NCDA&CS
Plant Industry Division
Annual Report
2024

Steve Troxler

Commissioner of Agriculture

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NORTH CAROLINA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

Mission Statement

The mission of the North Carolina Department of Agriculture and Consumer Services is to provide services that promote and improve agriculture, agribusiness, and forests; protect consumers and businesses; and conserve farmland and natural resources for the prosperity of all North Carolinians.

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Plant Industry Division

Plant Industry Division Web Site: http://www.ncagr.gov/plantindustry/

Facilities

Plant Industry Division-Administrative Offices and NC Seed Laboratory

Physical Address: 216 West Jones Street, Raleigh, NC 27603

Support Operations

Physical Address: 1013 Blair Drive, Raleigh, NC 27603

Biological Control Services

Physical Address: 350 East Chatham Street, Cary, NC 27511

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Apiary Inspection Program

Prepared by D. Hopkins & G. Hackney

The Apiary Inspection Team is currently fully staffed, with six inspectors stationed throughout the state and one laboratory technician. The apiary staff continues to maintain outreach booths at both the Mountain State Fair in Fletcher and the NC State Fair in Raleigh, as well as participating in other outreach events throughout the year.

To protect the health of our honeybee industry, the Plant Industry Division requires permits for anyone wishing to sell queens, package bees, nucleus colonies (nucs), or hives. In 2024, the apiary team issued 176 permits. To obtain a permit, bees must be inspected, and the producers are required to comply with standards designed to maintain healthy colonies. Apiary Inspectors strongly encourage beekeepers to buy only from permitted dealers to avoid buying unhealthy or Africanized honeybees. The list of currently permitted beekeepers is found here: https://www.ncagr.gov/plant-industry/plant-industry-permit-sell-list/download?attachment

One of the most devastating and difficult to control bee diseases is American foulbrood (AFB). In 2024, NCDA&CS Apiary Inspectors inspected over 5,000 colonies, of which only two were found to be positive for American foulbrood.

The mite *Varroa destructor* persists as a major threat to the beekeeping industry and is probably a contributing factor to general poor health and mortality of bee colonies. Several new miticides have been registered; however, the mites have developed resistance to some of these materials which can reduce the efficiency of these products over time. Currently, the list of registered products for Varroa control in North Carolina includes Apistan®, CheckMite+®, Api-Life Var®, Apiguard®, Mite-Away Quick Strips®, Formic Pro®, Apivar®, Api-Bioxal®, and HopGuard®. All the aforementioned products are listed in North Carolina as Section 3 general use pesticides. Although chemical treatment of mites may be necessary, some miticides have been demonstrated to have adverse effects on bees. The growing use of unregistered materials may have negative impacts on honeybee health and may not be efficacious in controlling mites. This and, in some cases, the improper use of antibiotics to control diseases can further complicate useful treatment regimes.

Beekeepers are expressing concern about pesticides, particularly neonicotinoids, but the evidence of pesticide misuse has not been commensurate with the concern. Bee yards can be registered through the Plant Industry Division, for notification of intended aerial application of pesticides, so that the beekeepers can take steps to protect their colonies. The NCDA&CS Apiary Laboratory technician sends the list of registered apiaries to aerial applicators licensed in North Carolina. Additionally, the North Carolina Apiary Inspectors have developed a good working relationship with the Structural Pest Control and Pesticides Division (SPCP). The SPCP responds to reports of acute bee losses and follows up according to the evidence. If a pesticide problem is suspected, timely reporting to an Apiary Inspector or the Pesticide Section is crucial for a meaningful investigation and successful resolution. The SPCP and Plant Industry Divisions are working with EPA to develop a Managed Pollinator Protection Plan.

A continuing threat facing the beekeeping industry of North Carolina is the Africanized honeybee (AHB) (*Apis mellifera scutellata*), which is established in southern Florida and has been found at least once in Georgia. NCDA&CS Apiary Inspectors maintain swarm traps at the ports of Wilmington and Morehead City, to intercept any bees coming in via ship. The apiary team continues to engage in an outreach program to NC emergency response personnel to familiarize them with the potential threat of AHB. Apiary inspectors continue to collect samples of bees (particularly those from colonies with overly defensive behavior) to determine their geographic

origin and their propensity for this behavior. The NCDA&CS and NCSU are collaborating in conducting this survey. At this time, none of the samples collected have been determined to be AHB. Apiary inspectors encourage beekeepers and the public to notify our staff when any colonies seem to be displaying any unusual behavior, especially excessive defensiveness. NCDA&CS – Plant Industry Division strives to maintain a beekeeping industry in North Carolina that is not threatened by this more defensive type of bee.

The yellow-legged hornet (*Vespa velutina*) is a new apiary threat to the southeast. Yellow-legged hornet was first discovered in Georgia, in August of 2023 and has now been found in South Carolina. The NCDA&CS apiary team along with Matt Bertone, NC State University Plant Disease and Insect Clinic, developed educational identification cards for distribution that compare regulated hornet species with native or widely established look-alikes (Fig. 1.1). Both the yellow legged hornet and the northern giant hornet (*Vespa mandarinia*) were highlighted at presentations given to bee associations during winter 2024-2025. Beekeepers and the public have been asked to notify apiary staff of any suspected sightings of these regulated insects.

Honeybee viruses remain a growing concern among beekeepers. The Apiary Inspection Program does not have the capacity to provide a diagnostics service for viruses; however, we continue to foster a good working relationship with our partners at the NC State University Apiculture Research and Extension Program. Apiary staff have had the opportunity to assist NC State University with some of their projects and would like to express our gratitude for their assistance in much of our work.

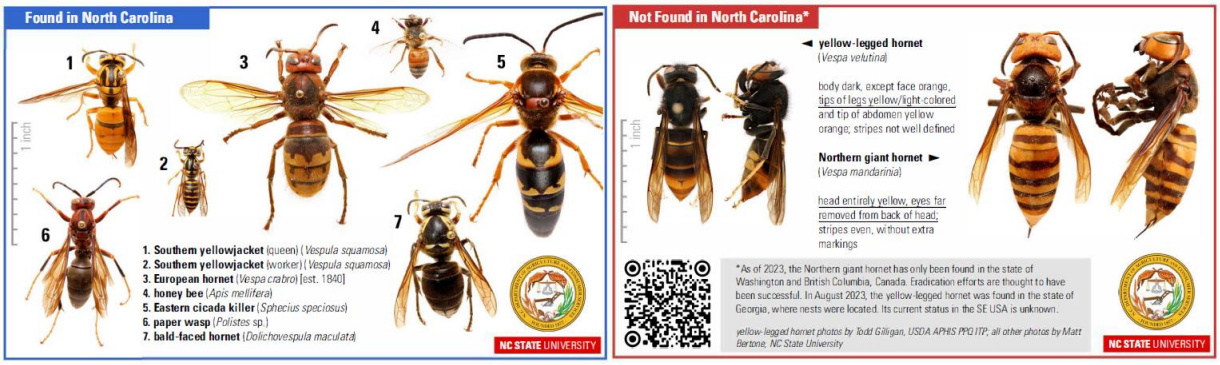

Figure 1.1, *Front and back of educational identification cards.*

Biological Control Program

Prepared by Martha Flanagan, Nancy Oderkirk, and Greg Wiggins

Program Overview

The NCDACS Biological Control Program operates the Beneficial Insects Laboratory (BIL) and implements and maintains biological control projects that benefit the residents and environment of North Carolina. Biological control is the use of natural enemies to help regulate pest populations. The NCDACS Biological Control Program focuses on the implementation of classical biological control against invasive pest species, where the natural enemies and invasive pests are from the same region of origin (i.e., they have a coadapted ecological association) and their life cycles are synchronous with one another. Currently, we have projects that focus on managing the invasive insect species hemlock woolly adelgid and spotted wing drosophila, as well as invasive knotweeds. We are also conducting a project supporting U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) biological control efforts for spotted lanternfly.

The staff of the BIL have made significant contributions to advancing the Biological Control Program during 2024. Dr. Nancy Oderkirk, Research Specialist, leads the knotweed biological control project, as well as serving as Quarantine Officer. Martha Flanagan, Research Specialist, leads the spotted wing drosophila biological control project and assists in management of the Quarantine Facility. Both Specialists also have provided valuable input to the hemlock woolly adelgid, spotted lanternfly, and other projects and activities. Jackie Fredieu, Entomology Program Specialist, provided vital assistance with the hemlock woolly adelgid project. The BIL employed five Temporary Research Assistants during 2024. Charles Dial, Landon Lemmens, Chandler Purser, Abbey Stewart, and Abby Vickery contributed to the work being conducted on all projects and activities at the BIL.

Greg Wiggins
Program Administrator

Biological Control of Hemlock Woolly Adelgid

Biological control programs focused on hemlock woolly adelgid, *Adelges tsugae* (Hemiptera: Adelgidae) (HWA) to this point have resulted in the mass rearing and release of natural enemies of HWA in the genus

Figure 2.1A, *Predators of hemlock woolly adelgid: A) Laricobius osakensis, B) Sasajiscymnus tsugae, C) Leucotaraxis sp.*

Laricobius (Coleoptera: Derodontidae) (Fig. 2.1A) and *Sasajiscymnus tsugae* (Coleoptera: Coccinellidae) (Fig. 2.1B). Predatory flies in the genus *Leucotaraxis* (Diptera: Chamaemyiidae) (Fig. 2.1C) are another natural enemy that currently is being assessed as an additional predator of HWA.

A program was initiated with the overall goal to enhance current biological control measures targeting HWA in North Carolina several ways. First, we are assessing the effectiveness of egg releases as a viable method to establish *Laricobius* spp. in the field. Related to this, we are working to enhance access to predators of HWA for State and other cooperators by expanding field insectaries of *Laricobius* predators. We are also utilizing whole-tree cages to determine the ability of the predatory *Leucotaraxis* silver flies to establish on hemlock species infested with HWA in the southern Appalachians. Finally, we have conducted surveys to help determine the long-term establishment of *S. tsugae* at historical release sites. Details of each of these projects are presented below.

Investigating Novel Methods to Release Laricobius spp. on Eastern Hemlock

For this study, *L. osakensis* is the primary beetle species on which efforts are focused (Fig. 2.1A). This *Laricobius* species is from the same region of origin in Japan as the HWA that infests hemlock in the eastern U.S., and *L. osakensis* has been released in the U.S. for several years. To obtain eggs for the egg release study, in the fall/early winter adult *L. osakensis* raised in the BIL were collected from rearing containers for use in the study. To supplement beetle numbers for lab rearing and for use in the egg release study, adult *L. osakensis* were collected from locations where they have established in North Carolina through consultation with staff of USDA Forest Service, NCDACS Forest Service, and the Hemlock Restoration Initiative. At the BIL, beetles were placed in 1-gallon containers (about 20 per container) on hemlock and monitored for egg production. As eggs of *L. osakensis* were produced, they were counted and sorted to take to the field.

Prior to egg releases at a site, HWA densities on nine study trees at each site were determined. Eggs of *L. osakensis* were placed on study trees in February and March (when HWA are producing eggs) (Fig. 2.2A). After all study trees received the assigned egg densities, no other activity was conducted at the site until the following September. This period of inactivity allowed the beetles to develop and aestivate with minimal disruption.

Figure 2.2, *A) Hemlock branch with L. osakensis egg-laden twigs attached, B) soil emergence cages under egg release canopies.*

To initiate the collection phase of this study, the September following egg placement on trees, soil emergence traps were deployed underneath the canopies of study trees at the study sites. Larvae of *Laricobius* species drop to the soil and spend the summer months completing development in the soil underneath hemlock canopies; adults emerge from soil and move into hemlock canopies in the fall. Under each of the study trees, three soil emergence traps were placed under branches where eggs of *L. osakensis* had been deployed the previous February and March (Fig. 2.2B). One bouquet of hemlock twigs was placed in each of the cages. Cages then were monitored weekly through the following February. Beetle specimens collected in emergence cages and beat-sheet samples were sent to Dr. Nathan Havill, USDA Forest Service, for identification by molecular analysis.

Previous releases at sites in McDowell and Cherokee Counties have shown mixed results. *L. osakensis* were able to establish in McDowell County. However, due to a combination of severe drought and record low winter temperatures, HWA populations crashed and *L. osakensis* did not survive at the Cherokee County site. Egg releases are planned for a third location in Wilkes County, and releases are projected to take place in February-March 2025.

Enhancing Access to Predators of Hemlock Woolly Adelgid

To maintain strong predator populations in North Carolina, the BIL has initiated both laboratory- and field-based efforts to enhance access to *Laricobius* species. We are currently maintaining a colony of *L. osakensis* in the laboratory to supply beetles for studies and limited release. In Spring 2024, over 2,000 *Laricobius* larvae were produced in the BIL, partially from beetles kept in colony and partially from adults collected in the field in Fall 2023. These larvae were maintained in growth chambers over the summer months as they completed their development and aestivated until Fall (Fig. 2.3A). Adult beetles began emerging from soil cups on October 7, 2024, and over 500 adult beetles emerged. These beetles were used to produce eggs for the egg-release study, as well as to maintain the colony.

Figure 2.3, *A) Soil cups containing developing L. osakensis, B) hemlock insectary area, Rendezvous Mountain Game Lands.*

To further enhance access to *Laricobius* beetles, a field insectary was initiated in Winter 2023. North Carolina Forest Service staff identified areas in Rendezvous Mountain Game Land (Wilkes County) where eastern hemlock could be planted in a natural setting and eventually be used to grow and collect *Laricobius* beetles. In December 2023, BIL staff assisted North Carolina Forest Service staff and B.R.I.D.G.E. (Building, Rehabilitating, Instructing, Developing, Growing, Employing) Program crews in planting over 150 eastern hemlock seedlings in two existing canopy gaps (Fig. 2.3B). In Spring and Fall 2024, several naturally grown

trees were monitored for HWA population levels and marked for egg releases of *L. osakensis*. Egg releases at this site are scheduled to occur in February and March 2025. The establishment of *L. osakensis* at this site will provide resource managers with an additional source of predators of HWA to release in new areas and supplement existing populations.

Novel Methods to Establish Silver Flies (Leucotaraxis spp.) in the Southern Appalachians

Although *Leucotaraxis* spp. have been released in several locations throughout the eastern U.S., recoveries have been sporadic. To help limit dispersal, the use of whole-tree cages (Fig. 2.4A) was investigated as a method to contain these flies on trees while allowing free range of movement within the tree canopy.

Figure 2.4, *Whole-tree cage study: A) caged and uncaged trees, B) releasing predators within cages, C) Leucotaraxis larva on hemlock foliage from study tree.*

A hemlock nursery in Bent Creek Experimental Forest, Buncombe County, NC was selected as the site for this study. Twelve trees were then selected to cage as study trees based on HWA infestation, and releases of only *L. osakensis*, only *Leucotaraxis*, and both *L. osakensis* and *Leucotaraxis* were conducted within the cages in early Spring 2023 (Fig. 2.4B). A two-week post-release assessment visually examining hemlock foliage under the microscope found both *Leucotaraxis* (Fig. 2.4C) and *L. osakensis* present. In coordination with cooperators at Cornell University, sampling for predator DNA residues in the environment (eDNA) also was incorporated into this study, but to date no *Leucotaraxis* has been detected using this method. Additional releases of *Leucotaraxis* at greater numbers in cages are planned for Spring 2025, and both visual and eDNA sampling will be used as monitoring techniques.

Evaluating the establishment of S. tsugae at historical release sites in North Carolina

In 2002, the BIL began rearing and releasing the lady beetle *Sasajiscymnus tsugae* (Coleoptera: Coccinellidae) (Fig. 2.1B), a predator of HWA. At the conclusion of this rearing and release program in 2016, over 640,000 *S. tsugae* beetles had been reared by the BIL. However, despite *S. tsugae* having been released in over 170 locations in North Carolina, little was known of their establishment and persistence at release sites.

To assess the establishment of *S. tsugae* at historical release sites, a survey effort focusing on recovery of *S. tsugae* was initiated in 2022. Release locations of *S. tsugae* were obtained from the Hemlock Woolly Adelgid Predator Database maintained by Virginia Tech, and 172 release sites *S. tsugae* were recorded in North Carolina. Surveys were conducted at a total of 99 *S. tsugae* release sites from April through July in 2022, 2023,

and 2024. (Fig. 2.5). At each site beat-sheet sampling was conducted on hemlock infested with HWA with a uniform sampling time of 1-2 hours. Beetles were visually identified as *S. tsugae*.

Adult *S. tsugae* were found in five sites surveyed in 2022, six sites in 2023, and one site in 2024 (Fig. 2.5). At the locations where beetles were collected, releases of *S. tsugae* had last been made between 2004 and 2009,

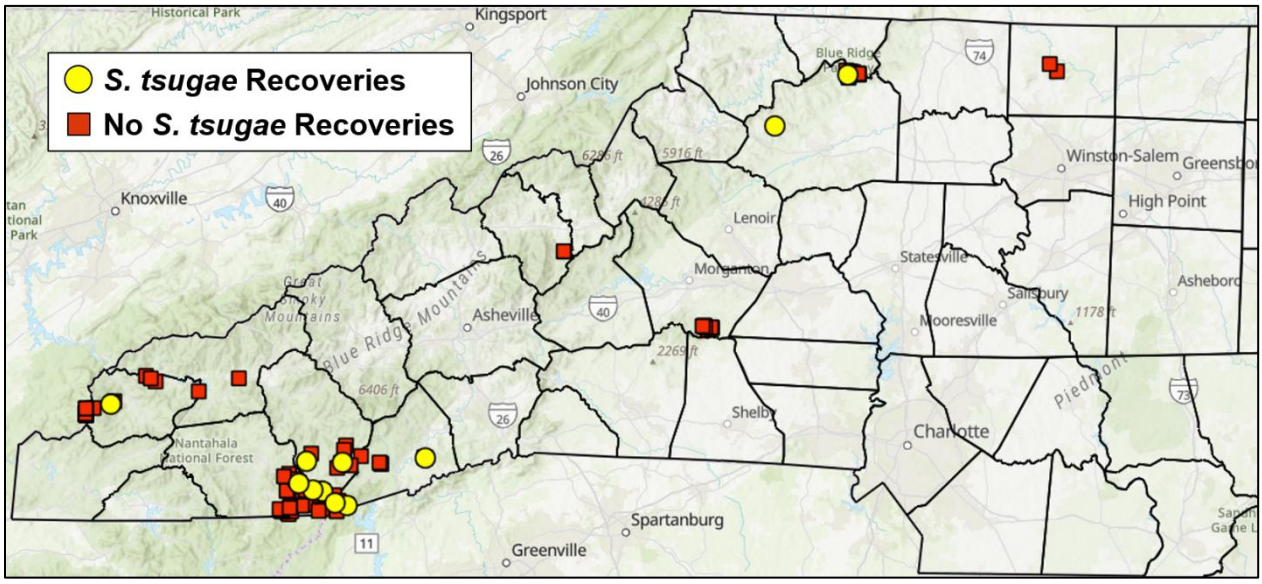

Figure 2.5, *Historic S. tsugae release sites surveyed, and sites where S. tsugae were recovered, 2022-2024.*

so, these populations have been established in these areas for over a decade. Additionally, an adult *S. tsugae* was collected in beat-sheet sampling at the Rendezvous Mountain Game Land insectary site, meaning it had migrated there from release sites over 15 miles away. These findings are significant, as *S. tsugae* feeds on the eggs and immatures of the HWA progredient generation, on which *Laricobius* species do not often feed. Future work could include assessing tree health, HWA populations, climatic conditions, and other attributes at recovery sites to identify factors that may contribute to the long-term establishment of *S. tsugae*.

Greg Wiggins

Biological Control Initiative for Spotted Wing Drosophila in North Carolina

The invasive spotted wing drosophila *Drosophila suzukii* (Diptera: Drosophilidae), a small vinegar fly with the potential to damage many fruit crops, especially thin-skinned fruit, is native to eastern Asia. Most species of vinegar flies attack overripe or damaged fruit, lessening the impact on growers/sellers. However, spotted wing drosophila (SWD) is unique as the female can lay eggs in healthy fruit using a large, serrated ovipositor with two rows of teeth (Fig. 2.6A). Once the eggs hatch and the larvae (maggots) move around inside eating, the fruit becomes soft and unmarketable. Detection of a single SWD larva in the fruit can cause the rejection of an entire shipment, leading to high financial risk for farmers of impacted crops.

While known to be in Hawaii since the 1980s, SWD was first detected in the continental United States when an infestation was reported in California in 2008. Found in NC in the late summer of 2010, SWD has spread throughout most of the US since that time.

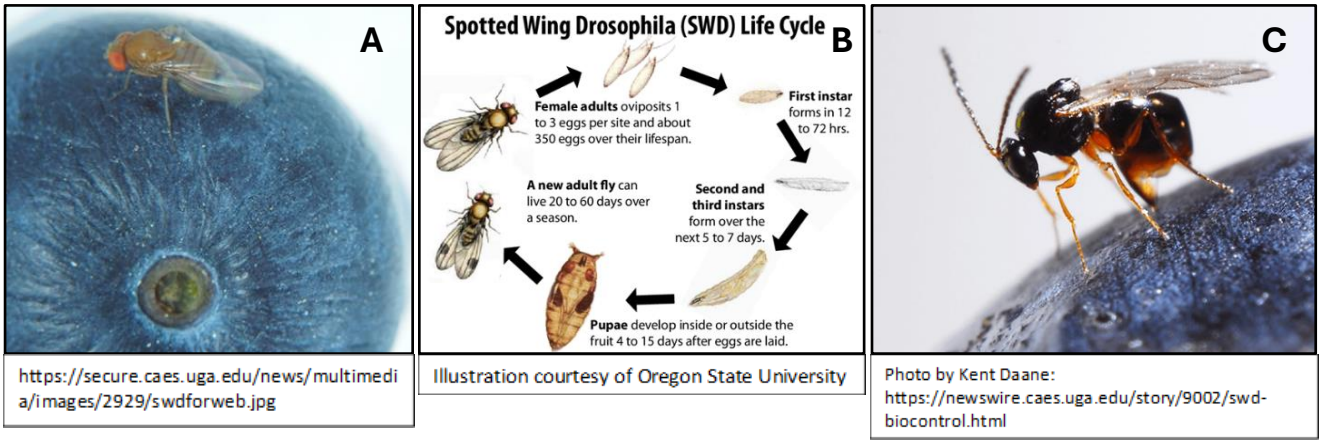

Figure 2.6, *A) Drosophila suzukii laying an egg in a blueberry, B) D. suzukii life cycle, C) Ganaspis kimorum parasitizing an SWD larva.*

SWD control presents multiple challenges. SWD is polyphagous, meaning it feeds on many different hosts, all soft-skinned fruits. These include blackberries, blueberries, raspberries, strawberries, cherries, and grapes among others. Chemical control (insecticides) can be ineffective, only targeting adults, as the chemicals won't reach the eggs and larvae already inside the fruit. Depending on temperature, SWD can complete all four life stages in under 14 days (Fig. 2.6B) and an adult female can lay over 300 eggs in her lifetime. As is often the case with invasive species, part of their success is due to the lack of natural enemies. Because of the ability of SWD to encapsulate and kill the eggs of native parasitoid wasps, research has focused on identifying non-native parasitoids successful in controlling this species.

In 2021 *Ganaspis kimorum* (Hymenoptera: Figitidae) (Fig. 2.6C), an Asian parasitoid wasp, was approved for release, as initial research determined it to be an effective and host-specific biological control agent for SWD. *G. kimorum* is a solitary larval parasitoid of SWD found in overlapping ranges in east Asia. The adult female wasp inserts her ovipositor and lays her eggs into SWD larvae within the fruit. The *G. kimorum* egg hatches inside the SWD larva and over time consumes the host as it progresses through its life stages. Eventually a single adult wasp emerges from the host puparium.

