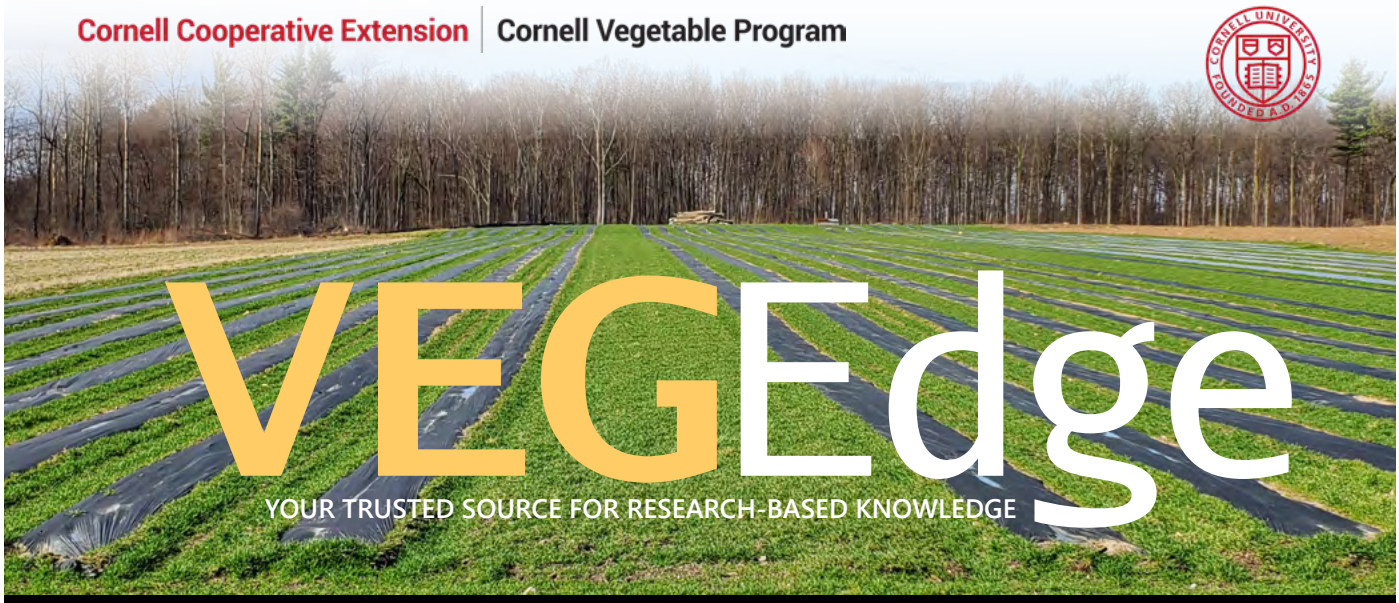
Cornell Cooperative Extension | Cornell Vegetable Program



VEGEdge

YOUR TRUSTED SOURCE FOR RESEARCH-BASED KNOWLEDGE

Volume 18 • Issue 4 • April 4, 2022

The High Cost of Fertilizer and Best Practices for Management

Sandra Menasha, Vegetable/Potato Specialist, Cornell Cooperative Extension – Suffolk County

Growers saw fertilizer prices spike in 2021 but are now seeing them hit even harder in 2022 resulting in sky high prices or an estimated increase around 80% since last year. Supply chain disruptions continue to wreak havoc and a fire at a US fertilizer plant at the end of January are only just some of the factors fueling the dramatic increase. With all that being said, countless studies have proven a strong correlation between nitrogen (N) and crop yield; as nitrogen rates increase so does crop yield. So, how can growers maintain yield goals while balancing the high cost of fertilizer? Growers can achieve profitable application of nitrogen fertilizers through the implementation of best management practices (BMPs). A few BMPs are discussed below in more detail.

Soil Testing

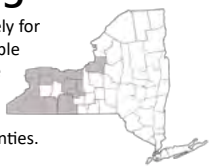
The first BMP has been preached many times and will continue to be preached. Soil test! It is the most important practice growers should be doing and it should be done at least once every three years. A soil test will provide an overview the nutrient status of the soil and current pH allowing for more precise nutrient applications; not applying a nutrient where there is excess and ensuring enough is applied where there are deficiencies. For example, many LI soils are very high in phosphorus (P). This allows for an opportunity to adjust rates when a soil test comes back very high for P. So, instead of applying 100 lbs P/acre (A), the rate can be reduced to 40 lbs P/A, reducing the cost of the fertilizer blend or overall program. Additionally, a soil test will provide the pH of the soil. For most vegetable crops, a soil pH between 6.0-7.0 is desirable. Adjusting soil pH to a recommended value can increase the availability of important nutrients making better use of your fertilizer dollar.

Split Applications of Nitrogen

Another recommended BMP is to consider split applications of nitrogen instead of applying all the N at once. Nitrogen-use efficiency can be improved if N is made available when crop demand is greatest. Early in crop growth when plants and roots are small, demand for N is low, especially under cool, spring conditions. As temperatures warm, crop growth increases and demand for N also increases. Multiple, smaller applications will ensure N is available when the crop needs it most compared to a single application of N at planting where the potential for N leaching and/or denitrification is increased. One approach would be to apply 40% of the total N needs of the crop at plantings and apply a sidedress application of the remaining 60% 3-4 weeks after seeding/transplanting.

continued on page 3

About VegEdge



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The newsletter is a service to our enrollees and is intended for educational purposes, strengthening the relationship between our enrollees, the Cornell Vegetable Program team, and Cornell University.

We're interested in your comments. Contact us at:
CCE Cornell Vegetable Program
480 North Main Street, Canandaigua, NY 14224
Email: cce-cvp@cornell.edu
Web address: cvp.cce.cornell.edu

Contributing Writers
Elizabeth Buck
Robert Hadad
Christy Hoepting
Margie Lund
Julie Kikkert
Judson Reid

Publishing Specialist/Distribution/Sponsors
Angela Ochterski

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Contents

The next issue of VegEdge newsletter will be produced on April 27, 2022.

Recorded 2022 Empire State Producers Expo Sessions Now Available Online

Julie Kikkert, CCE Cornell Vegetable Program

Empire State Producers EXPO

Did you miss all or some of the virtual Expo this year? Or do you want to go back and review some information? Well, you are in luck because a whopping 30 sessions were recorded and put on the public YouTube channel supported by Cornell University, College of Agriculture and Life Sciences. You can watch the videos for free at Empire State Producers Expo 2022 - YouTube.

