be obtained from a boar stud or a reputable semen seller. There are plenty of operations and price options to choose from. Research each to find what suits your needs. Boar semen is typically collected two times a week to ensure high quality semen. An extender is mixed with the semen to allow the semen to live longer – fresh semen without an extender will only live for about 30 minutes.

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Boar studs will ship cooled semen mixed with an extender in a cooler with gel packs using next day delivery. Keep semen at 60 to 65 F – 63 F is ideal. DO NOT put it in the fridge or freezer – this is too cold and will cause the semen to go into shock. Fluctuations in temperature will cause a shorter lifespan of semen.

Some producers use a wine cooler or place semen containers in the basement. A best practice is to keep a thermometer with the semen to ensure proper temperature. Discuss with the boar stud about what temperature they keep semen or other possible options to store semen until ready to use.

Tips for Keeping Semen Viable

- Gently rotate semen twice a day to suspend the semen and mix it with the extender, do not shake.
- Do not expose semen directly to sunlight.
- Semen with extender is typically viable for up to seven to nine days. Discuss with the boar stud the extender they use and typical lifespan of the semen for each boar.
- Personally check the quality of semen with a microscope.

Summary for breeding-

Artificial insemination (AI) offers several advantages over natural breeding, such as genetic improvement, ability to choose from a wide selection of boars, fewer boars needed, and the financial and time management resources. The keys to a successful AI program are detecting and recording estrous cycles and proper semen handling. Estrous cycles can be synchronized in females and AI allows multiple females to be bred at the same time. The procedure of AI is fairly simple and can easily be learned with some practice.

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