The NCDACS Biological Control Program at the Beneficial Insect Lab (BIL) in cooperation with other State and Federal agencies, continues to develop and assess a biocontrol strategy for invasive SWD in our state. In our third year of the project, we performed standardized releases and intensively monitored release sites to determine establishment, seasonal phenology, and parasitism levels in both crop and non-crop habitats. Building upon our previous efforts, we continued to refine rearing practices with the goal of high production numbers for seasonal field releases as well as sustainability for production in the lab. Our primary objectives this year were to 1) continue to grow a lab-reared colony of *G. kimorum*, refining methodology to increase production, 2) release increased numbers of *G. kimorum* at locations used for releases in 2023 as well as at additional release sites, 3) continue comparative studies on the effect of temperature on the rate of parasitoid development and the number of parasitoids produced, and 4) initiate a study to examine the effect sex ratio of the parental generation has on the sex ratio of the progeny.

Growing Our Lab Reared Colony of Ganaspis kimorum

In fulfillment of the first objective, our colony of *G. kimorum* was successfully and continually maintained in 2024. We used blueberries infested with SWD (Fig. 2.7A) as the host material and media for rearing *G. kimorum*. Colonies of SWD and parasitoids are stable and can be manipulated when needed to produce parasitoids (Fig. 2.7B and C) for field releases and studies.

Figure 2.7, *A) Blueberries infested with SWD used for G. kimorum rearing, B) vial of G. kimorum aspirated from blueberry cups, C) environmental chamber with G. kimorum vials.*

Over 122,000 *G. kimorum* was reared in 2024 at the Beneficial Insects Lab, and 61,200 *G. kimorum* were released during the 2024 field season.

To accomplish our second objective, we reached out to the Superintendents of the NCSU-NCDACS Research Stations (RS) in early Spring. Release sites from the prior year included: Sandhills RS (Montgomery County), Piedmont RS (Rowan County), and Mountain Horticultural Crops RS (Henderson County). During 2024, locations of release sites were modified. We continued to coordinate efforts with Station Directors to release in the first two of these established release sites. The third site, Mountain Horticultural Crops RS, was monitored during pre-release sampling; however due to regular applications of insecticide on berries, it was deemed inappropriate for continued biocontrol releases. Instead, a private no-spray, working farm focused on low-input farming practices with multiple berry varieties for an extended-release season was identified as a new release site (Fig. 2.8). While fruit at a working farm is harvested and taken off site, the variety of fruit and ripening

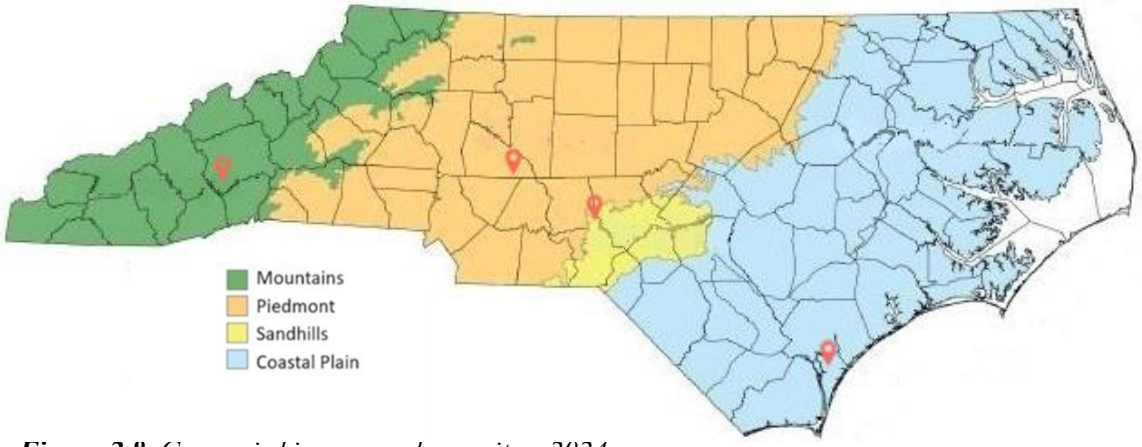

Figure 2.8, *Ganaspis kimorum release sites, 2024.*
Map modified from *Vascular Plants of North Carolina* website.

times throughout the season may provide habitat for *G. kimorum* to establish. This new mountain site is only 15 miles away from the previous one providing consistency for climatic and ecozone purposes.

In 2023 we identified a potential new release site in the Coastal Plains of North Carolina, which would result in release sites in all four ecoregions of the State (Fig. 2.8). Horticultural Crops Research Station in Castle Hayne (New Hanover County) is a research station specializing in blueberry research just outside of Wilmington, NC. We secured two distinct plots with blueberry varieties that ripen sequentially, with little overlap, to extend our release window over the course of the field season. While it was only monitored for parasitoids last year, in 2024 it was added as a new *G. kimorum* release site.

Preparing for Field Releases

Pre-release sampling was initiated in May 2024. Wild and cultivated berries were sampled bimonthly and monitored for emergence of both SWD and parasitoids. No *G. kimorum* was recovered during pre-release sampling. However, a self-introduced parasitoid, *Leptopilina japonica* (Hymenoptera: Figitidae), has been recovered from all four release sites. These findings may have implications for establishment of *G. kimorum* at these locations, as the interactions between *L. japonica* and *G. kimorum* at our sites are unclear.

To determine when to initiate parasitoid releases in 2024, populations of SWD were monitored using liquid traps (Fig. 2.9A). Populations of SWD were deemed suitable and parasitoid releases began in late May at and continued through the mid-September (Fig. 2.9B and 2.9C). Releases of *G. kimorum* were conducted at all four sites listed above, with 20,450 parasitoids released at Castle Hayne RS, 14,300 released at Sandhills RS, 15,250 released at Piedmont RS, and 11,200 released at the working farm in the mountains (Table 2.1).

Table 2.1, Releases of *Ganaspis kimorum (Gk)* in North Carolina, Summer 2022, 2023, and 2024.

SITE	COUNTY	# Gk RELEASED 2022	# Gk RELEASED 2023	# Gk RELEASED 2024	TOTAL RELEASED
Castle Hayne Research Station	New Hanover	0	0	20,450	20,450
Sandhills Research Station	Montgomery	483	1,010	14,300	15,793
Piedmont Research Station	Rowan	486	2,155	15,250	17,891
Working Farm	Buncombe	0	0	11,200	11,200
Mtn Horticultural Crops Research Center	Henderson	451	2,150	0	2,601
Total to Date		**1,420**	**5,315**	**61,200**	**67,935**

Post-release monitoring was initiated following the final releases of *G. kimorum*, and was similar to the protocol from the previous year. Ten to twelve days after the final releases, field fruit collections were performed at release locations. These collections included samples of any field fruit within 100 meters of the release points. This included both the crop berries and any wild berries in the vicinity. Berries were incubated and monitored daily for any parasitoid emergence. Post-release fruit collections continued at all sites until no fruit was available to collect. Parasitoids that emerged from field fruit were stored in alcohol for later identification.

Most parasitoids recovered from post-release samples were visually identified by staff in Dr. Hannah Levenson's lab at North Carolina State University. A small sample of 24 post-release parasitoids was sent to Dr. Tara Gariepy's lab, Agriculture and Agri-Food Canada, for PCR identification. We recovered 237 parasitoids from post-release fruit samples. Of those, 213 were visually identified and six were confirmed as G. kimorum.

Figure 2.9, *A) Liquid trap to monitor SWD levels, B) G. kimorum release on blueberries, C) Late season G. kimorum released on pokeweed berries.*

Five of the *Ganaspis* were recovered from Piedmont RS fruit collections and one came from the working farm. The majority of the remaining 207 parasitoids were identified as *Leptopilina japonica* with 19 identified as *L. heterotoma* (Hymenoptera: Figitidae). The 24 parasitoids identified by PCR were all *L. japonica*.

Rearing Studies

In 2024 we continued looking at the effect of temperature on the rate of parasitoid development by using three growth chambers set at 21°C, 23° C, and 25°C. Development time was determined by the time between introduction of adult ovipositing parasitoids into rearing cups to when the next generation of adult parasitoids began to emerge/eclose from those cups. We looked at over 1,000 cups combining data from 2023 and 2024 and found that the shortest parasitoid development time was observed at 25°C (21-22 days). Development time increased as the temperature decreased with cups at 23°C taking 24-25 days and cups at 21°C taking 26-27 days.

Using a subset of cups from 2024, we also compared the number of parasitoids produced per cup at these three temperature conditions. The greatest average number of *G. kimorum* per rearing cup was produced at 23°C (182 parasitoids/cup), compared to the other temperatures (171 parasitoids/cup at 21°C and 114 parasitoids/cup at 25°C).

Due to the lopsided production of males during the previous field season, we initiated a study to investigate the effect of sex ratio of the parental generation on the sex ratio of its progeny. We compared three different sex ratio treatments in rearing cups, using growth chambers set at 21°C and 23° C. The three treatments included equal numbers of male and female breeders, twice as many males as females, and twice as many females as males. The data from this study look interesting and is currently undergoing statistical analysis. We expect the end result to better inform us of ways to simultaneously produce appropriate numbers of both males and females for seasonal field releases as well as sustainability to optimize production in the lab.

Martha Flanagan

Biological Control Assessment of Invasive Knotweeds in North Carolina

The NCDACS Biological Control Program at the BIL continues to develop and assess a biocontrol strategy for invasive knotweed in our state (Fig. 2.10). Knotweeds within the *Fallopia* (syn. *Reynoutria*) species complex, native to East Asia, were once planted widely for their ornamental value and for erosion control. They have since escaped cultivation and have become invasive throughout their introduced range. The plant spreads vigorously via underground rhizomes and incidental distribution of viable plant fragments. The resulting stands outcompete native plants due to their aggressive growth habit and production of allelopathic chemicals. Knotweed is particularly undesirable within fragile riparian habitats and forest ecotones, highway rights-of-way, and in agricultural areas.

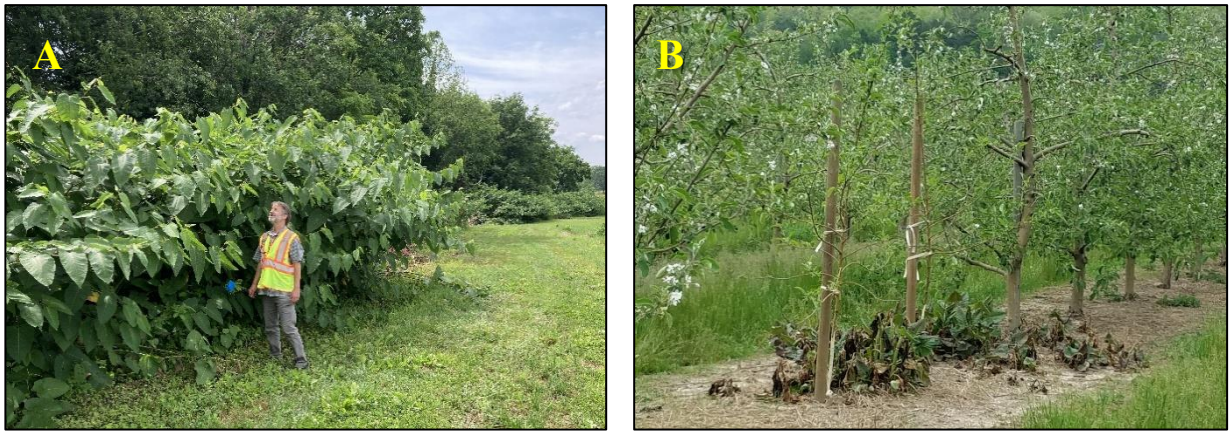

Figure 2.10. *Invasive knotweed in North Carolina; A) giant knotweed growing at field margin, B) knotweed in apple orchard resprouting after herbicide treatment.*

Knotweed control presents challenges due to limited access for mechanical control, accidental transport of plant fragments, and the long-term costs of repeated chemical applications. Thus, initiatives have been undertaken to establish biological control as an achievable and sustainable element of an integrated management plan.

BIL staff are collaborating in an international effort to control this weed by introduction of a knotweed-specific herbivorous insect, the knotweed psyllid, *Aphalara itadori* (Hemiptera: Psyllidae) (Fig. 2.11A). In the region of origin, the sap-feeding behaviors of knotweed psyllids result in severe leaf-curling (Fig. 2.11B), which leads to a reduction in photosynthetic capabilities, stunted growth, and eventual death of the plant. We have been working with three genetically distinct populations of psyllids. The Hokkaido biotype, from Northern Japan, is

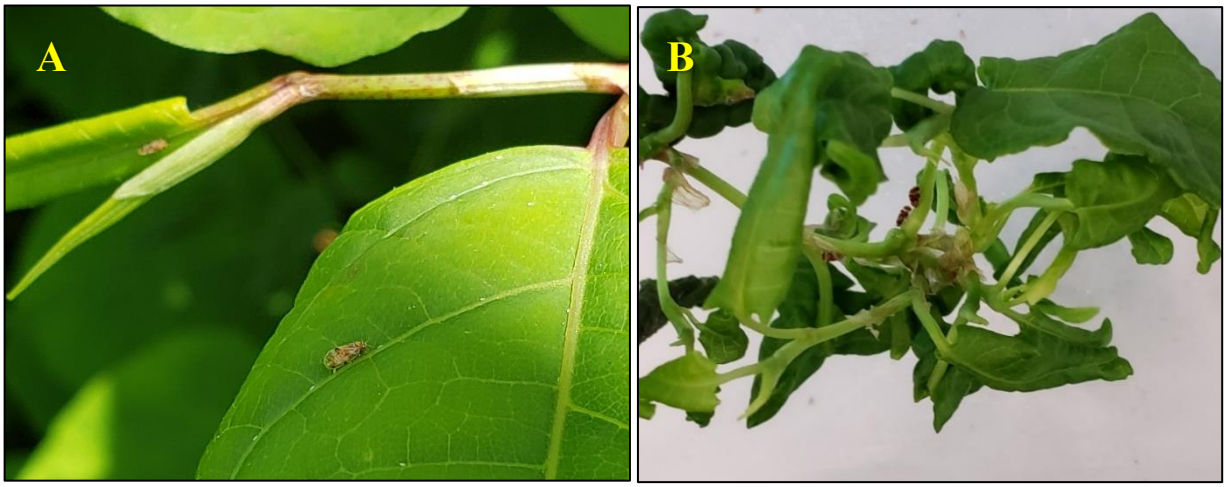

Figure 2.11, *Psyllid infestation on knotweed; A) psyllids on knotweed in the field three weeks following releases, B) symptomatic severe leaf-curling.*

specific to giant knotweed, *Fallopia sachalinensis*. The Kyushu biotype, from Southern Japan, prefers Japanese knotweed, *F. japonica*, and can also become established on the hybrid Bohemian knotweed, *F.* x *bohemica*. The newly acquired Murakami biotype, from central Japan, prefers hybrid Bohemian knotweed and can also become established on Japanese Knotweed. All three knotweed species occur in

North Carolina, and we have verified that knotweed psyllids can survive winter here. Our ongoing objectives are to determine whether these psyllids can establish populations in this region and document any impacts of the psyllid on plants in release sites.

We maintain psyllids in our lab on plants propagated from field-collected rhizomes (Fig. 2.12A). In addition, psyllids are overwintered in tents within field cages (Fig. 2.12B) to assess and retain overwintering capability and phenotypic plasticity. We have set up field sites through cooperative agreements across the state. Psyllids have been distributed via several methods, including free release within a knotweed patch, containment on a sleeved knotweed branch, introduction of psyllid-infested plants, and releases onto plants within field cages (Fig. 2.12C). Surveys are conducted for two weeks post-release and periodically during the growing season, for a minimum of 30 minutes per survey. We recorded numbers of psyllids and plant damage observed.

Figure 2.12, *Knotweed psyllid production and release; A) rearing cages in the lab, B) over-wintering cage in the field, C) field release cage.*

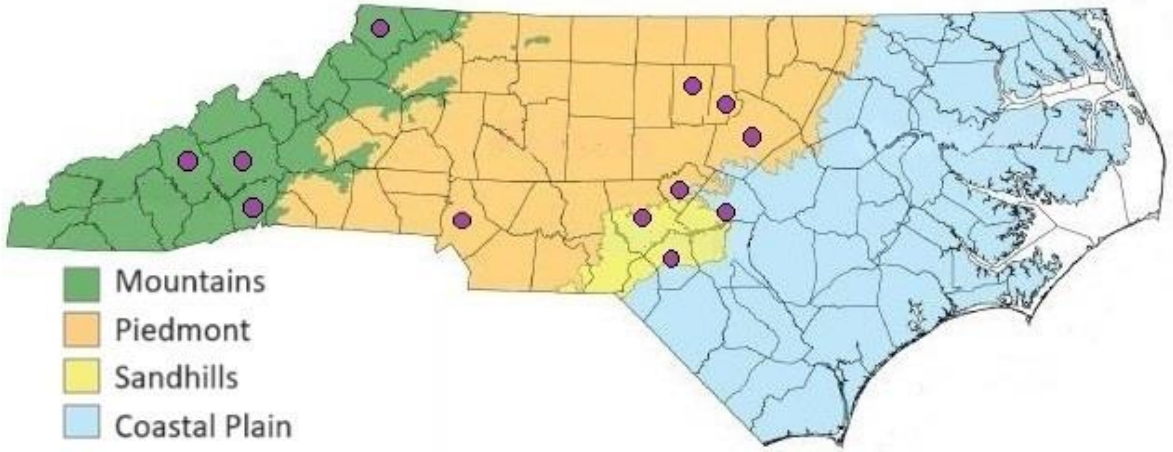

Figure 2.13, *Knotweed psyllid release sites in North Carolina, 2020-2024. Map modified from Vascular Plants of North Carolina website.*

We have released psyllids in twelve counties thus far, within all four ecoregions of North Carolina (Fig. 2.13). More than 120,000 psyllids have been distributed to date. Following recent protocol improvements, more than 47% of the total were released in 2024 (Table 2.2). Our strategy is to release psyllids annually for three consecutive years at each viable site, and to survey regularly during release years and for three post-release years to assess establishment of psyllid populations. While we have confirmed that psyllids can survive winter here, we have yet to observe either large populations of psyllids rebounding in spring or the significant leaf curl damage observed in their native
range where these species coexist. We suspect that this plant response requires high psyllid populations, which we have yet to observe.

Challenges to establishment and population growth include dispersal after introduction, predation by locally existing natural enemies, site disturbances, and climatic effects such as increasingly erratic weather events. To

address some of the challenges, we established new field sites that have been less subject to site disturbance, and situated release sites along tree lines, where afternoon shade might alleviate heat stress. Further, we initiated a release strategy wherein patches of knotweeds are enclosed in field cages, in attempt to mitigate predation, disturbance, and climatic factors, while preventing dispersal of first-generation psyllids. We have recovered live psyllids from overwintered field cages on BIL property each spring since the inception of the project, even following extended sub-freezing and near-record low temperatures for our region. We have so far also discovered overwintered psyllids in open field sites at two locations (Orange County and Buncombe County). We anticipate that psyllids released onto knotweed plants within field cages at our study sites should not only survive winter temperatures but should also be prevented from dispersal (which limits mate-finding success). In 2024, psyllid presence was documented at all sites for short durations during within-season monitoring, and within field cages for extended periods of 97- and 100-days post-release at two sites, both populated with Murakami psyllids. Overwintering survivorship from 2024 psyllid releases will be determined in Spring 2025.

Special note:
In Fall 2024, following a historically destructive hurricane, two sites in western NC were discontinued as release sites. We are in the process of identifying new sites to replace them.

Table 2.2, *North Carolina knotweed psyllid release sites, 2020-2024.*

County	Knotweed species	Psyllid biotype	# Released 2024	# Released to Date
Ashe	Giant	Hokkaido	2,825	9,525
Buncombe	Japanese	Kyushu	4,000	9,500
Durham 1	Hybrid	Kyushu	4,000	10,700
Durham 2	Hybrid	Murakami	6,000	6,000
Harnett	Hybrid	Murakami	6,800	8,030
Haywood	Hybrid	Murakami	5,000	5,000
Henderson	Giant	Hokkaido + Murakami	6,000	15,814
Hoke	Hybrid	Kyushu	0	1,544
Lee	Japanese	Kyushu	0	835
Mecklenburg 1	Hybrid	Hokkaido	0	1,564
Mecklenburg 2	Hybrid	Kyushu	2,000	10,100
Mecklenburg 3	Hybrid	Murakami	4,000	4,000
Moore	Japanese	Kyushu	5,000	13,900
Orange	Japanese	Kyushu + Murakami	6,000	15,375
Wake 1	Hybrid	Kyushu	0	500
Wake 2	Hybrid	Kyushu	5,000	7,919
Total Psyllids Released			**56,265**	**120,306**

Our work has been supported by the USDA and NCDACS Plant Industry Division. We appreciate the cooperation of Dr. Fritzi Grevstad, Oregon State University, as well as Raleigh Parks, Recreation, and Cultural Resources, Mecklenburg County Parks and Recreation, City of Charlotte, Charlotte-Mecklenburg Storm Water

Services, Ellerbe Creek Watershed Association, Campbell University Cape Fear River Initiative, North Carolina Department of Transportation, Duke Energy, and private property owners.

Nancy Oderkirk

Collecting Native Fulgoridae to Support Biological Control Testing for Spotted Lanternfly

Spotted lanternfly (SLF), *Lycorma delicatula* (Hemiptera: Fulgoridae), is an invasive species native to China and is a pest of many commercially and ecologically important tree species (Fig. 2.14). SLF is also an important pest of grapes in areas of establishment. It is currently found in 15 states and is projected to spread several more. If it becomes widespread in the U.S., it is feared that SLF could negatively impact vineyards, orchards, and the logging industry. In June 2023, the BIL initiated a project to collect select native planthopper and fulgorid species found in North Carolina to support host range testing efforts of USDA APHIS for SLF biological control.

Figure 2.14, *Spotted lanternfly adult (bugwood.org).*

Currently, USDA APHIS is conducting host range testing on the parasitoid wasp *Dryinus sinicus* (Hymenoptera: Dryinidae), which is from the same native range as SLF. If *D. sinicus* is to be approved for release against SLF in the U.S., extensive host testing is required to demonstrate it has little or no risk of impacting non-target native species. Adults of *D. sinicus* prefer to lay their eggs on the second instar nymphs of SLF, which measure 5.1 - 6.4 mm in length, so non-target species included in host range testing should have growth stages within this size range. The fulgorids and planthoppers we are targeting have growth stages in this size range, and providing researchers with these native species for host range testing would be of great benefit.

The fulgorid species targeted for collection by the BIL are *Amycle vernalis, Cyrpoptus belfragei*, *Cyrpoptus reineckei*, *Poblicia fuliginosa*, and *Scaralina marmorata* (formerly *Calyptoproctus marmoratus*) (Fig. 2.15), as

Figure 2.15, *Species of Fulgoridae recorded from North Carolina: A) Amycle vernalis, B) Cyrpoptus belfragei, C) Cyrpoptus reineckei, and D) Poblicia fuliginosa and E) Scaralina marmorata (all photos except P. fuliginosa obtained from bugguide.net).*

well as other select planthoppers. To survey these fulgorid species, we obtained permission to utilize several natural areas where host plants were likely to occur as collection sites, including eight NCDACS Plant Conservation Preserves (PCP), two NCDACS Research Stations, two State-managed forests, and several municipal parks across the state. A variety of native grass species can serve as host plants for nymphs of *A. vernalis*, *Cy. belfragei*, and *Cy. reineckei.* Oak species, such as water oak (*Quercus nigra*), are suspected to be the main hosts of *S. marmorata*, and winged sumac (*Rhus copallinum*) serves as the main host plant of *P. fuliginosa*. We have planted select grass species and seedlings of water oak on the grounds of the BIL to serve as host plants for collected species until they can be shipped to APHIS cooperators for host range testing. We also have a colony of about 350 *P. fuliginosa* on winged sumac growing in field cages on the BIL grounds.

To survey our target insect species during 2024, we utilized several sampling techniques, including sweep-net sampling, plant vacuuming, and light trapping, as well as visually examining plants for the presence of insects. We conducted sampling at all sampling sites at least once, and we used at least two sampling techniques during each survey trip.

To date, the only species in the family Fulgoridae we have collected is *P. fuliginosa*. However, because we maintain a field colony of this species on the grounds of the BIL, we were able to ship 93 nymphs to USDA cooperators upon request to conduct host testing in Summer 2024. We have been in consultation with other entomologists in efforts to refine our sampling techniques and timing to increase the likelihood of collections of other fulgorid species in 2025.