Sorry, you must have attended the live presentation to receive CCA or DEC recertification credits. We look forward to being back in-person next January in Syracuse, but for now, we hope you enjoy the videos. ●

Upcoming Events

NY Certified Organic (NYCO) On-Farm Meeting

April 12, 2022 (Tuesday) | 10:00am
formerly Pedersen Farms, 11798 County Rd 4, Seneca Castle, NY

Duncan Family Farms (formerly Pedersen Farms) grows both conventional and organic vegetables, and field crops. The meeting will include a tour of the machinery used at Pedersen Farm and the opportunity to view and ask questions pertaining to it. There will also be an after-lunch discussion about adapting to changing climate with Caroline Marschner from Cornell Weed Ecology and Management Laboratory.

Our timing of an April meeting was to safely allow for a fully in-person meeting by holding it mostly outside. We will have tables and chairs set up to allow for lunch. As usual with NYCO, there will be a pot-luck lunch. No need to register just bring your questions and a dish to pass. For more information, contact Luke Gianforte at 315-877-1328.

continued from page 1

Controlled Release Nitrogen Fertilizer

Controlled release nitrogen fertilizer (CRNF) is another BMP growers can use to increase crop nitrogen use efficiency. The basic concept behind CRNF is like the one described above for using split applications where it is more beneficial (economically and agronomically) to make multiple, smaller applications of N compared at applying all the N at once. CRNF technology is designed to match N release with crop N demand which increases overall use efficiency. N is available when the crop needs it most and not as readily available early in the crop growth cycle when demand is low and leaching and/or denitrification potential is high. Multiple studies conducted at the Long Island Horticulture Research and Extension Center over the past 15 years have demonstrated that CRNF is a reliable alternative to conventional soluble N fertilizer as crop yields were either maintained or increased at reduced N rates (a reduction of up to 20% is recommended). When using CRNF it is important to match the release duration of the product with the crop. A 90-day CRNF is more commonly available commercially and has shown, through our trials, to be a good fit for crops like potatoes, sweet corn, tomatoes, and pumpkins (to name just a few) who reach maturity between 70-100 days.

Placement

The last BMP we will discuss involves fertilizer placement. To make the best use of your fertilizer dollar, fertilizer should be placed where it is most accessible to the growing crop. Banded fertilizer applications place the fertilizer in the root zone of the growing crop while broadcast applications may place some fertilizer outside the crop root zone where it can be leached or used by weeds. Overall, banded applications provide higher concentrations and better efficiency of the fertilizer applied than broadcasting. Phosphorus is not very mobile and is primarily supplied to the roots by diffusion and root interception. This fact is important as P is not supplied to the plant roots by mass flow. Mass flow is the movement of nutrients to root surfaces through soil water movement. Because it is not supplied by mass flow and instead primarily supplied by root interception and diffusion, roots need to contact P in the soil for them to take it up. Broadcast applications of P limit the amount of P the roots will encounter by placing it outside the root zone. P applications will be much more efficient and have a higher cost benefit if band applied. When banding fertilizer, remember to place the fertilizer at least 2" the side and 2" below the seed to minimize injury. Additionally, to prevent salt burn when banding fertilizer, avoid using more than 80-100 lbs of N+K2O per acre in the band at planting or move the band so it is 3" away from the seed.

With fertilizer prices estimated to be 80% higher this season than in 2021, no one wants to risk lower crop yields or quality because of nutrient deficiencies. The only option is to increase fertilizer use efficiency and make better use of your fertilizer dollar by implementing one or all the above mentioned BMPs. (*Note: this article only discusses a few BMPs and is not inclusive of all fertilizer BMPs a grower can implement*). Your local Extension Office can help interpret soil test results and make fertilizer recommendations based on those result incorporating many of the above mentioned BMPs. ●

Choose Heat Tolerant Snap Bean Varieties

Emmalea Ernest, University of Delaware Cooperative Extension; reprinted with permission from the Weekly Crop Update, Vol 30, Issue 1, March 4, 2022

[Emmalea gave a very insightful presentation on heat stress in beans at the 2022 Empire State Expo in the Snap Bean Stress Mitigation Session. Watch for free at Empire State Producers Expo 2022 - YouTube. ed. J. Kikkert, CVP]

Snap beans are sensitive to high night temperatures during flowering. Sixty-eight degrees Fahrenheit (68°F) is considered the threshold temperature for damage to anthers and pollen which leads to poor pod set, misshapen pods and reduced marketable yield (Figure 1).

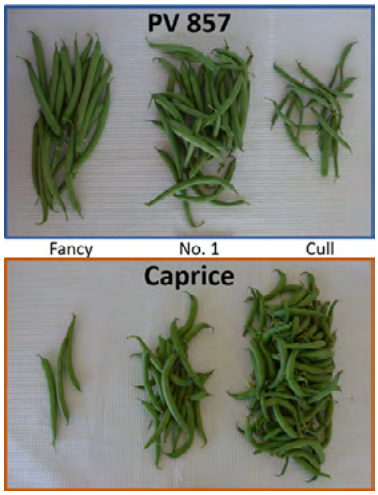

Figure 1. A 300 g sample of quality graded pods from heat tolerant PV 857 vs heat susceptible Caprice. Caprice has a high percentage of pods in the cull category whereas PV 857 produced mostly marketable pods graded Fancy or No. 1.

Plantings of snap beans made in June and early July are likely to be exposed to high night temperatures during flowering. Flowering occurs 30 days after planting, falling between July 2 and August 10, a time period where the average daily minimum temperature exceeds 68°F based on 30 years of data (1991-2020, National Centers for Environmental Information).

From 2017 to 2021, I conducted snap bean variety trials at the Carvel Research and Education Center in Georgetown, Delaware. The purpose of these trials was to identify snap bean varieties that maintain yield and quality when night temperatures are higher than 68°F. The round-podded varieties that produced the highest marketable yields under heat stress in multiple years of trials are 'PV 857' and 'Bridger'. Two additional varieties of interest are 'Jaguar' and 'Byrd'. Jaguar performed well in the 2021 heat stress trial but has only been trialed in Delaware for one year. Byrd has moderate heat tolerance based on 2020 and 2021 trials and was the highest yielding variety in a 2021 trial where many varieties succumbed to pythium root rot. Among the flat podded varieties tested in 2019 and 2021, 'Usambara' performed well under heat stress in both years and produced significantly higher yields than the other trialed varieties. 'Tapia' is another flat podded variety that had good yields in both years' trials.

Full trial reports for the 2017-2021 trials are available on the Vegetable Variety Trials page. ●

Lorsban is Banned: How to Control Cabbage Maggot in Brassicas Now?

Christy Hoepting, Cornell Cooperative Extension, Cornell Vegetable Program, and Brian Nault, Cornell AgriTech

The full version of this article, which contains more details **including trial results** used to make these recommendations, is available on the Cornell Vegetable Program website, **CVP.CCE.CORNELL.EDU, under any of the Brassica crops**.