During spring and summer 2024, we collected nymphs and adults of two planthopper species of interest, *Rhynchomitra microrhina* (98 individuals total) and *Scolops sulcipes* (130 individuals total) (Hemiptera: Dictyopharidae) at multiple locations (Fig. 2.16). Adults and late-instar nymphs were placed on caged host plants planted on the grounds of the BIL in efforts to start a field colony of these species. We also shipped 35 nymphs of the proper size to USDA cooperators to conduct host testing.

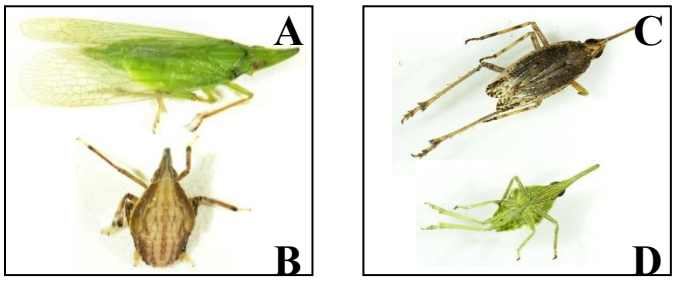

Figure 2.16, *Rhynchomitra microrhina A) adult and B) nymph; Scolops sulcipes C) adult and D) nymph.*

Figure 2.17, *Microcentrus perditus nymph on oak leaf.*

We also collected 26 nymphs of *Microcentrus perditus* (Hemiptera: Membracidae) (Fig. 2.17) from water oaks at two locations. We shipped 10 nymphs of this species to USDA cooperators for host testing (some individuals were parasitized by a small wasp and some died before they could be shipped). This species is cryptically colored and difficult to see on the plant. However, based on collections in 2024, we anticipate additional collections in 2025.

We continue to build upon previous knowledge and our growing field experience to better inform our survey times and methods. We are continuing to survey for nymphs of *A. vernalis*, *Cy. belfragei*, and *Cy. reineckei* in grasses at field sites throughout the winter, and we plan to begin survey efforts for our other species of interest in early spring. With collection efforts during 2025 starting earlier in the season, we are more likely to find populations of our target fulgorid species. We are also expanding the number of survey sites for 2025, which should increase the likelihood of finding populations of target species and enhance USDA host-testing efforts.

NCDA&CS Quarantine Facility Report of Activities: 2023-2024

The NCDACS Beneficial Insects Laboratory (BIL) houses the Department's biological control research and insect rearing programs. An important subunit of the BIL is a USDA-approved Quarantine Lab designed for the reception and handling of potentially invasive, nonindigenous arthropods and plants. We are authorized to receive Class A organisms (those considered dangerous or unsuited for experimentation in a natural setting), Class B organisms (those considered as potential biological control agents, but with gaps in our understanding of ecological, biological, or taxonomic information), and Class C organisms (those considered promising biological control agents, but with a requirement for specific additional studies).

One major objective of the Quarantine Lab is to facilitate the handling, propagation, and assessment of natural enemies in developing classical biological control programs. Another objective is to contain suspected invasive species discovered in North Carolina, until such time that species identification and status assessment can be made.

The Quarantine facility has supported three noteworthy endeavors since our last report. First, in 2023 as part of the North American Knotweed Biological Control program, we received seeds of Alaska wild rhubarb, *Aconogonon alaskanum* (Family Polygonaceae, the buckwheat family), which is native to Alaska and the Pacific Northwest. This plant is distantly related to knotweed species that are non-indigenous and invasive in North America, so it was included in a host-specificity test of their biological control agent, the knotweed psyllid, *Aphalara itadori* (Hemiptera: Psyllidae.) Seeds were shipped under USDA APHIS PPQ authority to our location for the purpose of serving as a potential secondary testing facility. We successfully germinated and grew this plant in the Quarantine Lab, as it is not native to North Carolina. Upon completion of host specificity tests, the non-indigenous plants were destroyed according to standard operating procedures.

From July through October 2024, the Quarantine Lab hosted a study of native parasitoids of the invasive spongy moth, *Lymantria dispar* (Lepidoptera: Erebidae). The moth has not established in most of North Carolina, so our Quarantine facility served as a safe and appropriate location to pursue this work. Egg masses and pupae of spongy moth that were collected during scouting and trapping efforts were held in the Quarantine Facility and monitored for emergence of parasitoid wasps and flies. Several species of parasitoids emerged over a period of more than four months and have been submitted for identification.

In August 2024, staff of the North Carolina Cooperative Agricultural Pest Survey (CAPS) received a report of suspected box tree moth, *Cydalima perspectalis* (Lepidoptera: Crambidae). This destructive and invasive moth, native to Asia, had been detected in 2021 infesting nursery shipments in several states, including Tennessee and South Carolina, but not in North Carolina. The reported shrub was transported to our Quarantine Lab and held until the insects could be identified at the Plant Disease and Insect Clinic of NCSU. Fortunately, they were identified as two species of no regulatory significance: the omnivorous leafroller, *Platynota stultana* (Lepidoptera: Torticidae) and twirler moths (Superfamily Gelechioidea; most likely *Glyphidocera* species). The readiness and ability of the Quarantine Lab to serve in these diverse roles exemplifies the importance of the Lab as a resource to provide containment services to the state of North Carolina.

Nancy Oderkirk

Cooperative Agricultural Pest Survey (CAPS)

Prepared by Josie Pasche, State Survey Coordinator

The CAPS program is a national, early warning pest detection network, funded through a cooperative agreement with USDA-APHIS-PPQ for domestic surveillance of exotic plant pests. Such pests hold economic, agricultural and/or environmental importance to North Carolina (NC) and the U.S. and typically include plant pests that are not known to occur domestically. These surveys help safeguard our nation's agriculture and natural resources through early detection, especially for those pests that pass through front-line inspections at our ports of entry. Surveys also concentrate on pests of export significance which are of concern to our trading partners. The CAPS program follows guidelines to ensure that data, on a continuing basis, is scientifically valid, current and reliable. The state CAPS advisory committee helps drive and focus surveys for each state. Its core members include the State Plant Health Director (SPHD), State Plant Regulatory Official (SPRO), Pest Survey Specialist (PSS) and the State Survey Coordinator (SSC). Other members may be invited to provide guidance in their area of expertise. National and/or State level surveys concentrate on three main areas of importance: entomological, pathological or exotic weed species. Data collected from these surveys are entered into the National Agricultural Pest Information System (NAPIS).

Amy Michael changed roles within NCDA&CS from CAPS Coordinator to State Regulatory Entomologist in March of 2024. She functioned as the interim SSC until the new CAPS Coordinator, Josie Pasche, began in August of 2024. The 2024 North Carolina CAPS program was successful in procuring funding for CAPS and PPA §7721 surveys for early detection of exotic plant pests. Nine independent surveys were conducted throughout the state, covering 59 counties. Surveys included mollusk, forest pests, oak commodity, Asian defoliators, grape commodity, solanaceous commodity, a *Phytophthora* spp. survey, box tree moth, and spotted lanternfly. Additionally, the Invasive Species Outreach program continued to be administered by the CAPS Coordinator in 2024. Four seasonal plant pest aide positions were filled to conduct trapping throughout the state. One taxonomic specialist was hired to assist with dissection-based insect identification as required for some of our samples.

A total of thirty-seven different exotic plant pests were surveyed from March through late October. All surveys were completed following the 2024 CAPS guidelines, so that negative data was reportable. Several PPA 7721/ Farm Bill surveys also fall under the direction of the CAPS program. Grant applications are submitted annually to conduct survey work in solanaceous commodity (tomatoes, peppers, eggplants, etc.), *Phytophthora* spp. (important plant pathogens affecting nursery and natural areas), grape commodity, Asian defoliators (largely surveyed at ports of entry), box tree moth, and spotted lanternfly (early detection/ host mapping). Many of these surveys follow CAPS guidelines for how they are conducted. Survey priorities for 2024 were determined with help from the CAPS advisory committee and new survey proposals were submitted through CAPS and Farm Bill (PPA 7721). All grant proposals were funded for 2024 surveys, while proposals for the 2024 survey season were successfully submitted by early August 2024.

CAPS Surveys

Mollusk Survey

The mollusk survey was conducted as a joint operation between NCDA&CS and USDA-APHIS-PPQ at three locations of tile importers in Durham County (Figure 3.1), meeting our survey goal for the year. Eleven exotic taxa of mollusk were surveyed for: giant African snail (*Lissachatina fulica*), Chinese slug (*Meghimatium pictum*), Hygromiid snails (*Cernuella* spp. and *Monacha* spp.), Cochlicellid snails (*Cochlicella* spp.), and Leatherleaf slugs. (*Veronicella* spp., *Belocaulus* spp., *Colosius* spp., *Laevicaulis* spp., *Sarasinula* spp., and

Semperula spp.). Survey locations were selected by the USDA-APHIS-PPQ team in response to a potential giant African snail sighting reported on iNaturalist in Durham County. Sites were chosen based on factors such as potential introduction pathways, storage locations, and the presence of suitable habitat for establishment. No target pests for this survey were recovered.

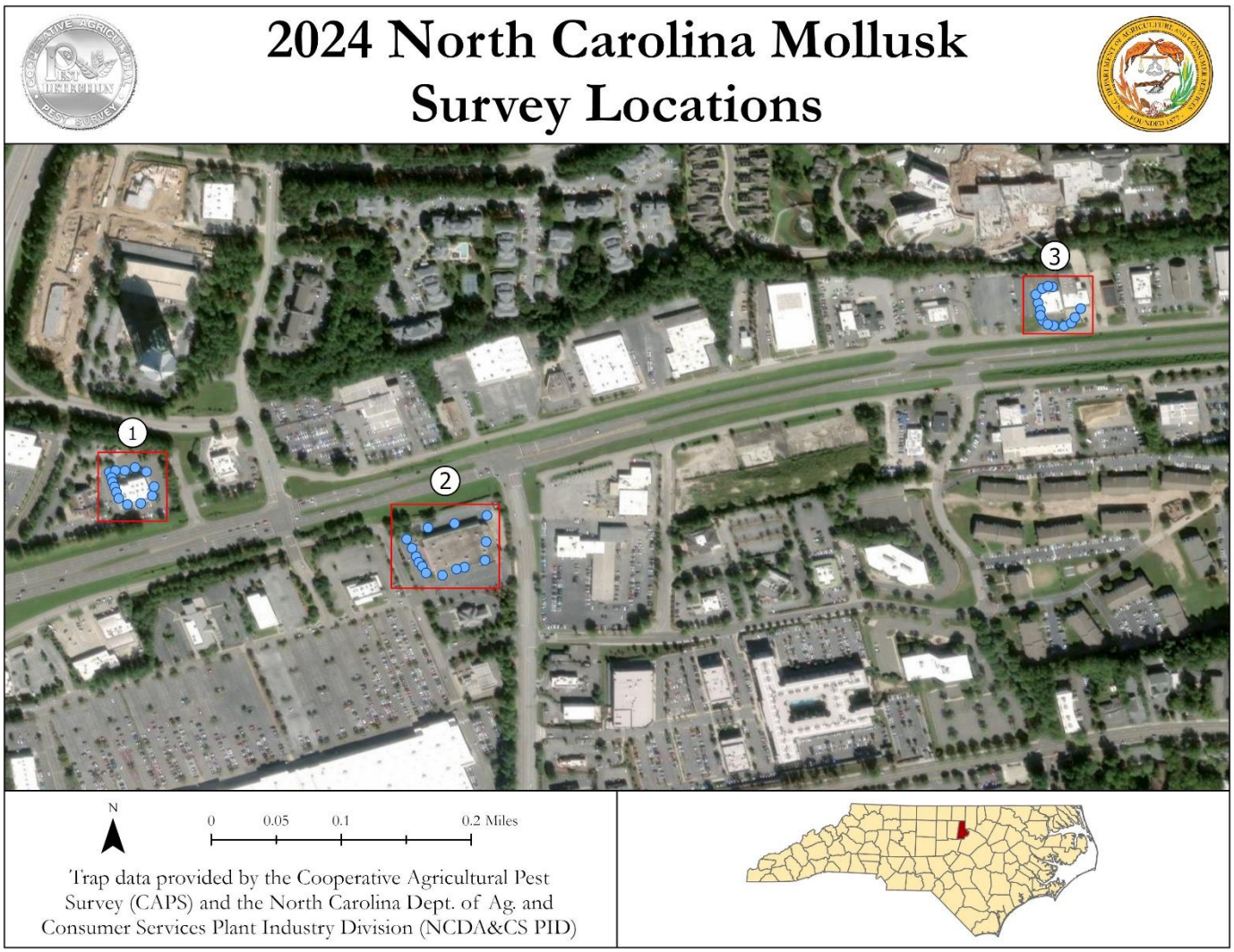

Figure 3.1, *Map of Mollusk Survey sites, 2024*

Oak Commodity Survey

North Carolina completed the 2024 oak commodity survey at 30 locations (Figure 3.2), surpassing the goal of 20. This survey included the following species: oak processionary moth (*Thaumetopoea processionea*, OPM) and oak ambrosia beetle (*Platypus quercivorus*, OAB). Oak processionary moth is a defoliating pest that can kill host trees through heavy feeding. The oak ambrosia beetle carries an additional threat in the form of the pathogen Japanese oak wilt (*Raffaelea quercivora*). Trapping for the insects included in this survey began in late March and ended by early November. Monthly visits were conducted at all locations for lure replacement, sticky card collection or trap replacement. Bi-weekly visits for the OAB multi-funnel trap were accomplished to limit the decomposition rate of beetle specimens so identification could be possible. Samples from the OAB traps were screened by the taxonomic specialist. No target pests for the Oak Commodity Survey were recovered.

Forest Pests Survey

The Forest Pest survey throughout the state concentrated on Asian Longhorned beetle (*Anoplophora glabripennis*; ALB) and Oak Splendor Beetle (*Agrilus biguttatus*; OSB). ALB is capable of infesting and killing healthy trees across 12 genera. The primary impact of this pest in infested areas of the US has been in maples (*Acer* spp.), which is the second-most abundant tree genus in North Carolina.

ALB surveys began in March and concluded in November. In total, 439 visual surveys for ALB were conducted in 39 counties (Figure 3.2). 15 of the sites surveyed are shared with the Oak Survey, as the rest stops, campgrounds, and sawmills share the pathway risk of infested log introduction. Maple trees were surveyed at each of the 15 shared sites 3 times per year coinciding with key points in ALB phenology: once at the beginning of the survey season before maple trees have fully leafed out, once during predicted adult emergence (May-July), and once in the month prior to leaf fall to target stressed trees. The remaining locations were visited only once as a response to suspicious damage noticed by the surveyor. No evidence of ALB infestation was observed.

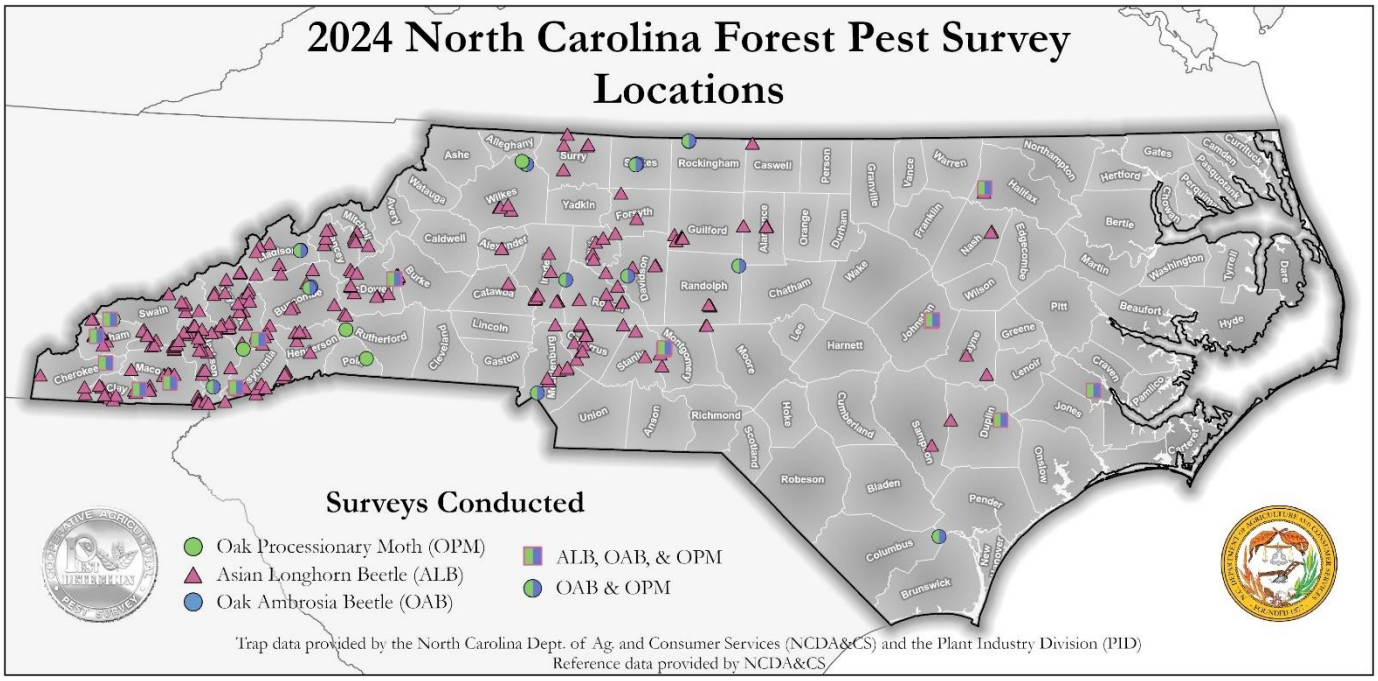

Figure 3.2, *Map of Oak and Forest Pest Survey Sites, 2024*

PPA 7721 Surveys

The SSC annually applies for Federal assistance for the state to conduct exotic plant pest surveys. In 2024, money for 7 cooperative agreements funded by the Plant Protection Act §7721 was awarded to NC. These included 5 early detection surveys, 1 emergency pest response program, and 1 outreach program. Detection surveys included box tree moth, Asian defoliators, grape commodity, solanaceous commodity, and a *Phytophthora* blight (*Phytophthora ramorum*) survey (see Plant Pathology Programs). The response plan for Spotted Lanternfly included statewide early detection/ host mapping surveys conducted by CAPS personnel (see Entomological Programs).

Asian Defoliators Survey

Nine exotic plant pests were surveyed under Asian defoliators: Asian Gypsy Moth (*Lymantria dispar asiatica*), Okinawa gypsy moth (*L. albescens*), Japanese gypsy moth (*L. dispar japonica*), Hokkaido gypsy moth (*L. umbrosa*), Rosy Moth (*L. Mathura*), Nun Moth (*L. monacha*), Pine Tree Lappet (*Dendrolimus pini*), Masson Pine Moth (*D. punctatus*) and Siberian Silk Moth (*D. sibiricus*). Locations included rest areas, ports of entry, and military installations. An introduction of any of these exotics would have serious implications for North Carolina forests. Host trees for these pests are considered economically important and include oak, pine, ash, elm, maple and walnuts.

A total of 16 trapping locations were placed at ports of entry over a four-month period from early May to mid-October (Figure 3.3), meeting our survey goal of 15 locations. Monthly site visits were used to replace sticky cards and/or lures. Typical survey sites include rest areas, deep water ports, and military installations. Multiple survey locations exist on larger installations which may include a combination of several forms of conveyance including deep water ports with rail yards, airstrips or a combination thereof. These are important pathways for this survey and are prioritized accordingly. All samples were collected at the servicing of each trap and screened for the presence of target pests. No target pests for this survey were recovered.

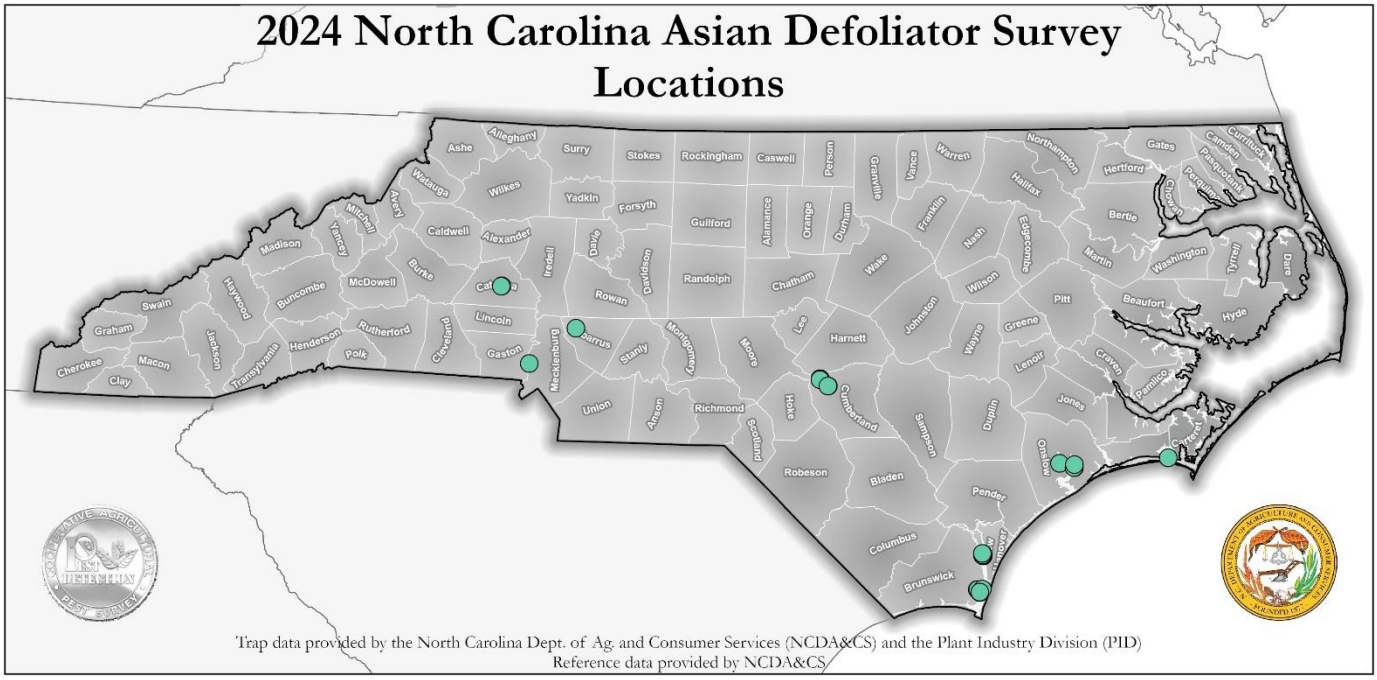

Figure 3.3, *Map of Asian Defoliators Survey sites, 2024*

Grape Commodity Survey

The Grape Commodity survey was completed at 23 locations (Figure 3.4), exceeding our goal of 20 sites. Vineyards surveyed included both European (*Vitis vinifera*) and native muscadine grapes (*Vitis rotundifolia*). We surveyed three exotic species; Christmas berry webworm (*Cryptoblabes gnidiella*), spotted lanternfly (*Lycorma delicatula*; SLF), and European grapevine moth *(Lobesia botrana*). Traps were set beginning in late May and were pulled in October (Figure 4). Visual surveys for spotted lanternfly were conducted within vineyards at each visit in accordance with the approved guidelines. Lampshade traps were also set at each vineyard as an additional potential detection method, but these did not replace monthly visual surveys. No target pests for this survey were recovered within vineyards.

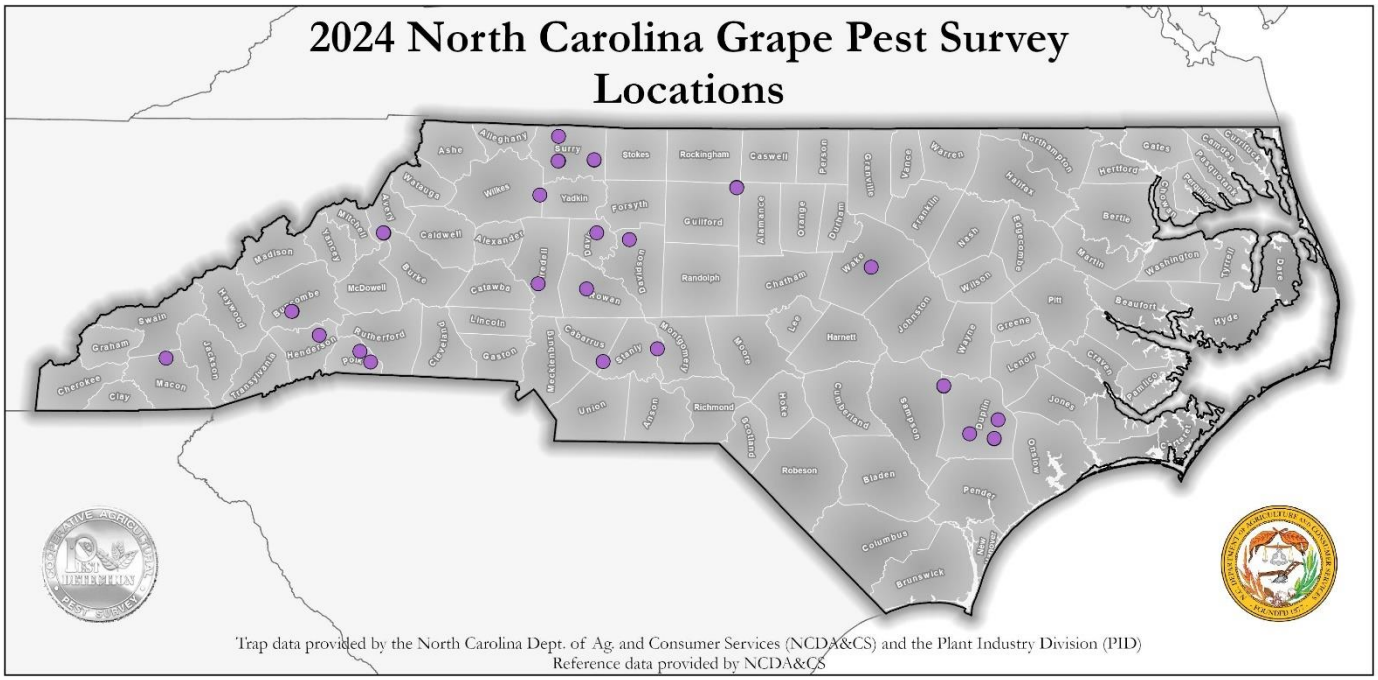

Figure 3.4, *Map of Grape Survey sites, 2024*

Solanaceous Commodity Survey

Insect pests (field survey)

We surveyed 28 host sites that included commercial tomato, eggplant, and pepper production fields (Figure 3.5) for insect pests, exceeding our goal of 20 sites. Seven exotic insect pests of solanaceous plants were surveyed from May-October 2024: tomato leaf miner (*Tuta absoluta*), old world bollworm (*Helicoverpa armigera*, OWB), golden twin spot moth (*Chrysodeixis chalcites*), tomato fruit borer (*Neoleucinodes elegantalis*), silver Y moth (*Autographa gamma*), false coddling moth (*Thaumatotibia leucotreta*), and cotton cutworm (*Spodoptera litura*). All are regarded as being highly destructive pests of solanaceous crops and pose a significant threat to North Carolina agriculture as the state has host material and climate conducive to supporting these exotics.

Old world bollworm is known for quickly developing levels of resistance to commonly used insecticides, including resistance to transgenic crops using *Bt*. Capable of long-distance migration, it may adapt to environmental conditions if it becomes too warm or dry. Economically, it is one of the costlier pests and reports of serious losses up to 100% are common in infested areas. It has also shown a propensity to hybridize with the native New World Bollworm, (*Helicoverpa zea*, NWB) in South America and Puerto Rico. NWB is already a leading pest in several NC commodity systems, and there would be potential for rapid sharing of resistant genes between these species if OWB becomes established. Early detection and identification of this pest will limit spread to the natural environment and aid in eradication. Invasive OWB and native NWB are impossible to distinguish by their external appearance. A taxonomic specialist was hired to conduct gentilic dissections on all *Helicoverpa* spp. collected in this survey to rule out positive identifications for OWB. While several states including NC saw increased that bycatch of NWB was much higher in 2023 compared to previous years, bycatch was much closer to normal levels in 2024.

No target insect pests were recovered because of this field survey.

Pepper Thrips (*Thrips parvispinus*) interception
In September, an infestation of Pepper Thrips (*Thrips parvispinus*) was intercepted in a greenhouse in Catawba County. The infestation originated from a shipment of plants received from a Florida nursery on July 22, 2024. Despite standard thrips treatments conducted by the receiver, the infestation persisted, prompting the company to submit samples to NCSU-PDIC for identification. On August 30, 2024, NCSU-PDIC confirmed the presence of *Thrips parvispinus* and immediately notified NCDA&CS and USDA-APHIS-PPQ. Classified as quarantine significant by APHIS and not established in North Carolina, containment efforts commenced swiftly. The initial infestation was isolated to one greenhouse bay, but additional Pepper Thrips were identified in an adjacent bay housing tomatoes and cucumbers—both hosts for *T. parvispinus*. The State Regulatory Entomologist and SSC coordinated with company employees to bag and remove all infested material, ensuring destruction through deep burial.

Tomato Brown Rugose Fruit Virus (greenhouse survey)
In summer 2020, USDA issued a call for a new pest to be added to solanaceous surveys. Tomato Brown Rugose Fruit Virus (ToBRFV) is a relatively new tobamovirus that was first discovered in Israel in 2015. It has since been detected in several countries including Mexico and has been intercepted in several US states. This virus can affect several solanaceous crops (tomatoes, peppers, and eggplants). Symptoms tend to appear in foliage first and lead to brown lesions on the fruit that can render the product unmarketable. While it can be seedborne, this virus spreads mechanically and can quickly contaminate entire production systems. Greenhouse-grown tomatoes appear to be the most susceptible.

Tomato Brown Rugose Fruit Virus (ToBRFV) surveys were conducted in winter and spring to correspond with the typical greenhouse production of tomatoes and other solanaceous plants in North Carolina and were led by the State Survey Coordinator and State Plant Pathologist. The first survey was conducted in March 2024 in Mecklenburg County. The remaining surveys were completed from early March – early April 2024 in Mecklenburg, Stokes, and Cumberland Counties. A total of 23 surveys in 10 locations were conducted in the state. AgDia ImmunoStrips for ToBFRV were used to screen any suspicious samples. 3 samples were taken; all samples tested negative by ImmunoStrip.

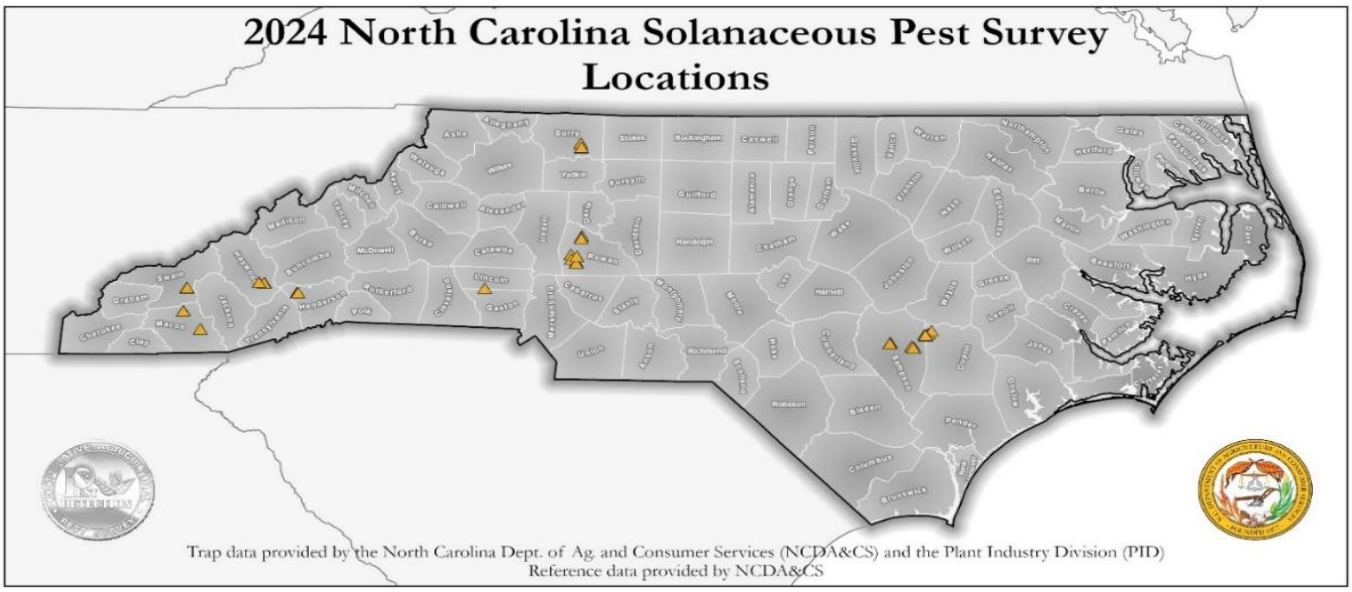

Figure 3.5, *Map of Solanaceous Trapping Survey Sites, 2024*

Box Tree Moth Survey

The Box Tree Moth (*Cydalima perspectalis*, BTM) is an emerging pest of boxwood (*Buxus* spp.) throughout Europe, and was recently detected in Ontario, Canada in 2018. After completing a successful pilot trapping program for early detection at nurseries and coordinating with USDA-APHIS-PPQ to confiscate plants related to a BTM trace-forward from 8 locations in 2021, we petitioned to repeat this survey in 2023 and 2024. The residences related to the trace forwards in 2021 were surveyed by USDA-APHIS-PPQ and are not reflected in our survey data.

Traps were placed at 24 boxwood-producing locations with priority given to large wholesale operations beginning in April 2024, exceeding our goal of 15 sites. Traps were checked once every 4 weeks through the end of October. The target pest was not detected because of our surveys anywhere in the state.

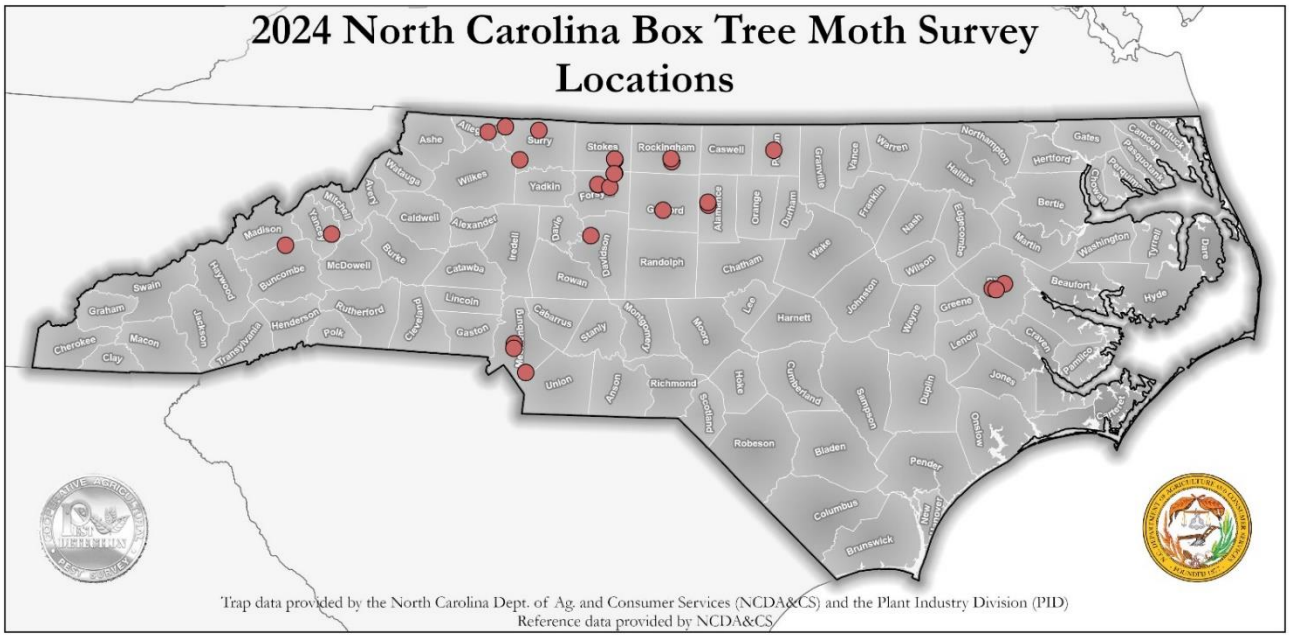

Figure 3.6, *Map of Box Tree Moth Survey sites, 2024*

Invasive Species Outreach

The Invasive Pest Outreach Program (funded by USDA PPA7721) supports public outreach centered on invasive pests. An ongoing central goal of this program is to help prevent the spread of invasive pests throughout North Carolina. The impacts and benefits from conducting statewide invasive pest outreach will result in quicker detection of incipient populations of pests, lead to a greater number of individuals reporting pests, and cause positive behavioral changes from the public that reduce the negative impacts of invasive pests and aid with slowing their spread. This in turn will help protect million- to billion-dollar nurseries, forests, and agricultural industries. Through a combination of presentations, advertising, and in-person events, messaging reached an estimated >1.2 million North Carolinians in 2024 (Table 3.1).

Messaging was spread broadly throughout the state both geographically and to residents that may not be engaged with plant industries through events like Bug Fest, the Autumn Leaves Festival in Mt. Airy, and home exposition shows in Raleigh, Wilmington, and Greensboro. At these events and through partnerships with extension offices and other organizations we were able to distribute an estimated 16,171 units of educational

materials including several things that were printed in previous agreement years (Table 3.2). Several items were updated and reprinted to replenish stock. Many of our pest alerts historically had maps showing contact information for our Plant Pest Specialists' areas and their contact information. However, high turnover in recent years has created the need for us to update these pest alerts faster than we can distribute them. To try to avoid this issue, we have begun reformatting them by adding more pest identification photos and directing readers to our website.

To increase awareness of SLF and how to report finds to NCDA&CS following the Kernersville find, we continued our paid social media campaign in the Triad and in Surry County, where most of the YVAVA vineyards are located. This year, we renewed the campaign within the Triad and in Mecklenburg County. This county hosts Charlotte (our biggest population center), the largest inland transportation hub in the state, and lies along the I-77 corridor. Our encouraged early reporting (Figure 3.7). This campaign ran from just before Labor Day weekend through late September to get this information in front of users to coincide with both peak SLF adult mating season and peak leaf-change tourism travel dates for these areas. Target audiences included but were not limited to farmers, outdoor enthusiasts, truckers, pest control professionals, gardeners, transportation and moving professionals, and homeowners. This campaign amassed 416,752 impressions primarily on Facebook with a Click Through Rate (CTR) of 8.45% (Table 3.3), greatly surpassing the iHeartMedia average CTR of 1.86% (354% comparative increase). This year has also surpassed CTR from our campaign last year of 6.97%. This campaign also successfully reached the largest spotted lanternfly hub and surrounding areas (Figure 3.8).

There was a significant effort to promote outreach showcasing our Spotted Lanternfly (SLF) detector dog team. These highly skilled and capable dogs generated substantial attention and interest in the SLF program. Our detector dog team was featured in a television commercial, emphasizing the importance of SLF reporting. This commercial aired on ABC 13 WLOS with a total of 24 broadcast spots, reaching an estimated viewership of 128,146 across North Carolina.

Table 3.1, *Summary of Events and Advertisements in 2024*

Outreach Type	**No. of Events**	**Estimated No. Impressions/ Attendees**
Banner Display only	1	200,000
Outreach Booth	10	956,713
Print Advertisement	3	54,000
Presentations (in-person/virtual)	4	620
Social Media Campaign	1	416,752
Total Reached	**48**	**1,628,085**

Table 3.2, *Summary of Outreach Materials Produced and Distributed in 2024*

Title	No. Printed	Est. No. Distributed June 2024-Dec 2024
SLF ID cards	1,500	514
SLF Poster	100	40
SLF Pest Alerts**	500	750
SLF Look-alike**	0	337
Kid's Activity Packs*	N/A	660
SLF temporary tattoos**	0	817
SLF Origami Instructions**	0	650
SLF Origami**	1,500	650
SLF Sticky notes	0	932
SLF Rack Cards	0	851
SLF Air Fresheners	0	200
SLF Wine coaster	0	2,375
SLF Beer coaster	0	2,250
ALB Pest Watch**	500	800
ALB pencils**	0	774
ALB pencil sharpeners**	0	600
BTM Pest Watch	0	10
IFA Pest Alerts	0	100
Invasive Pest Fly Swatters	1500	1000
TOH & CB ID guides**	0	650
ALB Coloring page	500	500
SLF Coloring page	500	500
Detector Dog Frisbee	0	161
Detector Dog Pet Bag Dispenser	0	50
TOTAL	6,600	16,171

*Children's activity packs include pest alerts for both SLF and ALB, one ALB pencil, one ALB pencil sharpener, and additional materials produced in prior agreement years (e.g., SLF search-and-find activity). Materials included in the pack are counted again under each separate line (e.g., 660 ALB pencils in packs + 114 individually distributed pencils = 774 pencils total distributed). **Activity pack item

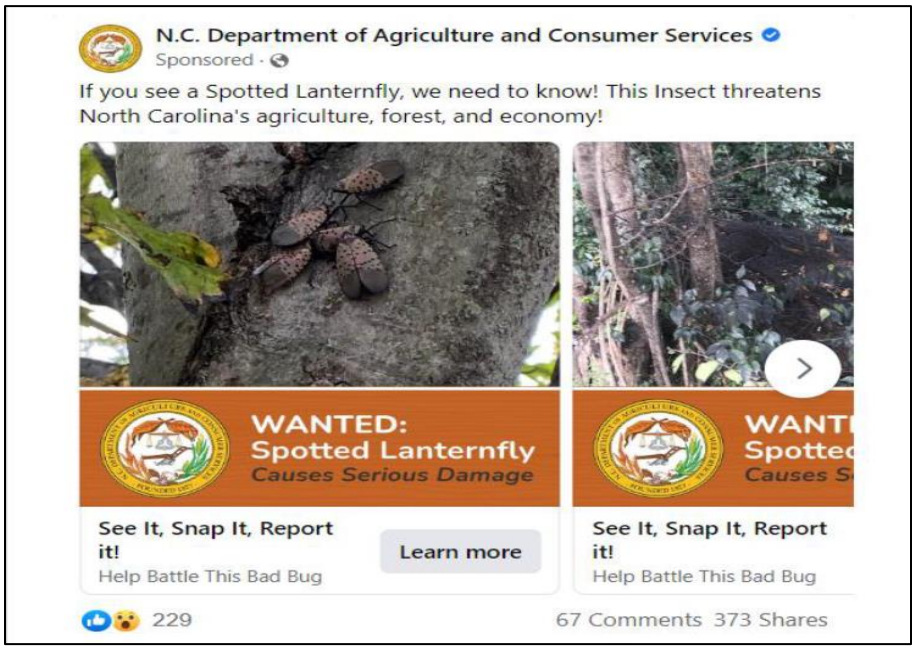

Figure 3.7, *Social media campaign messaging.*

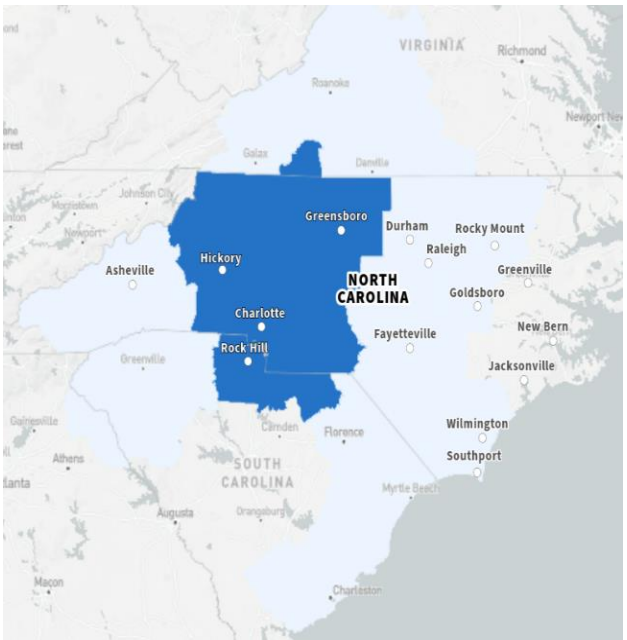

Figure 3.8*, Social media campaign geography.*

Platform	Run time	Total impressions	Total Clicks	Click Through Rate
Facebook	8/24-9/30/2023	393,857	34,010	8.63%
Instagram	8/24-9/30/2023	22,895	1,207	5.27%
TOTAL	8/26-9/30/2023	**416,752**	**35,217**	**8.45%**

Table 3.3, *Social Media Campaign Metrics*

Entomological Programs

Prepared by Amy Michael, Entomological Programs Manager, Sara Lalk, Gypsy Moth Program Coordinator, and James Goethe, GIS Analyst

The following report summarizes the primary activities and accomplishments of the NCDA&CS Entomological Programs in 2024

SWEET POTATO WEEVIL PROGRAM

North Carolina's sweet potato production continues to be a success as demand for sweet potatoes increases in the national and international markets. The success of the sweet potato industry in NC is attributed to several factors including an efficient marketing strategy and strong research programs at state universities aimed at developing new and better varieties of sweet potatoes. Additionally, at NCDA&CS Plant Industry Division, we manage an intensive regulatory program intended to keep the sweet potato weevil (*Cylas formicarius*; SPW), the most important pest of sweet potatoes in the world, out of production areas in NC. SPW is a pest of regulatory concern that can significantly affect the NC sweet potato industry by 1) reducing yields in affected fields, 2) damaging the quality of infested sweet potatoes, 3) increasing the production cost for farmers, and 4) imposing restrictions on the movement of sweet potato from affected to non-affected areas in NC and outside of NC.

Our mission at NCDA&CS Plant Industry Division is to implement effective plant pest programs to reduce the risk of accidental introductions of SPWs into NC sweet potato production areas and to mitigate and eradicate weevil populations that might have been introduced to the state to protect the NC sweet potato industry. Early detection and rapid response (EDRR) of weevil detections is instrumental for a successful eradication program. Our most important tool for EDRR is surveys. Every year, surveys are conducted throughout the state using traps baited with lures containing a female-produced pheromone that attracts male sweet potato weevils. These traps are deployed in production fields, regulatory sites including but not limited to storage, processing and packing facilities, micropropagation greenhouses, and/or any other sites where regulated articles for sweet potato weevil are found. Traps are also deployed in the NC sweet potato weevil quarantine area in New Hanover and Brunswick counties to monitor potential movement of sweet potato weevils into the production areas and to conduct research.

Field Surveys

Field surveys were conducted from mid-August through October 2024 in 39 counties, primarily in eastern North Carolina. Reported acreage indicated 9,951 fields totaling 90,622.16 acres were intended for planting in 2024 (Table 4.1). NCDA estimates the number of traps necessary for 2024 based on historical trap set data indicated approximately 11,113 traps would be set. Actual trap set numbers totaled 10,699 with 258 traps being in unreported fields meaning our estimate was 96.8% accurate. Trap set was done following the established guidelines and protocols developed by the Southern Plant Board (SPB) in 1995. Traps were deployed at a minimum of one trap per 10 acres with a minimum of two traps per field (exceptions were made if a field was under two acres). Conventional green boll weevil traps were used because of their low cost (Figure 4.1a). Traps

were deployed at an average density of one trap for every 8.47 acres and left in the field for an average of 30 days. These values are in accordance with the established SPB sweet potato weevil survey guidelines. Custom-made georeferenced pdf maps were used in mobile devices (iPads) to navigate and locate sweet potato fields and to collect data including time and date of trap set, field type (reported, unreported, and absent), and coordinates (latitude and longitude) for each trap set. Data collected during the trap pull process includes the trap condition (lost, damaged, good) and the number of weevils found. **No weevils were found in field surveys during this period in 2024.** Of the 10,699 traps placed 9,933were collected in good condition, which is approximately a 92.8% success rate. The remaining 8.2% were either missing, damaged, or inaccessible. Weather events and harvest prior to trap retrieval account for most of this 8.2%.