Cabbage maggot (CM) feeds on brassica seedlings by tunneling into the stem of the plant just below the soil line. Their feeding can result in unsightly and unmarketable produce in the case of root brassicas like turnips, and in stunting, reduced stand, and reduced yield in head and stem brassicas like cabbage and broccoli. **Lorsban and other formulations containing the active ingredient chlorpyrifos were the first line of defense for control of cabbage maggot in several brassica crops.**

Lorsban is Banned in New York and Nationwide

Unfortunately, Lorsban and all of its generic products for food and feed uses were banned in New York as of July 31, 2021, and in the United States as of February 28, 2022. For more information on the US ban, see: https://pestmanagement.rutgers.edu/chlorpyrifos-revocation-of-all-food-tolerances-effective-february-28-2022/

In the absence of Lorsban and other chlorpyrifos-containing insecticides, **NY brassica growers have 6 products belonging to 4 chemical classes available to manage cabbage maggot** (Table 1).

2022 Top Picks to Use Instead of Lorsban for Cabbage Maggot Control in Brassicas

1. ***Mustang Maxx Directed Spray at Plant Base***
   - Trialed once by Cornell in New York on Long Island (Zaman, 2021), Mustang Maxx 4 fl oz/A applied 4 times as a directed spray (DS) at the base of cabbage plants (5 days after transplanting, then weekly for 3 weeks) resulted in **72% reduction in CM-infested plants** compared to the untreated under high pressure (untreated: 57% CM-infested).
   - Mustang Maxx is by far, the most affordable alternative to Lorsban for the level of control it provides (~$1/fl oz x 4 fl oz/app x 4 apps = ~$16/A).
   - Its disadvantage is that multiple foliar applications are required for effective control.
   - Currently, **Mustang Maxx is only labeled for control of cabbage maggot in radish, rutabaga and turnips**, although it is labeled on head and stem brassicas (e.g. cabbage, broccoli, Brussels sprouts, etc.) for management of other insect pests.
   - **Cornell is working with FMC to acquire a Section 2(ee) label expansion for both Mustang Maxx and Hero** (a.i. in Mustang Maxx + bifenthrin) to include use against cabbage maggot in head and stem brassicas. Ideally, both will be available soon for the 2022 growing season.

2. ***Verimark Tray Drench***
   - Overall, **best control of cabbage maggot with Verimark is achieved with 13.5 fl oz/A applied as a tray drench (TD).**
   - Verimark 13.5 fl oz/A TD provided **~56% reduction in CM-infested plants under high pressure** (untreated: 57% CM-infested) (Zaman, 2021). **TD + DS (14 days after planting) resulted in 55% reduction in CM-infested plants under very high pressure** (untreated: 91% CM-infested) (Zaman, 2020). CM control using these Verimark TD treatments were not significantly different than control provided by Lorsban in 2020 and Mustang Maxx in 2021.
   - At ~$105/A, Verimark 13.5 fl oz/A is the most expensive alternative to Lorsban, but the excellent 4-6 week control of flea beetle and worm pests that Verimark provides could help offset its high price.
   - If a follow up DS application is warranted, the cheaper Mustang Maxx could suffice.
   - Verimark is relatively safe for handlers (Table 1).
   - The tray drench application can be tricky, because amount of Verimark and water volume is calculated on a per tray basis, and the plugs must be drenched without the solution running out the bottom of the tray. Also, the rate of Verimark per plug can vary greatly, because it is calculated based on plant population (see full article for details).
   - Tray drench (TD) is the best application method.
     - TD applications of Verimark were better than transplant water (TW) applications, and up to 3-times better than DS applications (see full article for details).
     - Verimark TW applications were more effective than DS applications (see full article for details).
   - In DS applications, the high rate of Verimark 13.5 fl oz/A ($105/A) had numerically 43% fewer CM-infested plants than the low 6.5 fl oz/A rate ($51/A), suggesting that rate does matter (Hoepting & Nault, 2021).

continued on page 5

continued from page 4

Other Products

Radiant SC

- In Cornell trials, **Radiant DS resulted in 22 to 51% reduction in CM-infested plants compared to the untreated** with no rate relationship between 5 – 10 fl oz/A (Zaman, 2020; Hoepting & Nault, 2021).
- Radiant 10 fl oz/A was generally not as good as Lorsban (Zaman, 2020; Hoepting & Nault, 2021).
- Radiant 5-10 fl oz/A DS (~$35-70/A) was similar to Verimark 13.5 fl oz/A DS (Hoepting & Nault, 2021; Joseph & Iudice, 2020).

Coragen

- In an on-farm trial in Oakfield, NY, **Coragen 5 fl oz/A (~$11/A) in transplant water (TW) was not significantly different than the untreated** for CM-infested plants (Hoepting & Nault, 2021).
- In non-Cornell trials, Coragen was generally less effective than Verimark.
- See Table 1 for pros and cons.

Diazinon

- **Diazinon AG500 3 qt/A (~$60) applied in transplant water (TW) resulted in 93% reduction of CM-infested plants** compared to the untreated (Hoepting & Nault, 2021) and was **by far the best treatment with the longest residual activity in any of the Cornell trials.**
- Major disadvantages of this treatment are that it poses significant risk for worker exposure and requires extensive PPE, and it is a Federally-Restricted Use pesticide (Table 1).
- Unfortunately, the safer option of applying **Diazinon AG500 3 qt/A broadcast spray pre-plant incorporated (PPI) to 3-4 inches, was not effective** in Cornell trial (Hoepting & Nault, 2021).
- See Table 1 for other cons.

Head and Stem Brassicas Can Tolerate Some Cabbage Maggot

- Minor cabbage maggot feeding damage does not cause yield reduction or economic losses in head and stem brassicas, unless plants are severely infested to the extent that stand is reduced or stunting reduces marketable yield.
- Some level of injury is acceptable; even if a product is not perfect at controlling CM and kills only 65% of the maggots, 2 or 3 maggots feeding per stem is much less damaging than 6 or 9.
- In the Cornell trials, the severity of the CM root damage was significantly less than the untreated and was generally minor, which would not cause stunting or stand loss (Zaman 2020 & 2021, Hoepting & Nault, 2021). See full report for more details.
- Therefore, **unless cabbage maggot pressure is high, chances are that any of the products listed in Table 1 would provide adequate control of CM in head and stem brassicas**, provided they are applied correctly.

Target Treatment to the Base of the Plant Just Below the Soil Line

- Because cabbage maggots begin feeding on the stem at the soil line and then work their way down, it is important to target the insecticide treatment to this area, especially for products that get tied up in the soil.
- TD applications that soak the root ball are the most effective, followed by TW applications.
- Directed sprays in a narrow band at the base of the plant that use high water volume are more effective than wider bands or DS applications made with lower water volumes, which are all more effective than broadcast sprays.
- Higher rates and multiple applications are more effective than lower rates and single applications.