Table 4.1 *Number of Traps set per county and the reported number of fields and acres in 2024.*

County	Rep. Fields	Rep. Acres	Traps Set	County	Rep. Fields	Rep. Acres	Traps Set
Avery	1	1.00	0	Lee	8	7,673.96	12
Beaufort	11	98.79	10	Lenoir	192	2,050.51	222
Bertie	58	533.17	88	Martin	142	1,374.64	188
Bladen	2	48.00	5	Moore	9	126.85	21
Cabarrus	1	2.00	2	Nash	1,247	8,532.37	1,170
Caldwell	1	0.08	3	Onslow	1	2.50	2
Carteret	2	3.90	3	Orange	6	6.92	4
Chowan	19	199.63	31	Pasquotank	1	2.50	2
Columbus	33	247.65	44	Pitt	629	5,860.47	567
Craven	158	1,019.66	111	Polk	3	7.01	6
Cumberland	133	1,350.88	212	Richmond	2	8.00	2
Duplin	196	2,197.57	260	Robeson	14	517.55	58
Edgecombe	897	8,286.71	891	Rockingham	1	0.50	0
Forsyth	3	3.50	2	Sampson	1,449	15,504.71	2,076
Franklin	66	454.34	67	Stokes	1	0.25	2
Granville	23	80.84	14	Vance	18	67.78	16
Greene	450	5,176.26	528	Wake	170	934.43	136
Halifax	149	1,077.06	114	Warren	1	40.00	5
Harnett	463	2,521.73	405	Wayne	976	8,271.39	1,028
Hertford	18	227.26	33	Wilson	1,302	8,433.83	1,169
Johnston	1,093	7,673.96	1,186	Yadkin	2	2.00	4
				TOTALS	**9,951**	**90,622.16**	**10,699**

Regulatory Sites

Sweet potato regulatory sites include but are not limited to storage facilities, processing plants, micropropagation units and greenhouse operations growing ornamental sweet potatoes and were surveyed all year long. Because of the inter- and intra-state movement of sweet potatoes these regulatory sites are a high-risk pathway for the introduction of sweet potato weevil. Universal moth traps (or bucket traps) were used instead of the conventional green boll weevil traps in the field because of the higher trapping efficiency (Figure 4.1b). For these operations, a minimum of two traps (one inside and one outside) were set per structure containing sweet potatoes. Traps were placed in strategic locations where sweet potatoes are stored and/or in and around the locations outside the buildings where sweet potatoes are loaded or unloaded. Lures were changed in each trap once a month and data collection were accomplished using the same procedure detailed for the field surveys. A total of 184 unique regulatory sites (totaling 3,669 inspections) were surveyed and **no weevils were found in storage facilities during the 2024 season.**

a)  b) 

Figure 4.1, *a) Green boll weevil trap baited with SPW lure used to survey sweet potato fields; b) bucket traps used to survey storage facilities*

Sweet Potato Weevil Quarantine

North Carolina, despite leading the U.S. in sweet potato production, has an infestation of sweet potato weevil (*Cylas formicarius*). Fortunately, these infestations are confined to two coastal communities of North Carolina in Brunswick and New Hanover counties where a quarantine has been established to protect sweet potato production areas (Figure 4.2). Since the discovery of these populations the goal has been, and continues to be, eradication. NCDA&CS was awarded Specialty Crop Block Grant funding for a two-phase project with phase 1 being dedicated to understanding spatial and temporal distribution of the populations of sweet potato weevil in both counties and phase 2 being dedicated to an eradication effort using male annihilation technique (M.A.T.) through “super” efficient traps pictured and described below in Figure 4.3. This project has experienced a fair share of setbacks with inconsistent temporary labor, funding issues, the COVID-19 pandemic, and environmental conditions to name a few. However, progress has been made.

In 2024, all traps were in place and checked consistently 1 time per month. As it stands, since 2018 we have used the same 10 delimiting grids (labeled A-J) for monitoring and eradication purposes. Of the 8,392 weevils caught this year 98.34% were caught in Brunswick County (delimits H-J) and more specifically in delimit area I which accounted for 88.50% of all weevils caught (Figure 4.4). This trend is consistent with previous years' data for both the county and delimit area. Brunswick County has always produced significantly more weevils, and those weevils have always been most localized to the I delimit grid which is both the largest delimit and has the highest host density. The host in this case is Seaside or Beach Morning Glory (*Ipomoea imperati*), a perennial flowering vine and relative of the sweet potato, that is found on the dunes of Caswell Beach in Brunswick County. In contrast, sweet potato weevils in New Hanover County are subsisting on an assemblage of other annual morning glory species growing in disturbed habitats like roadsides and undeveloped residential lots. This area has seen a surge in building development in the past decade that has drastically reduced host availability for the weevils. In 2024, "legacy traps" that have seen host lost and have not caught sweet potato weevils for several years were identified; 34 traps were removed from the Carolina Beach area.

As is typical, we see weevil populations expanding rapidly in summer (late July-September) and often rise through December when cold temperatures force both the weevil and its host to recede, bottoming out in late winter to early spring (February-April) (Figure 4.5).

Consistent monitoring will continue in 2025 and, given that host destruction is not available as a control method, M.A.T. will be used as funds allow and the use of entomopathogenic fungi will continue to be explored and if possible, implemented in 2026.

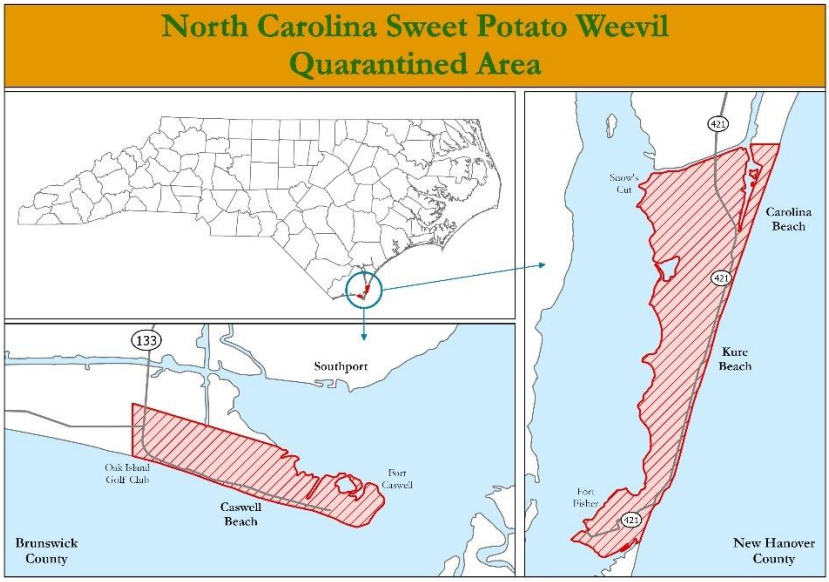

Figure 4.2, *Current Sweet Potato Weevil Quarantine area in North Carolina*

***Figure 4.3**, a. Details of the sweet potato weevil trap to use in the MAT. b. The base of the trap is a funnel made with galvanized mesh (3). This allows weevils to walk to the bucket trap fitted within a PVC ring that holds the funnel (2). The bucket trap includes a solar cell (1) that charges an LED diode that produces a green light shown to attract more weevils. The diode is activated late in the evening when weevils are active and deactivated when there is sunlight.*

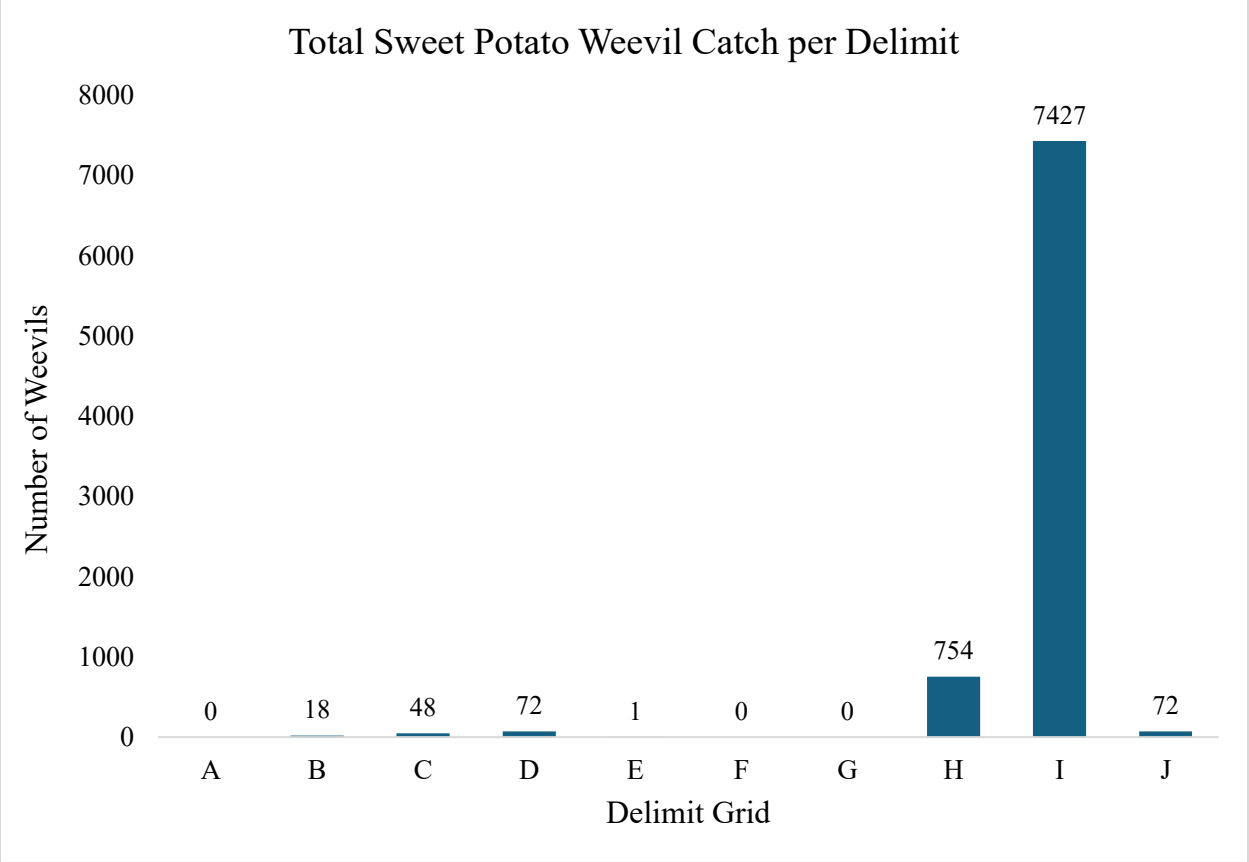

***Figure 4.4,** Total annual catch of sweet potato weevils within each of the 10 delimit areas. Delimits H-J are in Brunswick Co. at Caswell Beach while the others are in southern New Hanover Co.*

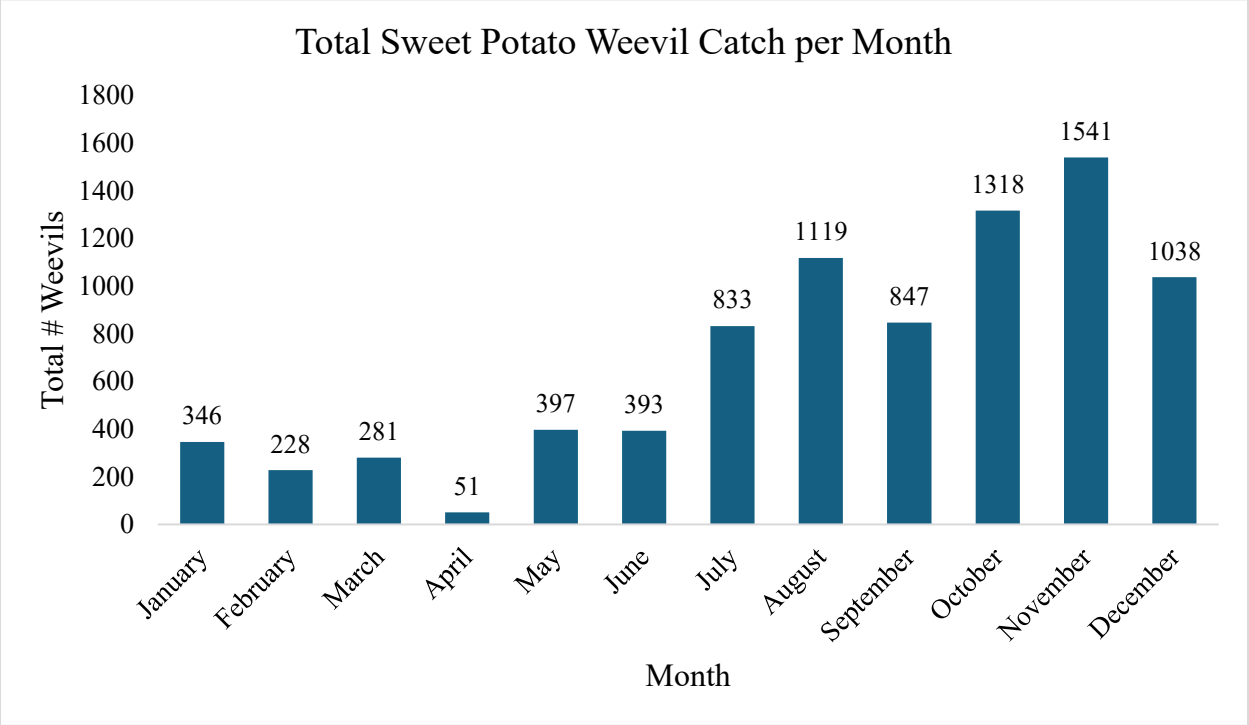

Figure 4.5, *Total weevils captured per month across delimits.*

SPONGY MOTH PROGRAM

Spongy moth (formerly gypsy moth; *Lymantria dispar dispar*) is an invasive species first established in parts of the U.S. in 1869. Spongy moth caterpillars feed on over 300 species of trees and shrubs in the United States and are considered one of the most destructive insect pests threatening our rural and urban forests. NCDA&CS has proudly helped to contain the spread of this pest for 44 years, and the spongy moth survey and management programs are among the most successful invasive species management programs in the United States to date. In North Carolina the program is divided into the Slow the Spread Foundation-funded slow the spread action area (STS) and the USDA APHIS-funded eradication area (EGM) (Figure 4.6). The program includes annual detection surveys (trapping), pest mitigation (treatment), outreach, and regulatory activities which are outlined below.

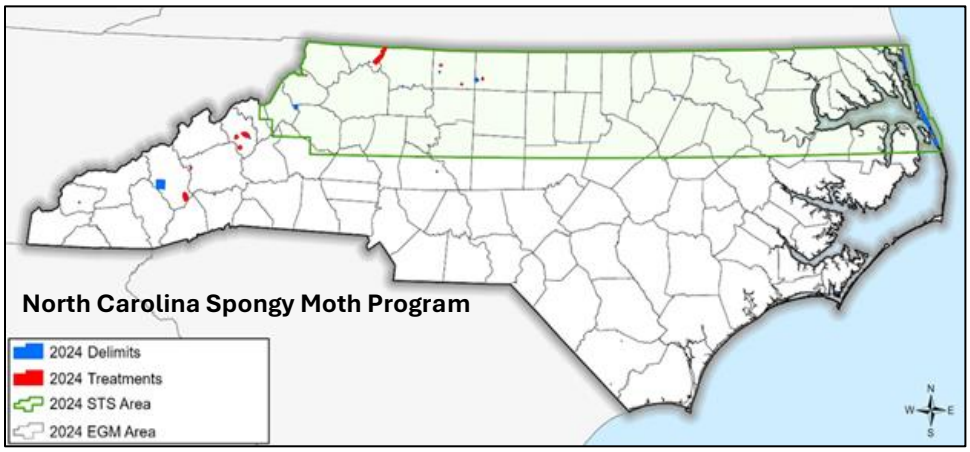

Figure 4.6, *Spongy moth program areas and 2024 spongy moth treatment site and delimiting grids*

Trapping

In 2024, 15,363 traps were set across North Carolina between April and May and removed between July and September 2024. 8,374 traps were set in the STS-funded area (highlighted in green in Figure 4.6) by contractors and NCDA&CS personnel, and 6,241 traps were set in the APHIS-funded eradication area by NCDA&CS personnel. An additional 388 traps were placed at locations with a high risk of spongy moth introduction and establishment across the state as well. Traps were baited with departure, the female-produced sex pheromone of spongy moth (2-methyl-7R, 8S-epoxy-octadecane) and trap locations and data were recorded with iPad units and submitted to the national Slow the Spread database. Trapping resulted in 4,543 adult spongy moth males captured in 1,142 traps (Table 4.2).

Table 4.2*, North Carolina spongy moth trap catches numbers by county, arranged by percentage of traps with at least one spongy moth capture.*

County Name	Traps Placed	Positive Traps	Moths	% Positive
Haywood	151	49	2,688	32%
Caswell	270	71	106	26%
Stokes	315	79	115	25%
Person	247	57	64	23%
Rockingham	415	94	128	23%
Guilford	266	59	78	22%
Granville	332	70	79	21%
Warren	290	60	89	21%
Forsyth	206	41	44	20%
Surry	348	67	92	19%
Vance	188	36	43	19%

County Name	Traps Placed	Positive Traps	Moths	% Positive
Alleghany	168	31	60	18%
Currituck	162	27	448	17%
Gates	229	38	47	17%
Alamance	176	26	29	15%
Durham	119	17	18	14%
Orange	177	25	30	14%
Franklin	225	25	41	11%
Yadkin	195	18	18	9%
Yancey	92	8	13	9%
Camden	131	11	14	8%
Hertford	227	19	20	8%
Northampton	361	26	35	7%
Jackson	100	7	16	7%
Halifax	447	30	40	7%
Randolph	221	14	14	6%
Davidson	169	9	9	5%
Wake	248	13	14	5%
Madison	111	5	5	5%
Ashe	279	12	14	4%
Watauga	211	9	16	4%
Lee	71	3	3	4%
Wilkes	425	17	25	4%
Montgomery	124	4	4	3%
Rowan	159	5	20	3%
Bertie	303	9	10	3%
Buncombe	183	5	7	3%
Dare	186	5	6	3%

County Name	Traps Placed	Positive Traps	Moths	% Positive
Davie	79	2	2	3%
Moore	203	5	5	2%
Nash	171	4	4	2%
Cleveland	135	3	3	2%
Pasquotank	146	3	3	2%
Chatham	209	4	4	2%
Gaston	111	2	2	2%
Beaufort	171	3	3	2%
Wilson	119	2	2	2%
Mitchell	61	1	1	2%
Chowan	82	1	1	1%
Richmond	92	1	1	1%
Washington	98	1	1	1%
Avery	99	1	1	1%
Burke	142	1	1	>1%
Caldwell	166	1	1	>1%
Catawba	126	1	1	>1%
Edgecombe	148	1	1	>1%
Hyde	132	1	1	>1%
Iredell	177	1	1	>1%
Martin	131	1	1	>1%
Stanly	116	1	1	>1%
Alexander	78	0	0	0%
Anson	87	0	0	0%
Bladen	97	0	0	0%
Brunswick	106	0	0	0%
Cabarrus	105	0	0	0%

County Name	Traps Placed	Positive Traps	Moths	% Positive
Carteret	82	0	0	0%
Cherokee	124	0	0	0%
Clay	39	0	0	0%
Columbus	114	0	0	0%
Craven	77	0	0	0%
Cumberland	144	0	0	0%
Duplin	84	0	0	0%
Graham	39	0	0	0%
Greene	48	0	0	0%
Harnett	173	0	0	0%
Henderson	103	0	0	0%
Hoke	62	0	0	0%
Johnston	233	0	0	0%
Jones	47	0	0	0%
Lenoir	44	0	0	0%
Lincoln	86	0	0	0%
Macon	91	0	0	0%
McDowell	118	0	0	0%
Mecklenburg	170	0	0	0%
New Hanover	75	0	0	0%
Onslow	69	0	0	0%
Pamlico	44	0	0	0%
Pender	89	0	0	0%
Perquimans	146	0	0	0%
Pitt	162	0	0	0%
Polk	67	0	0	0%
Robeson	106	0	0	0%

County Name	Traps Placed	Positive Traps	Moths	% Positive
Rutherford	159	0	0	0%
Sampson	188	0	0	0%
Scotland	36	0	0	0%
Swain	47	0	0	0%
Transylvania	70	0	0	0%
Tyrrell	89	0	0	0%
Union	129	0	0	0%
Wayne	95	0	0	0%
Total	**15,363**	**1,142**	**4,543**	**7%**

Trapping surveys in both the STS-funded area and APHIS-funded eradication area were conducted following national program methods. Orange, coated-paper sticky traps were set between 3 and 5 kilometers apart throughout the southern portion of North Carolina, though traps were set at a closer 2 kilometer spacing within 30 miles of the Virginia border and 1 kilometer or less spacing in some areas to characterize suspected reproducing spongy moth populations (delimiting). Funding provided by USDA-APHIS was used to employ 9 temporary employees, purchase survey supplies (including traps, lures, trap assembly supplies, and office supplies), and for operational expenses (including fuel and maintenance for survey vehicles) within the eradication area. In the STS-funded area, six contractors set traps in 25 bid units. Temporary personnel and permanent NCDA&CS staff performed quality control inspections on a minimum of 10% of the traps set by contractors, and no significant quality issues were noted.

The greatest number of moths were detected in the mountainous western portion of the state, from the Virginia-North Carolina border south through the Waynesville area. (Figure 4.7).

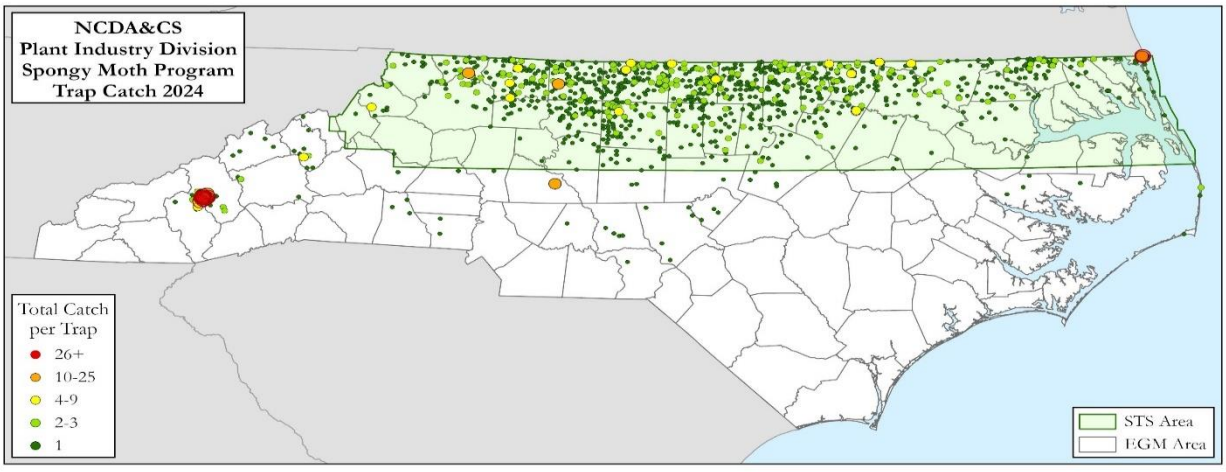

***Figure 4.7**, Spongy moth trapping results indicate the above areas with potential population establishment (red and yellow).*

As a result, five larvicide (*Btk*) treatments totaling 7,009 acres are proposed for spring 2025, pending federal funding availability (Table 4.3). Multiple higher density trapping areas are planned as well to allow accurate characterization of suspected spongy moth populations in high-capture locations.