Protection Against Cabbage Maggot Most Critical from April through June

- **It is recommended to consider applying insecticides for CM protection beginning one week after initial fly emergence and continued until at least a week after peak flight activity, a total period of 2-4 weeks.**
- In New York, flies of the overwintering and first CM generations are active from mid-April to the end of June with peak flights occurring in early-May and mid-June, respectively.
- The next two CM generations are much less favored by hot and dry summer conditions, and larger plants (stem diameter > pencil-sized) are much more tolerant to CM.
- You can track CM emergence in your area:
  - By using NEWA (https://newa.cornell.edu/cabbage-maggot)
  - By paying attention to bloom of yellow rocket and orange day lily, which coincide with peak flight of overwintering and first CM generations, respectively.
- Treatments applied at- or closely following planting can be augmented with additional DS applications of Mustang Maxx, Radiant, Coragen or Verimark to target peak emergence or extend residual control. See full report for more details.

continued on page 6

continued from page 5

Table 1. Roster of Insecticides Labeled in New York for Cabbage Maggot Control in Brassicas, 2022.

Product	Active Ingredient	IRAC[1] Group	Rate	Application Method[2]	Crops Labeled	Relative Control of Cabbage Maggot[3]	Other Insect Pests Controlled[4]	PROS	CONS
Diazinon AG500, 50W, AG600 WBC	diazinon	**1B**	2-3 qt/A, 4-8 fl oz/50 gal TW (AG500)	PPI, TW	broccoli, Brussels sprouts, cabbage, cauliflower /brocco-flower and rutabagas (PPI only).	**TW: Excellent PPI: Poor**	Cutworms, wireworms	Long residual control	High risk for worker exposure – extensive PPE required[5]. Federally-restricted use[6]. TW application can cause significant stunting[7].
Mustang Maxx	zeta-cypermethrin	**3A**	3.2-4 fl oz/A	DS	Radish, rutabaga, turnips[8]	**4 apps – Good**	Worms, thrips, FB	Affordable (~ $16/A for 4 x 4 fl oz) Section 2(ee) label expansion for head & stem brassicas has been requested in NY.	Multiple applications required for effective control (short residual).
Capture LRF, Sniper LFR, Ruckus LFR	bifenthrin	**3A**	3.4-6.8 fl oz/A	IF, PRE, PPI	Head & Stem brassicas only	**Failed** in Cornell trials	Worms, thrips, FB	---	Coverage is critical, a.i. binds tightly to soil and organic matter.
Radiant SC	spinetoram	**5**	5-10 fl oz	DS 100 gpa	Head & Stem brassicas only	**Moderate** (labeled as suppression only)	Worms, thrips	---	---
Coragen	chloran-traniliprolie	**28**	3.5-7.5 fl oz	TW, IF, DS	Head & Stem brassicas only	**Poor-Moderate** (labeled as suppression only)	Worms	Affordable (~ $11/A (5 fl oz)) Minimum PPE requirements.	---
Verimark	cyan-traniliprole	**28**	10-13.5 fl oz/A	TD, TW, IF, DS	ALL	**TD: Good DS: Moderate**	Worms, FB	Excellent control of worms and FB. Minimal PPE required.	Tray drench application tricky. Expensive, but control of other insects could offset price. Plants must be planted within 72 h of treatment. Rate per plant can vary widely depending on planting density.

1 **IRAC**: **Insecticide Resistance Action Committee**. Active ingredients within an IRAC group have the same mode of action and cross-resistance may occur among them. Rotation among IRAC groups for resistance management is recommended.

2 **Application Method: PP**I: surface broadcast spray that is incorporated 3-4 inches pre-plant. **TW**: transplant water treatment. **DS**: directed spray at base of plant in 4-6 inch band, post-planting. **IF**: in-furrow at-planting application. **PRE**: applied with pre-emergent herbicides, broadcast surface application, not incorporated. **TD**: plug transplant tray drench.

3 Relative control ratings are based mostly on Cornell trials conducted by Zaman 2018-2021, and Hoepting & Nault, 2021.

4 **Worm** pests such as diamondback moth, imported cabbage worm, etc. **FB**: flea beetles.

5 PPE required for Diazinon includes a respirator with organic vapor cartridges, chemical resistant footware, chemical resistant gloves made of barrier laminate or viton, and goggles/face shield.

6 In NY, Federally-Restricted Use pesticides require that the applicator, which in the case of transplanting brassicas, would be the operator of the tractor pulling the transplanter, have their pesticide spray license or be supervised on-site within voice contact by a certified pesticide applicator.

7 Diazinon AG500 3 qt/A TW resulted in 46% stunting 25 days after planting in the on-farm trial in Oakfield (Hoepting & Nault, 2021). The label also cautions that TW application may cause stunting. Although the plants eventually grew out of the stunting, it seems backwards to apply a treatment that may cause stunting in order to protect the crop from an insect that can cause stunting.

8 **Mustang Maxx** is labeled on head and stem brassicas for other insect pests including worms, thrips and flea beetles. It is hoped that there will be a Section 2(ee) label expansion to include cabbage maggot on head & stem brassicas for Mustang Maxx and Hero (zeta-cypermethrin + bifenthrin) in time for the 2022 growing season.

Nitrogen Use in Muck-Grown Onions: Cornell Studies Indicate Opportunity to Reduce Rates

Christy Hoepting, Cornell Cooperative Extension, Cornell Vegetable Program

How Much Nitrogen do Muck-Grown Onions Really Need?

Record high prices of nitrogen and other fertilizers have begged the question: How much nitrogen do muck-grown onions really need? What was once “cheap crop insurance” is not so cheap anymore! The Cornell Guidelines recommend 100-120 lb/A of nitrogen applied at planting, and most growers still use these rates. These recommendations were developed in the late 1960s/ early 1970s and things have changed a lot since then: 1) the hybrid varieties that are grown today are much more vigorous, with

continued on page 7

continued from page 6

stronger root systems that mine nitrogen more efficiently; 2) the muck soils are now 50 years older and are not as prolific at releasing nitrogen (as organic matter decomposes) as young muck; and 3) barley nurse crops have been implemented for protection from wind erosion early in the season, and many onion fields are also now cover-cropped in the fall, both of which recycle nitrogen that was previously permanently lost from the system through oxidation and erosion. Since 2017, the CCE Cornell Vegetable Program (CVP) and Brian Nault's team (Cornell Vegetable Entomology) have **conducted 11 on-farm nitrogen fertility trials in muck-grown onions**, in which the results have overwhelmingly showed no significant crop responses to different rates of applied nitrogen. This article examines recent data that further reinforces the opportunity to reduce the rate of nitrogen fertilizer in muck-grown onions.

No Significant Onion Crop Response Between 60 and 150 lb/A of Applied Nitrogen

1. In 2017 and 2018, in two studies conducted by Brian Nault's graduate student Ashley Leach in the Elba muck, there were **no significant differences between 60, 75, 105 and 135 lb/A of total applied nitrogen** (urea), although **all of these treatments yielded significantly ~50% more than zero nitrogen** (data not shown). Note that these trials were conducted in shallower muck with overhead pivot irrigation. These results suggest that **60 lb/A of nitrogen is sufficient**.
2. In 2018, **there were no significant differences in yield among 37, 100, and 150 lb/A of applied nitrogen** (urea) at planting in the two CVP onion variety trials where these rates were tested with 7 and 12 varieties in Elba and Oswego, respectively (Fig. 1). Note that these trials were conducted in deep muck and were not irrigated. Also, poor yields in the Elba trial were due to competition from very heavy weed pressure. These results suggest that **37 lb/A of nitrogen is sufficient**.
3. In 2019, **there were no significant differences in yield among 10, 30 and 60 lb/A in the CVP onion variety trial in Elba**, where these rates were tested with 9 varieties (Fig. 1). It is not known whether a higher rate of nitrogen would have resulted in greater than 448 cwt/A. In the Oswego trial, **60 lb/A of applied nitrogen had significantly higher yield than 10 and 30 lb/A**, which were not significantly different from each other when tested across 11 varieties (Fig. 1). Amazingly, these **low rates of nitrogen yielded 986-1124 cwt/A**, suggesting that maximum yields were achieved. Note that these trials were conducted in deep muck and were not irrigated, and that 2018 was hotter and drier than 2019. These results suggest that **30 lb/A of nitrogen is insufficient**.

Note that **within varieties there were no consistent numerical trends with respect to applied nitrogen and yield in 3 out of 4 trials** (data not shown). In the fourth trial (Elba 2018), the highest yield was associated with the 100 lb/A rate, which was numerically higher than 37 and 150 lb/A rates of applied nitrogen.

4. In 2020 and 2021, in the CVP nitrogen timing trials in Oswego, there were **no significant differences in yield between 60, 90 and 120 lb/A of applied nitrogen** (urea) (Fig. 2). Note that these trials were conducted in deep muck and were not irrigated, and that 2020 was drier than 2021. These results suggest that 60 lb/A of nitrogen is sufficient.
5. In 2019, 2020 and 2021, in Regan and Nault's "fertility mile" project, there were **no significant differences between zero, half and full rates of NPK (not just nitrogen) in any year of study** (Fig. 3). For this project, growers were asked to apply zero, half and their standard full rates of NPK in ≥ 30 ft x 150 ft areas for each rate. Rates of nitrogen in the half NPK treatments ranged from 45-70 lb/A and from 89-140 lb/A in the full NPK treatments. Fields varied from being irrigated and non-irrigated, on shallow and deep muck, and on rotated and nonrotated ground. There were no consistent numerical trends among NPK rates within the 21 individual trial sites (data not shown). Furthermore, our grower cooperators struggled to see differences in bulb size or foliar health as they walked the "fertility mile" through the different rates of NPK. In fact, after the first year of the project, one farm dropped their nitrogen rate from 120 lb/A to 90 lb/A with no regrets. Another farm with newer muck has settled on using 60 lb/A of total applied nitrogen with no perceivable yield reductions.

There were **no significant differences in nitrogen levels in leaf or bulb tissues among rates of applied nitrogen** in any of the variety or nitrogen timing trials, and **no deficiencies were detected** (data not shown).

Oswego & Elba Onion Variety Trials, 2018 & 2019 (*Hoepting et. al.*)

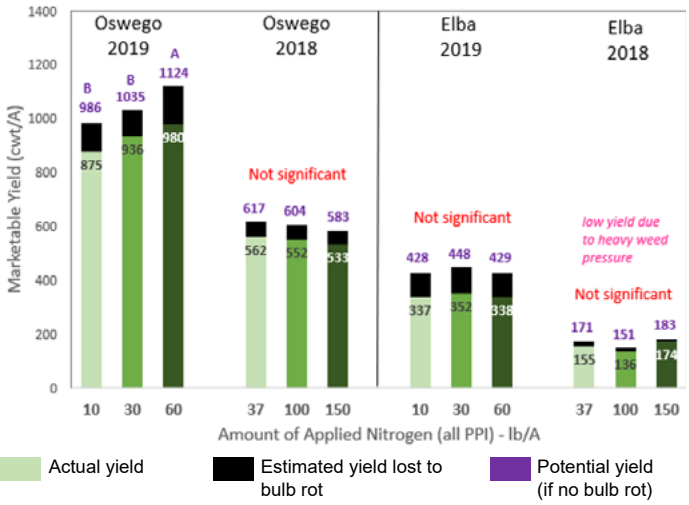

Figure 1. Effect of rate of applied nitrogen at planting on marketable yield in onion variety trials, 2018 & 2019, pooled across 7 (Elba 2018), 8 (Elba 2019), 11 (Oswego 2019) and 12 (Oswego 2019) varieties.

Bars in a trial year followed by the same letter are not significantly different, Fisher's Protected LSD test, $p<0.05$. **Potential marketable yield** is an estimate of what the yield would be if the rotten bulbs were healthy. It is the sum of the actual yield and the yield lost to bulb rot.

continued on page 8

continued from page 7

Oswego Nitrogen Timing Trials, 2020 & 2021 (*Hoepting et. al*).

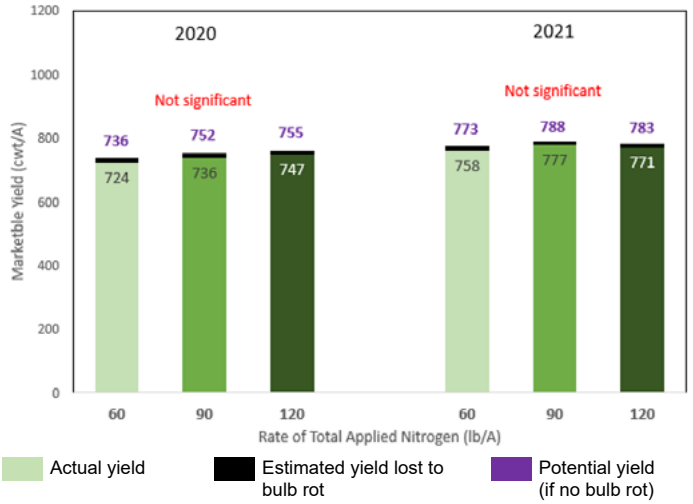

Figure 2. Effect of total rate of applied nitrogen on marketable yield in nitrogen timing trials, 2020 & 2021, pooled across nitrogen timings (all at-planting, 75% at-planting: 25% at side-dress 4-leaf, 75% at-planting: 25% at side-dress 1" bulbing).