Table 4.3, *Locations of larvicide treatments proposed for 2025.*

Block Name	County	Product	Dosage	Acres
Glade Valley	Alleghany	Foray 48B	24BIUx1	748
Dellw 1	Haywood	Foray 48B	24BIUx1	381
Hazel 1	Haywood	Foray 48B	24BIUx1	1,563
Hazel 2	Haywood/Jackson	Foray 48B	24CLUx1	2,909
Pinnacle	Stokes	Foray 48B	24BIUx1	1,408
			TOTAL	**7,009**

Treatment

In June 2024, ten mating disruption treatments were performed in North Carolina (Figure 4.1). A total of 29,921 acres were treated with 6g dosage of SPLAT GM-O (Table 4.4). Evaluation of the efficacy of these treatments will take place in 2025 and 2026.

Table 4.4: *Locations of mating disruption treatments in 2024.*

Block Name	County	Product	Dosage	Acres
Cumberland Knob	Alleghany	SPLAT GM-O	6g	10,900
Leicester	Buncombe	SPLAT GM-O	6g	756
Cruso	Haywood	SPLAT GM-O	6g	6,129
Ellisboro	Rockingham	SPLAT GM-O	6g	745
Hanging Rock	Stokes	SPLAT GM-O	6g	844
Walnut Cove	Stokes	SPLAT GM-O	6g	454
Zionville	Watauga	SPLAT GM-O	6g	437
Bowditch	Yancey	SPLAT GM-O	6g	5,250
Eskota	Yancey	SPLAT GM-O	6g	2,338
Pensacola	Yancey	SPLAT GM-O	6g	2,068
			TOTAL	**29,921**

Outreach

Opportunities for public interactions are an important part of spongy moth management success and allow this program the chance to learn from members of the public's lived experience and understanding of spongy moth establishment risks that are otherwise difficult to see from charts and data. The program has benefitted from the time, words of encouragement, and constructive criticisms that have been shared, and outreach and engagement is a continual process. Information sessions with the public were held for updating and receiving feedback on anticipated 2025 program activities. New and updated digitally available spongy moth resources continued to be developed for outreach events, and materials will be printed as needed.

Regulatory

The final component of the spongy moth control programs in North Carolina is regulatory management. The risk of additional movement and establishment of spongy moth beyond their natural spread is reduced by strategically restricting movement of high-risk regulated articles including timber products, outdoor household articles, recreational vehicles, and trees and woody shrubs out of generally infested areas following North Carolina and USDA regulations (02 N.C.A.C. 48A.1500 *et seq*., C.F.R. 7 §301.45(e)). In North Carolina, all of Currituck County and a small portion of Dare County were quarantined in 1988 and remain our only federally quarantined spongy moth areas (Figure 4.8).

Regulated articles may be moved from quarantined to non-quarantined areas if the appropriate personnel within organizations undergo training and receive a compliance agreement from NCDA&CS. These compliance agreements require inspection and/or treatment of articles to ensure that they are free of spongy moth life stages. Several businesses and individuals received training for new staff in 2024, and multiple new compliance agreements were processed.

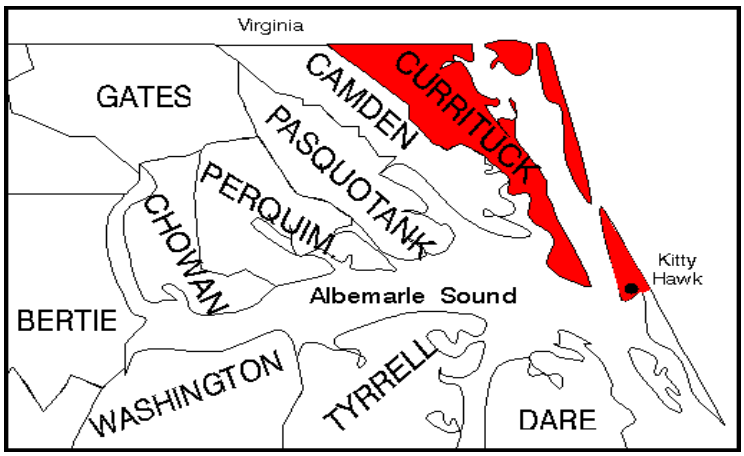

Figure 4.8, *Spongy moth quarantine area in North Carolina, shown in red.*

IMPORTED FIRE ANT PROGRAM

The Imported Fire Ant (*Solenopsis invicta*; IFA) continues to be a serious pest in the southern United States with infestations occurring in fourteen states. North Carolina is on the leading edge of the expanding range of fire ants. Currently, 77 of North Carolina's 100 counties are either partially or entirely infested. NCDA&CS' objective is to prevent the artificial spread of IFA from infested areas to non-infested areas through regulatory actions. The following report summarizes the NCDA&CS survey and regulatory activities conducted for the Imported Fire Ant Program from January 1 to December 31, 2024:

Survey

Drive-by surveys were conducted in 14 counties in NC yielding 504 data entries (Figure 4.9; Table 4.5). Data was collected using iPads and the ESRI Survey 123 for ArcGIS application and included new IFA mounds and established sites. The option to choose ‘0 mounds was included and indicates sites with no mounds reported. This was used to show the areas surveyed in all counties (negative controls). Based on the results of the 2024 IFA survey we recommend expanding our North Carolina IFA quarantine to include all or parts of Forsyth, Davie and Iredell Counties in 2026. Virginia and Tennessee have both expanded their IFA quarantine along the North Carolina border extending beyond our current NC IFA quarantine boundaries in the past few years. In 2025, we will continue to survey these borders along the newly expanded IFA quarantine line. We will also be surveying locations outside the current quarantine that were used as donation drop-off sites for hay, straw, and other articles capable of inadvertently transporting fire ants as a part of Hurricane Helene relief efforts.

Regulatory

As part of the IFA program’s regulatory activities, 8 blitzes were scheduled to be conducted in three locations across the state to ensure that operations moving regulated articles outside the quarantine area in NC are in compliance with federal and state regulations. A total of 8 blitzes were to be held in 2024 with 4 days in the spring and 4 days in the fall. Dates and locales are given in Table 4.6 below. NCDA&CS stopped a total of 25 trucks to inspect their load and review/record their paperwork in 2024. Of those 25 trucks we collected 19 total soil samples. A total of 4 trucks were returned to their origin, including 2 trucks hauling non-complaint dirty wheat straw, 1 hauling non-cleaned construction equipment, and 1 transporting potted palm trees to a film set outside of the quarantine and unaware of the need for inspection. The results of those samples are pending anticipated repairs at our Food & Drug Laboratory on some analytical equipment. Commodities carried by these trucks included greenhouse produced house plants, balled and burlapped trees, containerized shrubs, and other similar products.

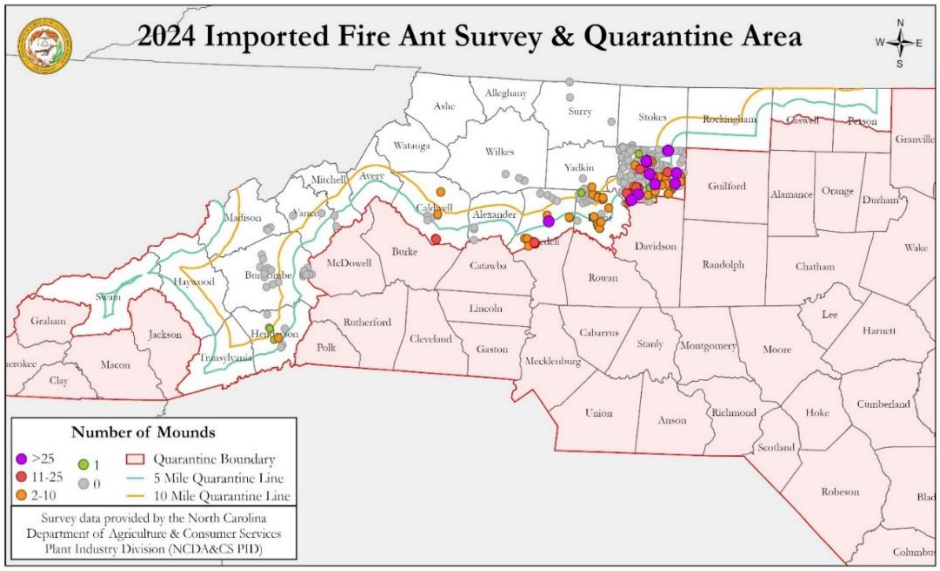

Figure 4.9, *NC Imported Fire Ant survey results (January-December 2024). 504 data points were collected, 321 of which were reported as ‘0 mounds observed’.*

***Table 4.5**, 2024 NC Imported Fire Ant survey summary.*

County	Areas Surveyed	Regulatory Action Recommended[1]	Absent	Established Sites	New Observation[2]	Total Sites
Alexander	5 miles from the quarantine	No action	3	0	0	**3**
Buncombe	5 & 10 miles from the quarantine; More than 20 miles from quarantine line	No action	30	0	0	**30**
Caldwell	5 & 10 miles from the quarantine	No action	4	2	2	**8**
Davie	5 & 10 miles from the quarantine	Add	18	30	9	**57**
Forsyth	5 & 10 miles from the quarantine; More than 20 miles from quarantine line	Add	231	32	81	**344**
Henderson	5 & 10 miles from the quarantine	No action	7	0	3	**10**
Iredell	5 & 10 miles from the quarantine; More than 20 miles from quarantine line	Expand	5	7	15	**27**
Madison	More than 20 miles from quarantine line	No action	4	0	0	**4**
Mitchell	5 miles from the quarantine	No action	2	0	0	**2**

County	Areas Surveyed	Regulatory Action Recommended[1]	Absent	Established Sites	New Observation[2]	Total Sites
Stokes	5 & 10 miles from the quarantine; More than 20 miles from quarantine line	No action	4	0	0	**4**
Surry	More than 20 miles from quarantine line	No action	4	0	0	**4**
Wilkes	More than 20 miles from quarantine line	No action	4	0	0	**4**
Yadkin	More than 20 miles from quarantine line	No action	3	0	2	**5**
Yancey	5 & 10 miles from the quarantine; More than 20 miles from quarantine line	No action	2	0	0	**2**
Total			**321**	**73**	**110**	**504**

[1]"No action" when numbers are not enough to justify a regulatory action. "Expand" when partially quarantined counties have shown significant numbers of IFA mounds above the quarantine line. "Add" when there is conclusive evidence that a significant number of IFA mounds are detected in a county where no previous mounds have been reported.

[2]For the purposes of this table new observations are only recorded for the presence of mounds. If a new observation was recorded but there were no mounds present that are recorded on the 'Absent' column of this table

Table 4.6, *2024 IFA Blitz Summary*

Date	Location	Trucks Stopped	Sample Taken
03/12/24	Halifax Co. (I-95 North Bound)	4	1
03/13/24		4	3
03/19/24		5	5
03/20/24		4	1

10/15/24	Halifax Co. (I-95 North Bound)	4	4
10/16/24		1	1
10/22/24		0	0
10/23/24		3	4
Totals		**25**	**19**

BLUEBERRY CERTIFICATION PROGRAM

The blueberry maggot (*Rhagoletis mendax*; BBM; Figure 4.10) is a serious pest of both lowbush and highbush blueberries. Infestations of this pest lead to unmarketable berries, reductions in yield, and increased production costs. The maggot is native to eastern North America and is found in the eastern United States, including North Carolina. While native to Nova Scotia, New Brunswick, and Prince Edward Island, the pest was detected in Ontario and Quebec in the mid-1990s—two regions where the maggot had not previously been known to exist. As a result, Canada regulates *R. mendax* to prevent spread of BBM into provinces that are currently free of this pest. The Blueberry Certification Program (BCP) was initiated by the Canadian Food Inspection Agency (CFIA) in 1999 to facilitate the movement of fresh blueberries while managing the risk of further spread of the blueberry maggot into non-infested areas of Canada.

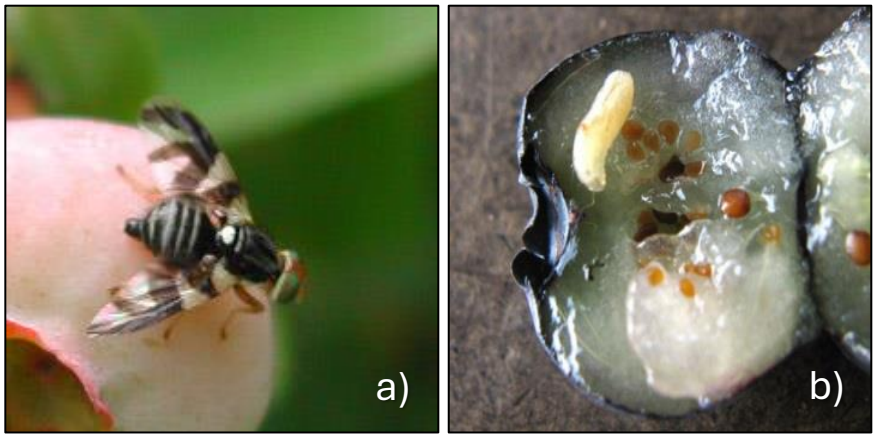

Figure 4.10, *Blueberry maggot (Rhagoletis mendax): a) adult; b) larva inside blueberry (Photos by Rufus Isaacs, MSU)*

In North Carolina, we currently have 20 blueberry farms located in four southeastern NC counties (Bladen, Duplin, Pender, and Sampson) participating in the Blueberry Certification Program. In May 2024, we mailed out the annual blueberry maggot flight letter informing all growers in the program that they should begin their internal audits. All growers are required to perform a brown sugar or salt flotation test on their berries every three days starting from when they receive their flight letter until they are done packing and shipping for the season. The flotation test involves soaking two pints of gently crushed berries in either a sugar or salt solution for 10 minutes to observe whether any maggots float to the surface (Figure 4.11; the complete method can be found at https://www.ncagr.gov/divisions/plant-industry/plant-protection/entomological-services/blueberry-certification-program.

In May and June, NCDA&CS Plant Protection personnel traveled to each farm to perform the annual regulatory audit. The NCDA&CS audit consists of performing the flotation test and checking the calendar spray treatment and/or trapping records (if utilizing IPM) to ensure the growers are following the CFIA BCP regulations. Every grower in the program elected to use the salt solution (as opposed to the brown sugar solution). The results were negative for all audits performed (both internal and regulatory). A total of 33 inspections were conducted this year for 20 farms. All 20 farms opted to use calendar spray treatments at all inspected locations. There were 137 spray treatments done by these 20 farms and 224 salt/sugar flotation tests all of which were negative for blueberry maggot.

In 2017, we began using Survey 123 to record data collected during the audits which fine-tuned the data collection process through use of a “smart form” (a form that modifies the input fields based on the data being collected, e.g. if a grower is using the calendar spray program the form will not ask you questions about IPM trapping results). We continue to utilize Survey 123.

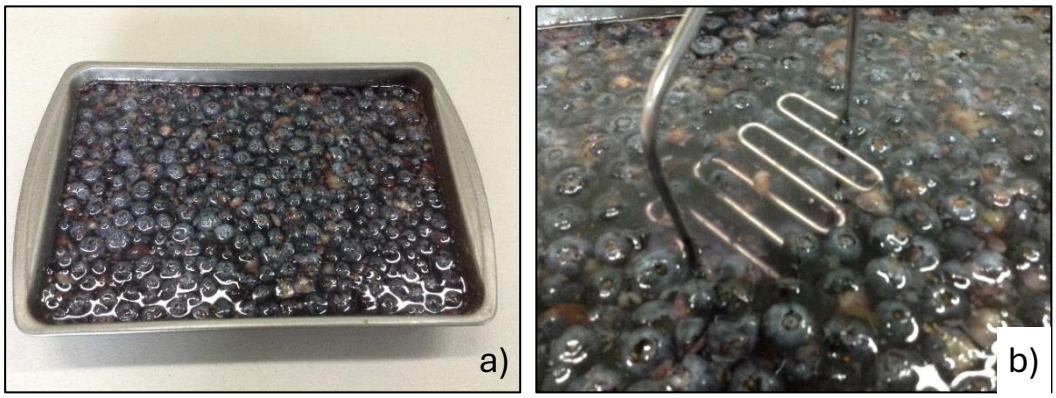

Figure 4.11, *Salt flotation test: a) blueberries soaking in saltwater solution for 10 minutes; b) close-up of flotation test showing potato masher used to gently crush berries. (Photos by Whitney Swink, NCDA&CS)*

COTTON BOLL WEEVIL PROGRAM

Field surveys for the cotton boll weevil (*Anthonomus grandis*) were coordinated and carried out by the NC Cotton Boll Weevil Eradication Foundation. In 2024, a total of 403,388.26 acres were reported in 48 counties (Table 4.7). Plant Industry Division personnel surveyed cotton gins, cotton processing facilities, and ornamental cotton in 32 counties totaling 574 individual inspections using conventional cotton boll weevil traps across 11 different specialist regions (Table 4.8). Traps were baited with a male specific sex pheromone and checked once a month.

***Table 4.7**, Cotton acreage by county in North Carolina for 2024*

County Name	Total Acreage	County Name	Total Acreage
ALAMANCE	0.00	LEE	312.91
ANSON	3,464.51	LENOIR	6,839.51
BEAUFORT	6,658.67	LINCOLN	122.07
BERTIE	37,084.12	MARTIN	25,283.08
BLADEN	14,266.27	MECKLENBURG	0.00
BRUNSWICK	0.00	MONTGOMERY	1,032.86
CABARRUS	840.47	MOORE	0.00
CAMDEN	162.34	NASH	7,252.27
CARTERET	0.00	NORTHHAMPTON	33,807.38
CATAWBA	0.00	ONSLOW	1,218.53
CHOWAN	11,622.80	ORANGE	0.00
CLEVELAND	138.51	PAMLICO	0.00
COLUMBUS	1,264.82	PASQUOTANK	1,209.71
CRAVEN	3,622.04	PENDER	235.71
CUMBERLAND	5,906.28	PERQUIMANS	13,174.78
CURRITUCK	0.00	PITT	22,120.38
DAVIDSON	0.00	RANDOLPH	1,847.02
DUPLIN	2,984.93	RICHMOND	965.79
DURHAM	0.00	ROBESON	10,999.47
EDGECOMBE	26,388.72	ROWAN	0.00
FORSYTH	0.00	RUTHERFORD	0.00
FRANKLIN	0.00	SAMPSON	8,076.81
GATES	14,102.07	SCOTLAND	4,473.61
GRANVILLE	0.00	STANLY	10,256.57
GREENE	4,040.99	TYRRELL	6,007.82
HALIFAX	43,647.41	UNION	1,170.74

County Name	Total Acreage	County Name	Total Acreage
ALAMANCE	0.00	LEE	312.91
ANSON	3,464.51	LENOIR	6,839.51
BEAUFORT	6,658.67	LINCOLN	122.07
BERTIE	37,084.12	MARTIN	25,283.08
BLADEN	14,266.27	MECKLENBURG	0.00
BRUNSWICK	0.00	MONTGOMERY	1,032.86
CABARRUS	840.47	MOORE	0.00
HARNETT	4,107.32	WAKE	48.41
HERTFORD	14,678.45	WARREN	416.25
HOKE	3,773.72	WASHINGTON	4,511.03
HYDE	13,310.02	WAYNE	2,999.08
IREDELL	1,868.90	WILSON	6,746.58
JOHNSTON	11,067.12	YADKIN	0.00
JONES	7,259.38	**Total**	**403,388.26**

***Table 4.8**, Cotton site inspections of traps placed inside, and outside facilities or ornamental cotton grow sites per inspector region per county for 2024.*

Inspector	County Name	# of Inspections
April Bauder	Durham	10
April Bauder	Wake	5
Bonnie Faulkner	Nash	3
Bonnie Faulkner	Wilson	3
Chris Carter	Bladen	15
Chris Carter	Cumberland	23
Chris Carter	Hoke	14
Chris Carter	Robeson	12
Daniel Brewer	Mecklenburg	10
Derreck Long	Halifax	122
Derreck Long	Northampton	71

Inspector	County Name	# of Inspections
Ginger Hemmings	Alleghany	12
Ginger Hemmings	Surry	9
Ginger Hemmings	Wilkes	15
Joe Davenport	Bertie	48
Joe Davenport	Chowan	25
Joe Davenport	Gates	24
Joe Davenport	Hertford	24
Joe Davenport	Hyde	24
Joe Davenport	Perquimans	24
Jonathan Bass	Duplin	10
Jonathan Bass	Sampson	5
Juliet Whitehurst	Beaufort	22
Juliet Whitehurst	Jones	4
Sam Harris	Anson	6
Sam Harris	Stanly	4
Sam Harris	Union	8
VACANT*	Edgecombe	3
VACANT*	Martin	2
VACANT*	Pitt	3
VACANT*	Greene	4
VACANT*	Lenoir	10
11	**32**	**574**

** Regions that are vacant due to the retirement or departure from NCDA&CS- PID are covered by other Plant Pest Specialists within the region*

SPOTTED LANTERNFLY PROGRAM

Spotted Lanternfly Overview

Spotted Lanternfly (*Lycorma delicatula*) (SLF) is a relatively new pest in North America. Discovered in Berks County, Pennsylvania in 2014, SLF has since spread to 17 states which include: Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Ohio, Michigan, Indiana, West Virginia, Maryland, Delaware, Virginia, Illinois, Kentucky, Tennessee, Georgia, and since June 23, 2022, known to infest parts of

North Carolina. At present, there are over 130+ host species for this insect including maples, birches, oaks, sycamores, roses, grapes, apples, and many others. Two preferred hosts for this pest that North Carolina has in abundance are Tree of Heaven (TOH, *Ailanthus altissima*) and Chinaberry (CB, *Melia azedarach*), both of which support SLF populations in their native range and are generally considered invasive in the U.S., thrive in disturbed habitats like railway and highway right of ways. The greatest risk of spreading SLF is through human assisted means via trucking, rail, and generally via interstate commerce and shipping. Accordingly, there are clear patterns indicating that SLF has reached these 18 states in a short 9-year span in this manner. Seeing this threat expanding, North Carolina was very proactive and received both specialty crops and PPA-7721 funding to do work related to spotted lanternfly preparedness like outreach to vulnerable industries, surveys for Tree of Heaven, and the acquisition of materials that would be needed to treat an infestation. Without those outreach efforts, it is unclear whether we would have discovered our known infestation by now or not. North Carolina has had three full seasons of treating SLF at the Kernersville infestation and continues to receive reports from varying North Carolina locales with reports of SLF. Each report continues to be investigated based on perceived risk. Both citizen reports and management activities are discussed below.

SLF Reports

In the calendar year 2024, the Plant Industry Division received approximately 286 citizen reports of suspect Spotted Lanternfly. The vast majority of these reports were from within the infestation area and were redirected to their local Extension office.

Six verified reports of SLF from outside the known infestation area that required additional inspection. Living or dead spotted lanternflies were reported include Watauga, Buncombe, Mecklenburg, New Hanover, Lee, Durham, and Wake counties. Follow up investigations at these sites yielded no additional findings or suspicions of establishment but will be followed up as time allows by detector canines in 2025. The majority of reports from outside of the known SLF-infested area remain misidentifications with giant leopard moth, various stinkbugs, and boxelder/milkweed bugs being the most commonly mistaken for SLF. NCDA&CS personnel were involved in 3 significant SLF detections/ interceptions in 2024:

Surry County: The same, singular parcel bordering Virginia in Surry County that had been positive for SLF adults in July 2023 and received immediate treatment was surveyed frequently to ensure treatment success during 2024. In February 2024, our western region Detector Dog team found a single egg mass at a rest area near the border with Virginia in Surry County that was immediately destroyed. Visual surveys were conducted at this site monthly from March – November. No additional SLF were found at this site in 2024.

Guilford County: In July 2024, our eastern region Detector Dog team found a new infestation in Greensboro (Guilford County) through surveying a high-risk property between the rail line and a major event venue. SLF survey crews have now found multiple locations with breeding SLF in the Greensboro

area. The Greensboro finds are largely not contiguous with the Kernersville population and could have been a separate introduction or spread by local traffic.

McDowell County: Our western Phytosanitary Specialist witnessed one interception while assisting with receiving disaster relief supplies following Hurricane Helene. She witnessed multiple dead adult spotted lantern fly between bags of feed shrink wrapped inside a pallet of pellets and alfalfa hay for WNC livestock as they were unloaded. Fortunately, there were no visible egg masses on the pallets.