Potential marketable yield is an estimate of what the yield would be if the rotten bulbs were healthy. It is the sum of the actual yield and the yield lost to bulb rot.

"Fertility Mile" NPK Onion Thrips Project 2019-2021 (*Regan & Nault*).

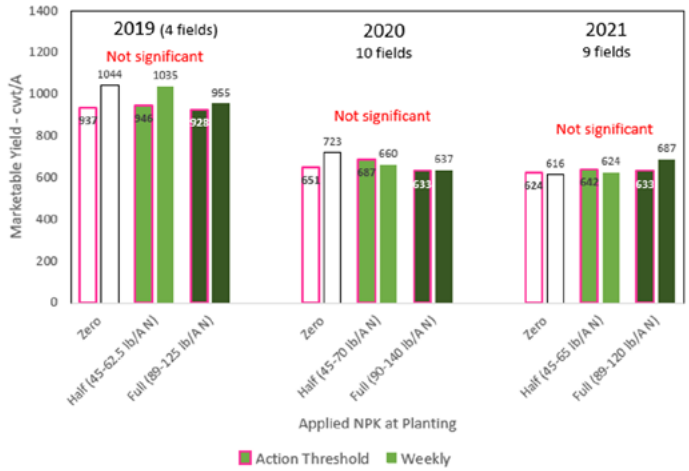

Figure 2. Effect of zero, half and full rate of NPK applied at planting on marketable yield in a large-scale study. Grower cooperators applied half and full rates of their standard NPK rates in ≥ 30 ft x 150 ft area. Within each NPK section, thrips were treated using an action threshold (1 thrips/leaf) and weekly. Results are pooled across 4 (2019), 10 (2020) and 9 fields (2021).

Rate of applied nitrogen did not have a significant effect on onion thrips in any of the 11 trials (= 100% of the time), or on bacterial bulb rot in 10 out of 11 trials (= 91% of the time). In the nitrogen onion thrips trial in 2017 (Leach), bulb rot in 0 lb/A applied nitrogen treatment was significantly lower (~1%) than it was in 60, 75, 105 and 135 lb/A applied nitrogen treatments (5-8.5% bulb rot).

More Important Factors than Nitrogen Affecting Yield

Growing Season

The greatest differences in yield occurred among growing seasons. All trials conducted during the moderate conditions of 2019 had higher yields than trials conducted in the hotter and drier years of 2018 and 2020, and the wetter year of 2021 (Figs. 1-3). Since nitrogen is mobilized with moisture, it is not as readily available during dry soil conditions. Alternatively, too much soil moisture can result in nitrogen leaching, or loss through conversion to nitrous oxide when soil is saturated, and when rainfall/irrigation exceeds plant evapotranspiration (ability of plant to uptake and use soil water), the efficiency of onion plant's ability to use nitrogen in reduced.

Variety

In the variety trials, the greatest differences in yield occurred among varieties, which was significant in all 4 trials. The differences in yield between the lowest and highest yielding varieties were 26%, 41%, 24% and 40% in Elba 2018, Oswego 2018, Elba 2019 and Oswego 2019, respectively (data not shown). Comparatively, the difference between lowest and highest yield in the only trial where significant differences in yield among nitrogen rates occurred (Oswego 2019) was only 12% (Fig. 1). Generally, yield increased as days to maturity increased.

Let Your Muck Give Your Onions the Gift of Free Nitrogen

Onions have the highest demand for nitrogen during bulbing and take up 50% of the crop's total nitrogen needs during that time (the last one-third of the growing season). Most growers apply a majority (if not all) of the fertilizer at planting. We examined the available nitrogen in the soil from early onion growth stages to harvest in 5 of our trials. In the Elba 2019 variety trial and the 2020 Oswego nitrogen timing trial, available nitrate-nitrogen (NO3-N) exceeded the total amount of nitrogen applied at planting in mid-June (4-leaf stage), which suggests that nitrogen was being released from the soil (Table 1). Additionally, NO3-N increased by 10 lb/A or more between 1" bulbing in early August and harvest in the 12 out of the 15 cases (= 80%) across these 5 trials (Table 1). Such results were the opposite of what was expected, which was that NO3-N would be drawn down during bulbing. Therefore, we can conclude that nitrogen was being added to the soil faster than it was being used by the crop, and that nitrogen was certainly not deficient or depleted by the onion crop in these fields.

Additional research results from these 5 trials revealed that NO3-N was found in the soil at harvest at levels ranging from 29-188 lb/A (Table 1). In CVP trials, we calculated that the onion crops used ~ 0.20 lb of N/cwt (e.g. 740 cwt/A x 0.2 lb N/cwt = 148 lb/A N; 450 cwt/A used 90 lb/A N). The fact that there is still plenty of NO3-N in the soil at the time high-yielding crops are harvested indicates that **muck soil can be relied on to provide a lot of the nitrogen needs of our onion crops**. Nitrogen is released when the organic matter in muck soil decomposes (especially in younger muck), and also from the decomposing residue of previous crops (eg. soybeans, cover crops, or barley nurse crops). Our results are consistent with the Cornell Guidelines which state, "on deep well-drained mucks, 50 lb/A may be sufficient for best yields".

continued on page 9

continued from page 8

Table 1. Available lb/A of nitrate-nitrogen (NO_3-N) in the soil at ~4-leaf, 1" bulbing, and at harvest in five Cornell trials in deep muck soil in Oswego and Elba, 2018-2020 (*Hoepting et. al.*).