Additional follow up site visits for these locations are planned in 2025 to make sure no populations are established. These finds also highlighted the increased risk of accidental pest introduction risk through disaster relief donations. NCDA&CS personnel will be surveying sites like donation centers and debris piles throughout impacted areas in 2025.

Kernersville Infestation Management

Treatment

NCDA&CS rekindled spring operations by treating with bifenthrin for first-instar nymphs on April 25th and April 30th – May 1st. This was approximately 4 weeks after the first nymphs were noted on April 1st. This was in line with our goals to treat after at least 50% hatch was observed to mitigate a greater percentage of emerging nymphs. Our second planned Spotted Lanternfly treatment occurred June 24th-June 26th. We utilized 7-9 staff each day to apply dinotefuran to TOH on priority parcels via backpack sprayers. We also utilized triclopyr-3 applied foliarly or in conjunction with tree girdling to remove various diameter TOH when possible. One additional bifenthrin spray was scheduled for early October, but this was cancelled to free up both our equipment and our personnel for recovery efforts following Hurricane Helene. Table 4.9 summarizes the extent of the work accomplished during calendar year 2024.

Table 4.9, *Treatment totals for calendar year 2024 treatment activities*.

Active Ingredient	Estimated # of treated trees & saplings	Total treated DBH	Gallons of mixed product	Total Parcels Treated*
bifenthrin	1901	N/A	663.50	62
dinotefuran	967	1598	30.25	49
triclopyr-3	4361	2798	35.83	78
TOTALS	**7,229**	**4,396**	**729.58**	**95**

**Many parcels received treatment with multiple products/ repeat visits. The total accounts for this overlap.*

Winter Egg Mass Surveys and QC

During the winter of 2023-2024, a total of 442 sites were surveyed for egg masses yielding 381 sites with egg masses present totaling 1,807egg masses on 20+ species of tree/plant/vine (Table 4.10). Egg mass surveys ran from November 27th, 2023 – May 16th, 2024. All eggs appeared to have hatched by April 19th, over a month before some northern states see complete hatch.

The first fresh egg masses of 2024 were found on September 12th, within 2 weeks of northern states. Late season and winter survey efforts were focused on identifying sites with egg masses, egg mass removal, and using that information to prioritize treatment efforts in the spring starting in April 2025. Host tree information was not captured as the 2023-24 survey confirmed that egg masses are laid indiscriminately.

From September 12th, 2024 – March 1st, 2025, 73 sites containing a total 2,347 egg masses were confirmed to have SLF egg masses. Approximately 25.15% of these egg masses were laid below 6 feet. The furthest egg mass at present is approximately 15.1 miles east of the estimated centroid, and there are also finds 9.6 miles north in Stokesdale, 9.4 miles west in Winston-Salem, and 4.0 miles south of the centroid in High Point. The majority of finds were within 2.0 miles of the centroid in Kernersville, but egg masses from satellite populations were reported in Greensboro, Oak Ridge, Winston-Salem, and Jamestown. No SLF egg masses were detected outside of Forsyth and Guilford counties.

Table 4.10, *List of trees with SLF egg masses, Nov. 29, 2023 – Apr. 19, 2024*

Common Name	Scientific Name
Maples & Boxelders	*Acer* spp.
Tree of Heaven	*Ailanthus altissima*
Mimosa	*Albizia julibrissin*
American hornbeam/ muscle wood	*Carpinus caroliniana*
Hackberry	*Celtis* spp.
Eastern Redbud	*Cercis canadensis*
Persimmon	*Diospyros* spp.
Beech	*Fagus grandifolia*
Holly spp.	*Ilex* spp.
Walnut spp.	*Juglans* spp.
Redcedar	*Juniperus virginiana*
Crepe Myrtle	*Lagerstroemia* spp.
Chinese Privet	*Ligustrum sinense*
Sweetgum	*Liquidambar styraciflua*
Tulip Tree	*Liriodendron tulipifera*
Honeysuckle	*Lonicera japonica*
Princess tree	*Paulownia tomentosa*
American sycamore	*Platanus occidentalis*
Bradford/Callery Pear	*Pyrus calleryana*
Black Locust	*Robinia pseudoacacia*

Black Willow	*Salix nigra*
Oak spp.	*Quercus* spp.
Pine spp.	*Pinus* spp.
Cherry	*Prunus* spp.
Elm	*Ulmus* spp.
Climbing Vine (wild grape, poison ivy, Virginia creeper, etc.)	N/A
Other	N/A
Unknown	N/A

Statewide SLF Survey

10 PID temporary employees conducted visual surveys for SLF and its preferred host trees, (tree-of-heaven and chinaberry tree) and placed lampshade traps at a total of 36 high-risk locations throughout the state. All data was collected through an ESRI Field Maps application created by our GIS Specialist James Goethe.

Host Tree Visual Survey

Approximately 5,916 sites were inspected for SLF and its preferred host trees (Tree of Heaven [TOH, *Ailanthus altissima*] and Chinaberry [CB, *Melia azedarach*]) throughout North Carolina while conducting this survey during calendar year 2024 (Table 4.11). In total, 9 temporary employees and 22 full-time employees participated in this survey in 2024. Since the statewide survey first began in 2020, we have surveyed 97 of our 100 counties. The remaining 3 counties are on the eastern extremity of our state, have low climate suitability for TOH, CB, or both, reducing the likelihood of pest introductions.

Table 4.11, *SLF statewide survey activities 2024 (excluding infested area)*

Survey Detections	2024 Surveys	Total (all years)
Tree-of-heaven sightings	3,959	15,913
Chinaberry sightings (TOH present)	279	398
Negative tree of heaven sightings	1,957	2,723
Chinaberry sightings (TOH absent)	1,416	4,139
Circle trap survey locations (through Dec. 2023)	0	133
Lampshade Trap survey locations	36	36
Counties surveyed	89	97

Trapping

NCAD&CS has used traps to supplement monthly visual surveys at high-risk locations since 2022. There is yet to be an effective pheromone lure/ trap combination developed for spotted lanternfly detection, however, USDA researchers have been looking into potential trapping methods since SLF was first found in Pennsylvania in 2014 and are consistently looking for different trap types that better fit with spotted lanternfly's biology and behavior. This group recently published their findings in an article that is available to the public at no cost:

https://doi.org/10.3389/finsc.2023.1154510. This data was also presented by the group at the 2024 Spotted Lanternfly Summit, which was attended by several Plant Industry Division employees. Their findings emphasized that the circle traps that we had used in previous years are not effective for detection. However, they also presented data on a new, more promising trap type. Lampshade traps are made by wrapping a roll of roofing shingle around a tree have recently found effective as oviposition traps for capturing egg masses laid by SLF females (Figure 4.13.a). The traps take advantage of SLF's tendency to lay eggs on dark, rough surfaces and climb high before laying egg masses. The trap allows them to crawl in, but they are stopped by batting at the top. The females then lay their eggs on the material and exit the trap, and egg masses can be removed from the field (Figure 4.13.b).

Lampshade traps were placed by CAPS trappers at locations vulnerable to SLF by high introduction or high damage risk. Visual surveys were conducted at each of these locations every month, in addition to servicing the traps. A total of 36 traps were placed in 2024, of which 24 were placed at vineyards, 7 along transportation pathways, and 5 popular destinations. These were placed primarily in conjunction with other CAPS survey traps that share pest introduction risk/ vulnerability, such as the Grape Commodity and Asian Defoliators surveys. Spotted lanternfly was detected at one of these sites in Surry County by the CAPS surveyor (see "SLF Reports" above).

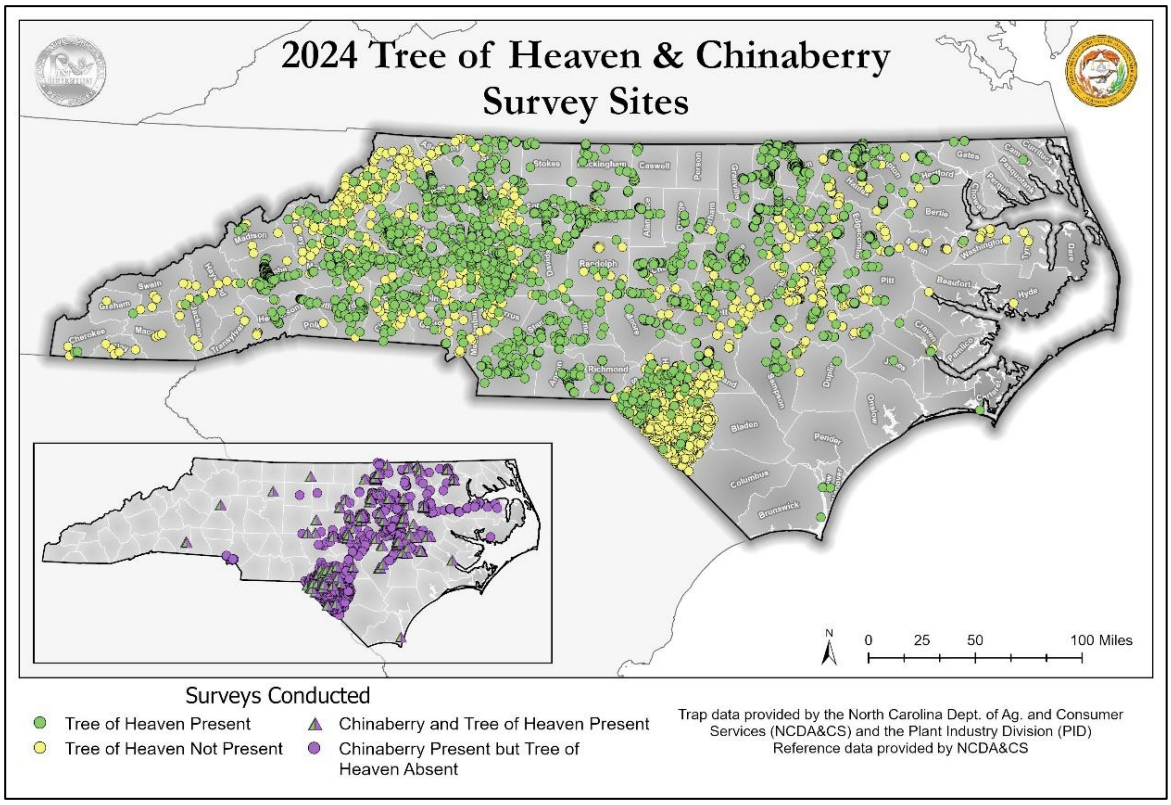

***Figure 4.12**, A. altissima (TOH) & M. azedarach (CB) observations in North Carolina in 2024*

Figure 4.13, *a) Lampshade trap setup on Ailanthus tree (photo by Phil Lewis, USDA-APHIS-PPQ Forest Pest Methods Laboratory). B) Lampshade trap from below with SLF egg masses, Kernersville, NC (photo by Jackie Fredieu, NCDA&CS-PID).*

BROWN GARDEN SNAIL PROGRAM

The brown garden snail (*Cornu aspersum*; BGS) was intentionally and illegally introduced into a small area in Kill Devil Hills (Dare County), North Carolina in the mid-1980s as part of a project intended to raise and sell these mollusks to restaurants and businesses (heliculture farming, which is prohibited in North Carolina). BGSs are a non-native species of mollusk that can be a potentially destructive pest for agriculture, and specifically the nursery industry.

Since BGS was reported in North Carolina, and a small population was established in the Kill Devil Hills area, NCDA&CS has been monitoring and containing its spread with periodic applications of molluscicides (Sluggo®) and by manually killing snails.

MOVEMENT OF LIVE ARTHROPODS FOR RESEARCH, COMMERCIAL, OR EDUCATION PURPOSES

The Entomological Programs Manager evaluated approx. 168 federal applications for PPQ 526 e-Permits in 2024. The large number of applications to move insects into North Carolina reflects the continued strong market in entomological research, commerce, and education in the state conducted by our public and private institutions.

CURRENT INSECT QUARANTINES IN NORTH CAROLINA

***Table 4.12**, Insect Quarantines in North Carolina Active in 2024*

Regulatory Species	**Quarantines as of December 2024**
Spongy Moth (*Lymantria dispar*)	**Currituck County** and a small portion of **Dare County.** Quarantine area remained unchanged relative to 2017. (Figure 4.8)
Imported Fire Ant (*Solenopsis invicta*)	Expanded to include all of Alamance, Burke, Guilford, Jackson, and McDowell counties. A total of **77 counties** are under entire or partial quarantine in NC. (Figure 4.9)
Sweetpotato weevil (*Cylas formicarius*)	Coastal areas of **Brunswick** (Caswell Beach) and **New Hanover** (Carolina Beach and Kure Beach) counties. (Figure 4.2)

Nursery Certification Program

Prepared by Joy Goforth

NCDA&CS' Plant Protection Specialists inspected 4,092 nursery dealers and nurseries during the 2024 season.

A license issued by the NCDA&CS is required by any person selling nursery stock in North Carolina. Nursery stock is defined as "all wild or cultivated plants or parts thereof, trees, shrubs, vines, bulbous plants and roots, grafts, scions and buds." Excluded in North Carolina's definition of nursery stock is "annual plants; cut flowers; tree, field, vegetable, flower or other true seeds; decorative plants or plant parts without roots not intended for propagation; and perennial plants intended for indoor use that are produced in North Carolina." A *nursery license* is required for any person growing and selling nursery stock whereas a *nursery dealer license* is required for any person obtaining and re-selling nursery stock. Nursery licensure certifies that plant material has been inspected and is apparently free from potentially harmful quarantine pests and must be renewed yearly.

The NCDA&CS Plant Protection Section licensed 1,366 nurseries and 2,726 nursery dealers during the 2024 calendar year (Table 5.1). Of the 1,366 nurseries, 693 were registered nurseries and 673 were certified nurseries. A *registered nursery* has less than one acre of nursery stock and does not sell outside the state. A *certified nursery* has one or more acre of nursery stock and/or sells outside the state.

The data show a slight increase in nurseries and nursery dealers. The green industry remains incredibly strong in North Carolina and as the state population increases with new residents, so does the need for landscape and garden plants. Interstate shipping of plant material continues to increase due to a rise in online sales and homeowner direct shipments.

Table 5.1, *Number of NC nursery and nursery dealer licenses by year*[1]

Calendar Year	Number of Licenses by Category			Total Number of Licenses	
	Registered Nursery[2]	Certified Nursery[3]	Nursery Dealer[4]	Nurseries (Registered & Certified)	Nurseries & Dealers
2014	590	654	2,782	1,244	4,026
2015	594	612	3,188	1,206	4,394
2016	642	651	2,957	1,293	4,250
2017	620	646	2,858	1,266	4,124
2018	515	610	2,043	1,125	3,168
2019	504	602	1,697	1,106	2,803
2020	498	615	1,879	1,113	2,992

2021	601	649	1,629	1,250	2,879
2022	643	660	2,796	1,303	4,099
2023	672	688	2,698	1,360	4,058
2024	693	673	2,726	1,366	4,092

[1] Data based on receipt of license fees.
[2] Registered nursery – a location with less than once acre of nursery stock with no sales outside the state.
[3] Certified nursery – a location with one or more acre of nursery stock and/or sales outside the state.
[4] Nursery dealer – a location where nursery stock is sold, usually to the end user, but not actually grown.

The primary objective of Plant Industry's Nursery Program is to facilitate the movement of nursery stock while preventing the introduction and spread of quarantine plant pests into and within North Carolina. The movement of infested nursery stock represents one of the ways plant pests may be moved from one location to another and has the potential to directly impact both wholesale and retail nursery operations. North Carolina works to prevent such outbreaks by coordinating with other states and nursery industry to bring awareness of threats to the state.

Stop sale/movement notices are issued by Plant Industry Division field staff when high levels of pests and/or prohibited plants are noted. Plants can either be treated and/or destroyed when a stop sale/movement notice is issued. Plants can be released for sale/movement if testing of the material confirms they are free of the suspected pest(s). In 2024 ten (10) official Stop Sales were issued for regulatory violations. Seven (7) stop sale/movement notices were issued for prohibited *Ribes* spp. shipments to North Carolina, two (2) individual stop sale/movement notices were issued for bark scale infestations and one (1) was issued for hostas testing positive for Hosta Virus X.

Conversely, receiving states also issue Stop Sales, Notices of Non-Compliance or Notices of Rejection for plant material from North Carolina that does not meet the regulatory requirements of their state. The number of rejections received has risen exponentially due to direct homeowner plant shipments. In 2024 Plant Industry Division received fifty notices of rejection from five (4) states. Thirteen (13) of these were related to Christmas trees and holiday greenery and the remaining thirty-seven (37) were for live plant rejections from California, Maryland, Missouri, Florida, and Hawaii with the majority of the rejections from California. Not all states provide written communication regarding notices of rejection thus the numbers may not accurately reflect the total number of rejected shipments, but they do highlight the need for NC shippers to strengthen their regulatory compliance for out-of-state shipments.

Phytosanitary and Export Certification Program

Within the Phytosanitary and Export Certification Program, Plant Protection Specialists issue phytosanitary certificates to growers and/or brokers to facilitate movement of agricultural commodities to other states and to other countries. Phytosanitary certificates indicate that inspections and other specific requirements of the importing states or countries have been met. State certificates are used for movement within the U.S., and federal certificates are required for movement to another country. Countries and states vary greatly in what they require for various types of commodities such that careful research and interpretation of requirements are needed for each request for phytosanitary certification.

A phytosanitary certificate serves as official documentation that a plant, plant part, or plant-based product has been inspected and found to be apparently free of harmful pests. Each state and country enforce specific import phytosanitary requirements designed to safeguard their agricultural industries and natural ecosystems from potentially invasive or damaging pests.

The NCDA&CS Plant Protection and Export Certification Specialists facilitate interstate and international movement of plants, plant parts, and plant-based products by issuing both state and federal phytosanitary certificates to NC growers and brokers. State and federal phytosanitary certificates are issued for interstate and international movement, respectively. The NCDA&CS is responsible for implementing the state export program while the USDA is responsible for implementing the federal export program. However, the NCDA&CS works in collaboration with the USDA to issue federal phytosanitary certificates to support international export of plant-based products from NC.

Primary use of the USDA PCIT (Phytosanitary Certificate Issuance and Tracking) System to issue federal certificates began in October 2009. The number of federal and state phytosanitary certificates issued using the PCIT system is included in Table 5.2. In 2024, NCDA&CS staff issued 9,009 federal phytosanitary certificates and 856 state phytosanitary certificates. North Carolina Agricultural exports remain strong and continue to be a significant job responsibility for field staff. The majority of the NCDA&CS issued federal phytosanitary certificates in 2024 continue to be for sweet potatoes and lumber exports. During the calendar year, federal phytosanitary certificates were also issued for lumber, logs, firewood, tobacco, seed potatoes, apples, cotton and cotton seed, wheat, corn, soybean, mustard seed, stevia, hemp, Christmas trees and cut greenery, science kits containing plant material, peanuts, flower seeds, houseplants, nursery and greenhouse plants and other exported agricultural commodities. Federal Certificates were issued for the movement of commodities to 88 countries, while state certificates were issued for 40 states, Puerto Rico, Guam and the US Virgin Islands. 53.6% of our federal phytosanitary certificates were for commodities going to the European Union with sweet potatoes destined for Netherlands being the top recipient of certificates issued by NCDA&CS. 19% of the 2024 federal phytosanitary certificates were to Viet Nam and 11.2 % transited to China. Canada and Mexico combined comprise less than 9% of the phytosanitary certificates issued in 2024.

Table 5.2, *Number of phytosanitary certificates issued through the PCIT[1] system*
[1] PCIT = Phytosanitary Certificate Issuance and Tracking (USDA web-based application)

Fiscal Year	Federal				State
	Plant or Plant Part	Re-export	Processed Plant Product	Total	Total
2010/2011	2,781	21	0	2,808	323
2011/2012	4,221	13	18	4,252	206
2013 (Calendar Year)	5,830	15	134	6,658	412
2014 (Calendar Year)	6,980	32	172	7,184	348
2015 (Calendar Year)	6,560	21	162	6,743	561
2016 (Calendar Year)	7,140	17	199	7,356	703

2017 (Calendar Year)	7,932	15	91	8,038	580
2018 (Calendar Year)	7,729	15	18	7,762	951
2019 (Calendar Year)	9,179	24	30	9,233	3,191
2020 (Calendar Year)	10,529	16	1	10,546	1,903
2021 (Calendar Year)	8,635	13	0	8,648	864
2022 (Calendar Year)	9,677	16	0	9,693	813
2023 (Calendar Year)	9,677	16	0	9,693	1,682
2024 (Calendar Year)	8,999	10	0	9,009	856

Plant Conservation Program

Prepared by Julian Wilson with contributions from Kathryn Loughran, Geoffrey Austin, and Anabela Ramalho

Governance

The Plant Conservation Program (PCP) meets quarterly with members of the NC Plant Conservation Board (the Board) whose seven members are appointed by either the Governor or the Commissioner of Agriculture for four-year terms. Th board members in 2024 included: Julie Moore (Chairperson), David Hyatt, Jonathan Lanier, Esq., Dr. Charles Bruce Williams, James Slye, Dr. Matt Estep, and Michael Kunz. PCP also meets regularly with members of the NC Plant Conservation Scientific Committee. This seven-member committee primarily consists of positions designated to the committee by law. Members in 2024 included Dr. Alan Weakley (chair), Dr. Richard Braham, Michael Kunz, Dr. Shannon Currey, Andrew Walker, Jerry Reynolds, and Leigh Ann Hammerbacher. The positions representing the NC Natural Heritage Program and a Conservation Organization, previously held by Brenda Wichmann and Hervey McIver, were not filled until 2024 by the appointment of Andy Walker and Leigh Ann Hammerbacher.

Staffing

The Plant Conservation Program consists of a staff of four full-time employees. The Program Manager, Ecologist, and Administrative Assistant are state-funded, and the Botanist is federally funded. Julian Wilson, the Program Manager, and Anabela Ramalho, the Administrative Assistant, both joined the team in 2023 while Geoff Austin, Land Management Ecologist, came to PCP in 2020. In 2024, PCP's Botany Research Specialist position was vacant for roughly half the year after the departure of Katherine Culatta to a new position at the NC Natural Heritage Program in August. In December 2024, Kathryn Loughran was hired as PCP's new Botany Research Specialist with grant funds from the US Fish and Wildlife Service (USFWS), which also helped fund several part-time field technicians, two (Jacob Cochran, Nuriel Pehowic) in the Raleigh/Durham area, and three in the coastal plain (Miller Caison, HL Rich, and Barry McQueen).

United States Fish and Wildlife Service (USFWS) Partnership

In 2024, PCP and USFWS continued a long-standing cooperative agreement related to the recovery of endangered and threatened plant species in North Carolina. In September of 2022, the Cooperative Agreement was updated to include at-risk species, or species being reviewed for listing by the Service. This was the first update to this document since its origination in 1981. No substantive changes were made to this agreement in 2024. Grant funds obtained via this cooperative agreement provide critical recovery resources to North Carolina each year. This funding covers the program's research specialist position and a portion of the remaining funds support PCP temporary employees for part of the year. More specifically, the funding from this partnership supports imperiled plant monitoring; preserve management targeted towards federally listed candidate, and at-risk plant species; and regulatory programs including protected plant permit evaluation and issuance.

PCP has multiple ongoing projects funded by various USFWS grants including developing management plans for Plant Conservation Preserves and research and restoration for endangered plant species.

Regulatory Programs

The Plant Conservation Program is responsible for the protection and conservation of the NC Protected Plant List which currently includes 462 species, of which 28 are also federally listed. This list is updated every five years, and species must go through a thorough review process analyzing factors such as number of viable populations in the state, threats, and trends, to ensure the most imperiled species in our state receive protection and that species are not unnecessarily listed. If available data is deficient to support the full analysis for a species, it cannot be added to the Protected Plant List. This extensive analysis process for the 2026 update to the NC Protected Plant List is well underway by PCP staff with assistance from the NC Natural Heritage Program.