Trial Year, Location, and Planting Date	Total Applied Nitrogen (lb/A)	Nitrogen Application Timing	~4-leaf		~1" bulbing		Harvest		Change from bulbing to harvest (+, -, =)[1]
			Days After Planting (DAP)	NO_3-N (lb/A)[2]	Days After Planting (DAP)	NO_3-N (lb/A)	Days After Planting (DAP)	NO_3-N (lb/A)	
2018 Oswego Onion Variety Trial[3] Planted May 14	**37**	PPI[4]	31 DAP (Jun 14)	54.0 a	80 DAP (Aug 2)	49.4 c	137 DAP (Sep 28)	112 a	+
	100	PPI	31 DAP (Jun 14)	88.0 b	80 DAP (Aug 2)	91.1 b	137 DAP (Sep 28)	83.5 b	=
	150	PPI	31 DAP (Jun 14)	129 c	80 DAP (Aug 2)	119 a	137 DAP (Sep 28)	112 c	=
		p value (α = 0.05)	---	*0.0019*	---	*0.0024*	---	*0.0000*	---
2018 Elba Onion Variety Trial[3] Planted May 7	**37**	PPI	44 DAP (Jun 20)	55.9	82 DAP (July 28)	56.4	136 DAP (Sep 30)	108 b	+
	100	PPI	44 DAP (Jun 20)	75.4	82 DAP (July 28)	63.9	136 DAP (Sep 30)	129 b	+
	150	PPI	44 DAP (Jun 20)	124	82 DAP (July 28)	74.0	136 DAP (Sep 30)	188 a	+
		p value (α = 0.05)	---	*NS*	---	*NS*	---	*0.0272*	---
2019 Oswego Onion Variety Trial[3] Planted May 22	**10**	PPI	37 DAP (Jun 28)	30.4 a	78 DAP (Aug 8)	19.5 a	131 DAP (Sep 30)	35.3	+
	30	PPI	37 DAP (Jun 28)	30.3 b	78 DAP (Aug 8)	24.0 ab	131 DAP (Sep 30)	28.9	=
	60	PPI	37 DAP (Jun 28)	66.4 b	78 DAP (Aug 8)	30.4 b	131 DAP (Sep 30)	35.3	=
		p value (α = 0.05)	---	*0.0004*	---	*0.0372*	---	*NS*	---
2019 Elba Onion Variety Trial[3] Planted May 18	**10**	PPI	32 DAP (Jun 19)	57.0 a	80 DAP (Aug 6)	29.3 b	136 DAP (Oct 1)	53.6	+
	30	PPI	32 DAP (Jun 19)	70.9 b	80 DAP (Aug 6)	36.4 b	136 DAP (Oct 1)	47.6	+
	60	PPI	32 DAP (Jun 19)	78.8 b	80 DAP (Aug 6)	49.1 a	136 DAP (Oct 1)	53.6	=
		p value (α = 0.05)	---	*0.0024*	---	*0.0073*	---	*NS*	---
2020 Nitrogen Timing Trial, Oswego Planted May 6	**60**	PPI	42 DAP (Jun 17)	133 cd	72 DAP (Jul 16)	46.8	135 DAP (Sep 17)	47.6 c	=
	60	45 PPI: 15 SD std[5]	42 DAP (Jun 17)	147 bcd	72 DAP (Jul 16)	50.4	135 DAP (Sep 17)	48.8 c	=
	60	45 PPI: 15 SD late[5]	42 DAP (Jun 17)	119 d	72 DAP (Jul 16)	42.1	135 DAP (Sep 17)	52.9 c	+
	90	PPI	42 DAP (Jun 17)	192 ab	72 DAP (Jul 16)	60.3	135 DAP (Sep 17)	66.0 bc	=
	90	67.5 PPI: 22.5 SD std	42 DAP (Jun 17)	179 abc	72 DAP (Jul 16)	47.0	135 DAP (Sep 17)	78.8 ab	+
	90	67.5 PPI: 22.5 SD std	42 DAP (Jun 17)	138 cd	72 DAP (Jul 16)	61.1	135 DAP (Sep 17)	69.4 bc	=
	120	PPI	42 DAP (Jun 17)	203 a	72 DAP (Jul 16)	59.4	135 DAP (Sep 17)	77.3 ab	+
	120	90 PPI: 30 SD std	42 DAP (Jun 17)	165 a-d	72 DAP (Jul 16)	66.0	135 DAP (Sep 17)	82.5 ab	+
	120	90 PPI: 30 SD late	42 DAP (Jun 17)	191 ab	72 DAP (Jul 16)	46.9	135 DAP (Sep 17)	95.4 a	+
		p value (α = 0.05)	---	*0.0256*	---	*NS*	---	*0.0047*	---

1 **50% of the nitrogen taken up by an onion crop is taken up during bulbing, the last 33% of the crop's life.** Theoretically, there should be a drawdown of nitrogen in the soil during this period as the onion crop takes up the majority of its nitrogen needs from the soil. An increase of 10 lb/A or more is indicated with a "**+**". Differences of less than 10 lb/A are indicated with a "**=**". There were no decreases "**-**" greater than 10 lb/A.

2 Numbers in a column followed by the same letter are not significantly different; **NS**: Not significantly different, Fisher's Protected LSD test, p<0.05.

3 Composite soil samples were taken across 7 (Elba 2018), 8 (Elba 2019), 11 (Oswego 2019) and 12 (Oswego 2018) varieties.

4 PPI: pre-plant incorporated at planting.

5 Total applied was nitrogen was split between 75% at PPI and 25% at standard side-dressing timing (**SD std**: ~ 4-leaf) or late side-dress timing (**SD late**: 1" bulbs).

Available nitrate-nitrogen exceeds the amount of total nitrogen that was applied at planting.

Results of 11 field trials overwhelming indicate that onions can be grown on good muck using 60-90 lb/A of applied nitrogen without yield loss. Onions grown in shallow muck soil may respond differently.

Applying All Nitrogen at Planting is Better than Split with Side-Dressing

In the two CVP nitrogen timing trials, we consistently saw a numerical trend (not significant) that yields were higher by 2-7% when all of the nitrogen was applied at planting rather than applying 75% at planting followed by 25% side-dressed at the 4-leaf stage. In the 2021 nitrogen timing trial, yield was significantly 3% higher when all of the nitrogen was applied at planting compared to 50% at planting followed by 50% side-dressed at 4-leaf stage. These results are consistent with the Cornell Guidelines which state, "muck onions have not responded to nitrogen side-dressings except in rainy seasons". Side-dressed nitrogen needs to be rained, irrigated or cultivated into the soil in order to work or else it will be lost through volatilization. So, unless you have the ability to irrigate or cultivate side-dressed nitrogen, you cannot reliably get it to the crop.

Since **phosphorous is important for early root growth**, it is a good idea to **use a starter fertilizer with emphasis on P such as 6-24-6 NPK** to stimulate root growth so that young onions can better mine the nitrogen from the soil.

Funding for These Numerous Trials was Provided by

- New York Onion Research and Development Program
- Seminis Vegetable Seeds
- USDA SCRI Stop the Rot bacterial bulb rot project (2019-511811-30013)
- USDA SCRI Onion Thrips project (#2018-51181-28435)

Thank You to Our Numerous Grower Cooperators for Hosting On-farm Trials

- Big O Farms, G. Mortellaro & Sons, Triple G Farms in Elba
- DiSalvo Farms in Oswego
- Johnson Potato Farm, Abe Datthyn in Wayne Co.

Chile Pepper Mild Mottle Virus: A Risk to Vegetable Crops Lurks Within the Greenhouse

Judson Reid, Cornell Cooperative Extension, Cornell Vegetable Program

Chile Pepper Mild Mottle Virus (CPMMoV) has been confirmed with widespread distribution in ornamental greenhouses this spring. Although calibrachoa (an ornamental in the petunia family) is the most commonly infected crop species, vegetable transplants are at risk for infection.

CPMMoV symptoms can be subtle. Foliage may show light green/dark green mottling patterns. Flowers may be small, faded or have color breaks. Most noticeably, infected plants have stunted growth. CPMMoV is in the TOBAMO family of viruses which includes Tobacco Mosaic Virus (TMV). Thus infected tissue may produce positive results in lab tests for TMV. TOBAMO viruses are manually transmitted, with pruning/pinching an effective distribution method. TOBAMO viruses can also be seedborne. In manual transmission, the virus enters the plant through either natural micro wounds in the tissue, or through intentional pruning. Once within the plant, the virus can't be removed. These viruses commonly affect vegetable crops, with pepper transplants at high risk. Infected vegetable crops may have stunted, distorted foliage and unmarketable fruit.

The symptoms of CPMMoV are subtle, but note the mottling on the calibrachoa leaves compared to the apparently healthy petunia. *Photo by J. Reid, CCE Cornell Vegetable Program*

The combination of peppers and ornamentals is high risk this spring with a new cross-species virus present. *Photo by J. Reid, CCE Cornell Vegetable Program*

Recommendations

The following recommendations come from plant material suppliers:

- Handle calibrachoa last when working with multiple species.
- Wear disposable gloves when handling calibrachoa and change regularly.
- Sanitize pruning equipment with an approved sterilant such as Greenshield or Virkon S.
- Dispose of affected plant materials.

This family of viruses is known to be very stable outside plant hosts, meaning surfaces such as doorknobs, carts, benches, etc. can harbor virus over the longterm. They are much more long-lasting than Covid-19!

Some sources will recommend the spatial separation of ornamentals from vegetable crops, which in theory would decrease risk. However, many greenhouses grow both vegetable transplants and ornamentals together in limited space, and nearly all retail greenhouses (the destination of nearly all wholesale product) offer both ornamentals and vegetable transplants together to their customers, so this is not practical.

We will be particularly interested in observing any spread to vegetable crops. Some sources indicate that peppers are the only susceptible species, whereas others indicate other nightshades including tomatoes are at risk. We do know that TMV has a wide host range. Please contact Judson or Elizabeth if you have concerns or questions.

Sources

- e-Gro update 3/31/22 Nora Catlin and Margery Daughtrey
- UMass Greenhouse Crops and Floriculture update
- NYSIPM, Betsy Lamb
- University of Florida, IFAS Extension
- Industry sources ●

Spotted Wing Drosophila Exclusion Netting for Blueberries: An Investment Alternative to Spraying Equipment

Anya Osatuke, Cornell Cooperative Extension, Harvest NY

The spotted wing drosophila, *Drosophila suzukii*, has been attacking berry crops in New York since 2011. This fruit fly is able to lay eggs in unripe berries such as blueberries, raspberries, blackberries, and strawberries, as well as soft fruits such as tart cherries and nectarines. Other species of fruit fly can only lay eggs in over-ripe or damaged berries because they have a smaller egg-laying organ. The eggs of fruit flies develop into small maggots inside of the berry. In this way, spotted wing drosophila damage can cause major profit losses for berry growers.

continued on page 11

continued from page 10

Populations of spotted wing drosophila increase over the summer. Early-ripening berries, such as 'Duke' blueberries, have not been damaged by this insect, whereas unprotected late-ripening berries, such as 'Elliot' blueberries, are almost certain to have larvae.

Because of spotted wing drosophila, many New York blueberry growers have had to start spraying to keep their late varieties marketable. Because the risk of developing resistance is high, growers are required to rotate sprays regularly. The development of a fine-mesh netting offers growers an alternative way to preserve marketable yields.

Spotted Wing Drosphila Exclusion Netting

Spotted wing drosophila exclusion netting has a very fine mesh, so the small fruit flies are not able to pass through it. The netting is draped over a rectangular support structure that covers the entire planting, which walls in the blueberry bushes. The nets are rolled down after pollination is finished, kept down the entire harvest season, and rolled up in the autumn to protect the mesh from snow and winds.

We trialed the spotted wing drosophila exclusion netting in summer of 2021 and found excellent control of spotted wing drosophila under netting. A total of 3 larvae were found in the netted planting between June 23 and August 24. In comparison, a neighboring patch of unprotected blueberries had 203 larvae detected in the berries. Most of the larvae were detected after August 10—mid-August is typically the time of year when spotted wing drosophila populations explode.

The mesh of the netting is fine enough to buffer rainfall and heavy winds, and birds cannot enter the planting. This additional protection prevents blueberries from falling off the bushes, and further extends the harvest season. In 2021, there were harvestable blueberries under netting as late as September 15, while the unprotected blueberry bushes did not produce a harvest after August 30.

Spotted wing drosophila exclusion netting can serve as a profitable alternative to spraying. This is a great option for commercial farms that have a crew of pickers because the netting must be handled with care to avoid tears. The netting is estimated to last 10 years if rolled up for the wintertime.

Outside view of spotted wing drosophila exclusion netting covering a half-acre planting of blueberries. *Photo by Anya Osatuke, Harvest NY*

Resources and Further Reading

Spotted Wing Drosophila IPM Blog: Managed by Dr. Juliet Carroll and Janet Elizabeth van Zoren, Cornell University Cooperative Extension, https://blogs.cornell.edu/SWD1/

Using Exclusion Netting to Manage Spotted Wing Drosophila (SWD) in Blueberries by Dale-Ila Riggs, owner of The Berry Patch and Berry Protection Solutions, Stephentown, NY

Frames to Support Exclusion Netting over Blueberries to Prevent Spotted Wing Drosophila Damage by Hannah Lee Link, University of Vermont

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Contact Us

VEGETABLE SPECIALISTS

Elizabeth Buck | 585-406-3419 cell | emb273@cornell.edu
fresh market vegetables, weed management, soil health

Robert Hadad | 585-739-4065 cell | rgh26@cornell.edu
farm food safety, organic, business & marketing, fresh market vegetables

Christy Hoepting | 585-721-6953 cell | cah59@cornell.edu
onions, cabbage, broccoli, garlic, pesticide management

Julie Kikkert, Team Leader | 585-313-8160 cell | jrk2@cornell.edu
processing crops (table beets, carrots, peas, snap beans, sweet corn)

Margie Lund | 607-377-9109 cell | mel296@cornell.edu
potatoes, dry beans, and post-harvest handling and storage

Judson Reid | 585-313-8912 cell | jer11@cornell.edu
greenhouses/high tunnels, small farming operations, fresh market vegs

PROGRAM ASSISTANTS

Sarah Caldwell | sv483@cornell.edu

Angela Ochterski | aep63@cornell.edu

Emma van der Heide | ev247@cornell.edu

ADMINISTRATION

Peter Landre | ptl2@cornell.edu

Steve Reiners | sr43@cornell.edu

Cornell Cooperative Extension
Cornell Vegetable Program

For more information about our program, email cce-cvp@cornell.edu or visit CVP.CCE.CORNELL.EDU

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