One of the protections for North Carolina's listed plant species is that wild collection and the sale of wild individuals are both prohibited without a permit from PCP. Thus, PCP staff work with an interagency panel to review permit requests affecting these protected plant species. PCP reviews permit requests from individuals, research institutions, agencies, and others requesting to move or collect protected plants, including all state and federally listed plant species in North Carolina. This permit requirement applies to transplant and rescue projects, nurseries which propagate, sell, and export protected species, as well as many scientific research projects. The review process incorporates input from the US Fish and Wildlife Service, NC Natural Heritage Program, and advisory capacity from NC Botanical Garden.

Fifteen protected plant permits were issued, and several additional requests were evaluated during 2024. This includes seven research permits and eight rescue or reintroduction permits. PCP works with the Plant Protection Section to issue Certificates of Origin for protected plant species being propagated for sale as part of the nursery inspection process carried out by PID plant pest specialists. Sixty-eight Certificates of Origin were issued for the sale of listed plants in 2024. Twenty-five listed species had Certificates of Origin, the most common being Venus Flytrap (*Dionaea muscipula*), with 14 Certificates of Origin issued. Bristle-leaf Sedge (*Carex eburnean*) and Prairie Dropseed (*Sporobolus heterolepis*) tied for the second most common protected plant for which a Certificate of Origin was issued, each with seven Certificates of Origin issued in 2024. Goldenseal (*Hydrastis canadensis*) had been the second most certified protected plant in 2022 (10 issued), but only one certificate was issued in 2023 and none in 2024.

PCP also administers the American ginseng (*Panax quinquefolius*) dealer licensing program for North Carolina. North Carolina American ginseng dealer licenses are issued annually prior to the opening of the harvest season which begins September 1st and ends December 31st. Licensed dealers may buy and sell ginseng during the buying season and must submit purchase records to PCP no less than once per month throughout the season. Copies of all purchase records must be retained by the dealers for inspection along with the roots at the time of certification for export. Copies of all export certificates are also submitted to PCP to help track not only the level of harvest per year in the state, but the volume exported as well. In the 2024 season, PCP licensed 24 resident and nine non-resident ginseng dealers.

For North Carolina's 2023-2024 ginseng buying season (which closed March 31st of 2024), plant pest specialists inspected and certified a calculated dry weight of 5,308.95 lbs. of American ginseng for export. The vast majority

(97.78%) of ginseng roots were wild harvested, totaling 5,190.95 lbs. (calculated dry weight), with the remainder being wild simulated (118 lbs. calculated dry weight). To understand how many plants are represented by these reports of total dry weights of ginseng roots, the standard is to multiply the total weight by 300 as an approximate number of dry roots per pound. **For 2023-2024, PCP estimates that approximately 1,868,742 American ginseng plants were harvested from the wild in North Carolina.** Although this number fluctuates year to year, PCP estimates that over 1 million plants are harvested for export every year.

Illegal harvest of American ginseng is a documented problem in North Carolina and throughout the species' range. In North Carolina, the Wildlife Resources Commission (WRC) has partnered with NCDA to facilitate the enforcement of legal protections for this species. The Commission provides an annual report of processed ginseng crimes in their 8th and 9th Districts. In 2024, WRC law enforcement staff reported a total of 35 cases/charges across 12 counties. Most of these cases were concentrated in Jackson (9), Haywood (5), Macon (4), and Madison (4) counties, with 1-3 cases in each of the following counties: Ashe, Avery, Buncombe, Burke, Cherokee, McDowell, Mitchell, and Swain. This was a notable decrease in cases compared to 55 cases in 2023 but in line with previous years (2022 - 24 cases, 2021 - 35 cases, 2020 - 49 cases). There are four counties which have had one or more violations in each of the five reporting years: Haywood, Macon, Madison, and McDowell.

In some cases, ginseng material was seized and reported. In 2024, officers seized 1,538 roots, less than half of the seizure number from 2023 (3,823), which included a single case in which 1,470 roots were seized. Prior years varied significantly in seizure numbers, ranging from a relatively low 740 roots confiscated in 2022, over 3,600 roots confiscated in 2020, and over 1,100 in 2021.

Friends of Plant Conservation, Outreach, and Partnerships

The Plant Conservation Program's closest partner is the Friends of Plant Conservation, Inc. (FoPC), a non-profit membership organization dedicated to supporting the mission of PCP. FOPC helps with fundraising and expands PCP's capacity for education and outreach as well as stewardship of the Plant Conservation Preserves*(Figure 6.1)*. In partnership with FoPC and Three Rivers Land Trust, PCP hosted a public education and wildflower tour at Suther Prairie in Cabarrus County as well as a wildflower tour with PCP's volunteer steward at Eastwood Preserve in Moore County. PCP also partnered with FoPC for a wildflower tour with PCP's volunteer steward at Tater Hill Preserve in Watauga County, a volunteer workday at Caraway Preserve in McDowell County, and monitoring Schweinitz's Sunflower in Gaston County.

Figure 6.1, *Educational tour hosted with FoPC and Three Rivers Land Trust at Suther Prairie Preserve*

PCP staff assisted FoPC with outreach efforts at the inaugural Flytrap Forum in Boiling Spring Lakes, hosted by the Venus Flytrap Champions and at the Festival for the Eno in Durham. FoPC hosted their 2024 Annual Meeting in Boiling Spring Lakes (Brunswick County), with field trips to The Nature Conservancy's Green Swamp Preserve and to PCP's Boiling Spring Lakes Preserve. PCP staff also assisted with providing and editing content for FOPC social media posts and newsletter articles regarding the hands-on conservation and management strategies being employed to protect and recover imperiled species across the state. FoPC supported the land management work conducted by PCP by purchasing equipment and supplies to restore and maintain rare plant habitats.

The Plant Conservation Program is a member of several statewide or regional conservation partnerships. Examples include the Bog Learning Network, the Southern Blue Ridge Fire Learning Network, Southeastern Plant Conservation Alliance, the Sandhills Conservation Partnership, Cape Fear Arch Conservation Collaboration, and the Greater Uwharrie Conservation Partnership. In 2024, PCP collaborated with NC Botanical Garden and NC Natural Heritage Program staff to plan and host the Rare Plant Conservation Discussion Meeting on March 5, 2024, at the NC Botanical Garden.

In addition, PCP outreach to the public includes special presentations, assisting on partner projects, and tabling events. In 2024, PCP staff gave an invited public lecture for the second annual F.L.A.M.E. (Fire Learning and Mitigation Education) Week hosted by NCFS's Turnbull Creek Educational State Forest in Bladen County and hosted a field trip stop for the NC Prescribed Fire Council at Cedar Mountain Bog Preserve in Transylvania County. PCP Staff also organized a partnership workday at Dulany Bog Preserve (Jackson County)(*Figure 6.2),* which is jointly owned by PCP, Highlands Biological Station, and the U.S. Forest Service (USFS). Workday participants included landowning agency representatives as well as partners from Atlanta Botanical Garden (ABG), Highlands-Cashiers Land Trust, and a joint Conservation Crew from USFS and the Eastern Band of Cherokee Indians.

Figure 6.2, *Partnership Workday at Dulany Bog Preserve in March 2024*

Partners from ABG worked with PCP staff to monitor transplants of White Fringeless Orchid (*Platanthera integrilabia)* at Bat Fork Bog Preserve in Henderson County. PCP staff worked with NC Department of Transportation (DOT) staff on rescue projects involving Spring-flowering Goldenrod (*Solidago verna*) at Croatan National Forest and Schweinitz's Sunflower (*Helianthus schweinitzii*) at PCP's Harvest Field Preserve in Randolph County. PCP staff attended the NC Museum of Natural Science's annual BugFest event to hand out materials, explain what PCP does, and ways that citizens can support the program's work. In collaboration with Three Rivers Land Trust, staff also worked to organize a ribbon cutting to celebrate the acquisition of the 55-acre Harris Tract, connecting the two sides of Eastwood Preserve*.(Figure 6.3)*

Figure 6.3, *Ribbon Cutting with Three Rivers Land Trust at the new Harris Tract in addition to Eastwood Plant Conservation Preserve featuring (from left to right) Travis Morehead (TRLT Director), Greg Hicks (NCFS State Forester), Dr. Bill Foote (Plant Industry Division Director), Commissioner Steve Troxler (NCDA&CS), and Will Summer (NC Land & Water Fund Director)*

North Carolina Plant Conservation Preserve System

The Plant Conservation Program, through the Plant Conservation Board, has the regulatory mandate to establish conservation programs for the long-term sustainability of the state's native flora. One of PCP's primary approaches to this is the establishment and management of Plant Conservation Preserves to protect imperiled plant species. These Preserves are the only state-managed lands selected and designed specifically for the conservation of plant species. Due to concerns about resource damage and plant poaching, access is generally limited to guided tours or to visits authorized by written permission issued by PCP. PCP Preserves serve as study sites for researchers of various disciplines including botany, geology, and herpetology. In 2024, 12 preserve access permits were issued for research ranging from botanical projects to geology research to insect surveys. An

additional seven permits were issued for volunteer preserve stewards to assist with land management activities. To help educate and engage the public about rare plants and their conservation, PCP conducts guided preserve tours and gives presentations and lectures for the public throughout the year in collaboration with the Friends of Plant Conservation. The Preserve system consists of 26 Preserves distributed across North Carolina covering close to 14,500 acres *(Figure 6.4)*.

Figure 6.4, *Map of PCP Preserves of North Carolina*

Preserve Management

Management and protection of Plant Conservation Preserves, and other selected sites is a key component of the NC Plant Conservation Program's (PCP) efforts to recover listed plant species in North Carolina. In part, active management is needed to meet the intent of the Endangered Species Act, which has the stated goal of conserving the ecosystems upon which listed species depend. Many of the sites where these species occur have been degraded by lack of management and/or incompatible land-use practices; active management as well as restoration efforts are urgently needed at these sites. In some cases, PCP works with other agencies and landowners to complement management of their lands for the benefit of rare plants and habitats.

In 2024, PCP staff focused on habitat restoration for the following projects and sites:

- Bunched Arrowhead (*Sagittaria fasciculata*)- Continued habitat restoration at Bat Fork Bog and Ochlawaha Bog Preserves in Henderson County
- Smooth Coneflower (*Echinacea laevigata*)- Continued habitat restoration in multiple protected sites in Durham and Granville Counties
- Schweinitz's Sunflower (*Helianthus schweinitzii*)- Continued habitat restoration at four PCP Preserves located in Gaston, Union, Randolph, and Montgomery Counties

- Rough-leaved Loosestrife (*Lysimachia asperulifolia*) and Venus Flytrap (*Dionaea muscipula*)- Continued habitat restoration at Boiling Spring Lakes and Hog Branch Ponds Preserves in Brunswick County
- Mountain Sweet Pitcherplant (*Sarracenia jonesii*), Mountain Purple Pitcherplant (*S. purpurea* var. *montana*), and Swamp Pink (*Helonias bullata*)- Continued habitat restoration at Cedar Mountain Bog and Dulany Bog Preserves in Transylvania and Jackson Counties respectively
- Pondberry (*Lindera melissifolia*) and Pondspice (*Litsea aestivalis*) – Continued habitat restoration at Pondberry Bay Preserve in Sampson County
- Northern Oconee Bells (*Shortia brevistyla*)—Continued habitat restoration at Caraway Preserve in McDowell County.
- Canby's Dropwort (*Tiedmannia canbyi*) and associated species—Continued habitat restoration at McIntosh Bays Preserve in Scotland County
- Sandhills Lily (*Lilium pyrophilum*)—Continued habitat restoration at Eastwood Preserve in Moore County
- Canada Lily (*Lilium canadense*)—Continued habitat restoration at Suther Prairie Preserve in Cabarrus County

Invasive species control

Invasive species control remains one of the most time and resource intensive habitat management strategies employed at the PCP Preserves. Invasive species control is also one of the most important habitat restoration strategies land managers use to maintain high quality rare species habitats. There are a multitude of important invasive species, some with regional importance including, but not limited to, Japanese Stiltgrass, Japanese Honeysuckle, Wisteria, Chinese and Japanese Privet, Japanese False Hawksbeard, Kudzu, Reed Canary-grass, American Bittersweet, Porcelainberry, Lesser Celandine, Tree of Heaven, Princess Tree, Chinaberry, Multiflora Rose, Marsh Dewflower, Purple Loosestrife, and several more. PCP uses a variety of control methods to make all customs fit to the sensitivity of the site. Where effective and safe PCP staff use herbicide in the most selective application method appropriate. Where herbicides are unsafe, staff use mechanical methods to remove plants.

Prescribed burning

Prescribed burning is one of the most pressing management needs across the Preserve system to enhance rare species populations and improve habitats for these species. With assistance and support from NC Forest Service and other partners, PCP staff conducted controlled burns at four PCP Preserves across four counties totaling almost 100 acres this past year.(*Table 6.1)* Many planned burns could not be completed due to periods of unsuitable weather and wildfire control demands on NC Forest Service personnel. PCP continues to play an active role in all phases of burn planning and preparation as well as mop-up after burns are conducted. In addition to the burns in the table below, PCP also assisted with multiple prescribed burns at NCDA&CS Research Stations Division Picture Creek Diabase Barrens Preserve in Granville County.

***Table 6.1**, Prescribed Burns on PCP Preserves in 2024*

Preserve	County	Burn Unit	Date	Acres	Target species
Tater Hill	Watauga	Grassy Bald	3/13/2024	7	Mountain grassy bald
Eastwood	Moore	Thomas	4/28/2024	56	Longleaf pine communities
Harvest Field	Randolph	A	4/21/2024	29	Shortleaf-oak-hickory
Redlair	Gaston	Adam Hunter Prairie, Stone Bottom, & Long Bottom	3/12/2024	6	Piedmont prairie community

Hurricane Helene Impacts

Of PCP's 26 preserves, 10 are within the mountains of Western North Carolina. These preserves were impacted in a variety of ways by the path of Hurricane Helene through Western NC in late September 2024. Impacts to preserve included downed trees, culvert and hydrological impacts, and in some cases, scouring that uprooted rare plants. Across all 10 preserves, areas with downed trees totaled over 180 acres. In addition to tree cleanup around rare plants and on access roads/trails, future work related to Hurricane Helene must also include monitoring for invasive species in areas where large volumes of water may have washed in seeds of invasive plants.

1. Bat Fork Bog (Henderson County) experienced no substantial tree fall within the swamp forest. The Bunched Arrowhead ditch population weathered the storm safely. Bat Fork Creek staged at around 8 feet and lots of sediment is clear on vegetation. The trail camera was irreparably damaged by water.
2. Caraway (McDowell County) had numerous large trees down, including around the Oconee Bells. Scouring and erosion along Tom's Creek was also observed with limited wash out in some patches, although most of the Oconee Bells remain intact. Staff were able to replant some of the uprooted plants.
3. Cedar Cliff Mountain (Jackson County) experienced negligible impacts from Helene. A few trees are down throughout the property, but some pre-dated Helene.
4. Cedar Mountain Bog (Transylvania County) experienced some of the most significant impacts from Helene out of all PCP preserves*(Figure 6.5).* It saw a little flooding but substantial tree fall. All portions of the preserve had downed trees. Thankfully, no trees fell on the rare plants, although a clump of Southern Appalachian Purple Pitcherplant was lost from scouring in the cataract bog area. A culvert on a cul-de-sac road interior to the preserve was damaged and should be repaired or removed in the future.

Figure 6.5, *Drone footage of Hurricane Helene damage in one area at Cedar Mountain Bog Preserve*

5. Dulany Bog (Jackson County) had some sedimentation and wash out in the main creek, but the Southern Appalachian Purple Pitcherplants were not adversely affected. One tree came down and some scouring was observed on the creek banks.
6. Melrose Mountain (Polk County) is primarily in good shape, with minimal damage along interior logging roads and a few downed trees. Some erosion was observed along roadbeds and trails. It will be critical to observe how the White Irisette populations respond, as many are located along old roadbeds.
7. Ochlawaha Bog (Henderson County) experienced a 10–12-foot stage from Mud Creek and the sediment was clear on vegetation. The entire wetland remained under water for weeks. A culvert was clogged by storm debris, and beavers further impounded the flow of water. In late 2024, heavy machinery was rented and used to clear the culvert and allow the flow of water to continue. Installation of a "beaver deceiver" in early 2025 is planned to help maintain the flow of water.
8. Paddy Mountain (Ashe County) had many downed trees in the areas that were surveyed. The access road will eventually need to be cleared by chainsaw.
9. Tater Hill (Watauga County) had many downed trees, and flooding and water volumes washed out an existing beaver dam, changing the landscape of the bogs. It remains to be seen what the impact of this long term will be. A "beaver deceiver" on an inholding access road was damaged by downed trees and needs to be repaired as well.
10. White Oak Mountain (Polk County) had notable impacts, including the main road to the preserve being under repair during staff's initial visit. There are significant numbers of trees down on slopes near the ridgeline including some known White Irisette areas which will need to be checked on in 2025 *(Figure 6.6).*

Figure 6.6, *Hurricane Helene damage at White Oak Mountain Preserve*

Rare Species Monitoring

Understanding the status and trends of the populations we protect is very important. To that end, PCP has been collecting flowering data on several species across the state. In 2023, census and/or population monitoring work was conducted for the following federally listed species:

- Bunched arrowhead (*Sagittaria fasciculata*) - Henderson Co. (2 sites)
- Canby's dropwort (*Oxypolis canbyi*) - Scotland Co. (1 site)
- Heller's blazing star (*Liatris helleri*) - Ashe Co. (1 site)
- Michaux's sumac (*Rhus michauxii*) – Durham Co. (1 site)
- Mountain sweet pitcher plant (*Sarracenia jonesii*) - Transylvania Co. (1 site)
- Pondberry (*Lindera melissifolia*) – Sampson Co. (1 site)
- Rough-leaved loosestrife (*Lysimachia asperulifolia*) – Brunswick Co. (2 sites)
- Schweinitz's sunflower (*Helianthus schweinitzii*) - Randolph, Montgomery, Union, Gaston Cos. (4 sites)
- Smooth coneflower (*Echinacea laevigata*) - Durham, Granville Cos. (5 sites)
- Swamp pink (*Helonias bullata)* - Henderson, Transylvania Cos. (2 sites)
- White irisette (*Sisyrinchium dichotomum*) – Polk Co. (2 sites)

Additional state-listed and rare plant surveys/monitoring conducted this year:

- Canada Lily (Lilium canadense) –Henderson, Cabarrus Cos. (2 sites)
- Montane purple pitcher plant (Sarracenia purpurea var. montana) - Transylvania Co. and Jackson Co. (3 sites)
- Wood Lily (Lilium philadelphicum) – Watauga Co. (1 site)
- Sandhills Lily (Lilium pyrophilum) - Moore Co. (1 site)
- Appalachian Dwarf Huckleberry (Gaylussacia orocola) – Transylvania Co. (1 site)
- Hoary puccoon (Lithospermum canescens) Durham and Granville Cos. (5 sites)
- Savanna milkweed (Asclepias pedicellata) – Brunswick Co. (1 site)

- Gray's lily (Lilium grayi) - Watauga Co. (1 site)
- Epling's Hedge-nettle (Stachys eplingii) – Henderson Co. (1 site)
- Roan Sedge (Carex roanensis) – Ashe Co. (1 site)
- Carolina Thistle (Cirsium carolinianum) – Granville Co. (1 site)
- Long-bracted Frog Orchid (Dactylorhiza viridis) – Watauga Co. (1 site)
- Robin Runaway (Dalibarda repens) – Transylvania Co. (1 site)
- Balsam Ragwort (Packera paupercula) – Granville Co. (1 site)
- Sandhills Pyxie-moss (Pyxidanthera brevifolia) – Cumberland Co. (1 site)
- Large, Purple-fringed Orchid (Platanthera grandiflora) – Watauga Co. (1 site)
- Veined skullcap (Scutellaria nervosa) – Granville Co. (1 site)
- Virginia Spiderwort (Tradescantia virginiana) – Cabarrus Co. (1 site)
- Sweet White Trillium (Trillium simile) – Polk Co. (1 site)
- Venus Flytrap (Dionaea muscipula) – Brunswick Co. (2 sites)
- Northern Oconee Bells (Shortia brevistyla) – McDowell Co. (1 site)

Plant Pathology Program

Prepared by Hsien Tzer Tseng, Regulatory plant pathologist.

Vascular Streak Dieback (VSD)

Vascular streak dieback (VSD) is threatening nursery production in the southeastern United States. Little is known about this emerging dieback issue, but it has already caused significant economic losses in the nursery industry. The fungus *Rhizoctonia theobromae/Ceratobasidium theobromae* has been isolated from trees exhibiting dieback, wilt, and vascular streaking. This detection is a newly reported fungi in the region and more information about the distribution is needed. In 2024, NCDA partnered with Tennessee, Virginia, South Carolina, Alabama, Kentucky, Maryland, Missouri, and Oregon for a multi-state survey for VSD.
Early symptoms include leaf chlorosis, scorched leaf margins, and stunting and/or wilting of current year's growth, eventually leading to death of individual branches and progression into the main stem. Streaking or discoloration within the vascular, or water conducting tissue occurs when symptomatic branches and/or main stems are cut. However, vascular symptoms may be subtle or absent on dogwood or other hosts, adding a challenge for diagnosis (Figure 7.1*).*

In 2024, fifteen locations have been surveyed by State Plant Pathologist (Figure7.2*),* including field grown tree nurseries, big-box stores, and container nurseries. Sixteen samples were collected, including redbud, maple, tulip poplar, and spicebush. Real-time PCR was used for identification. Six positive cases were confirmed by molecular method, all on redbud trees.

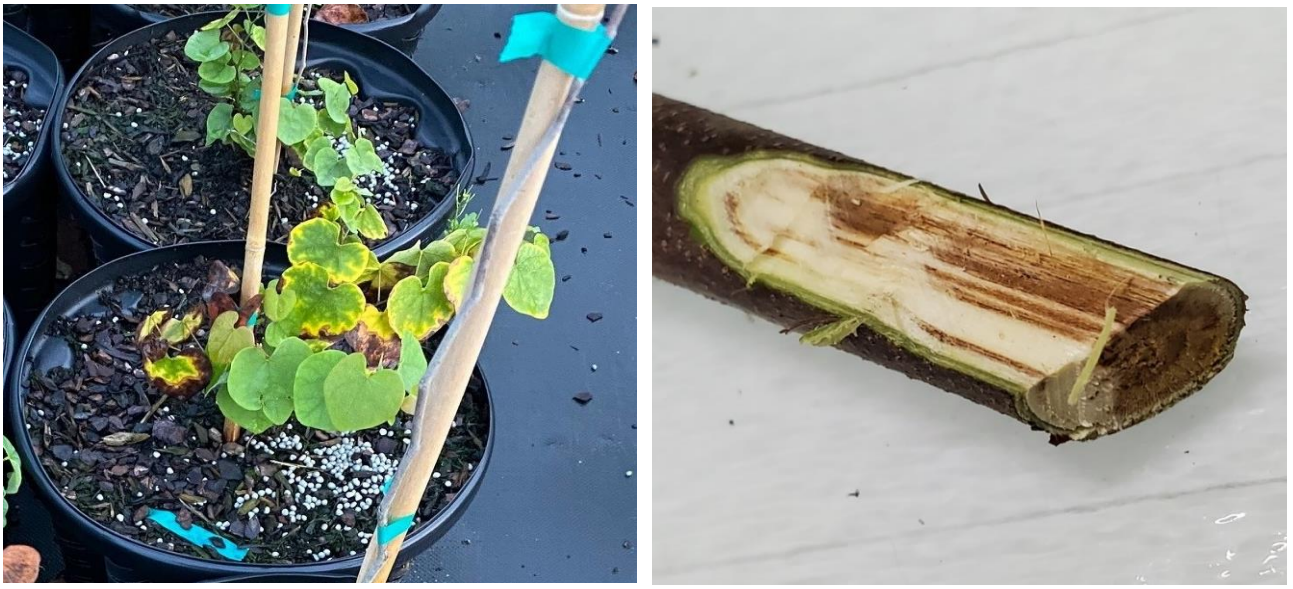

Figure 7.1, Symptoms of Vascular streak dieback on redbud. Left: leaf chlorosis, scorched leaf margins. Right: discoloration within the vascular tissue.

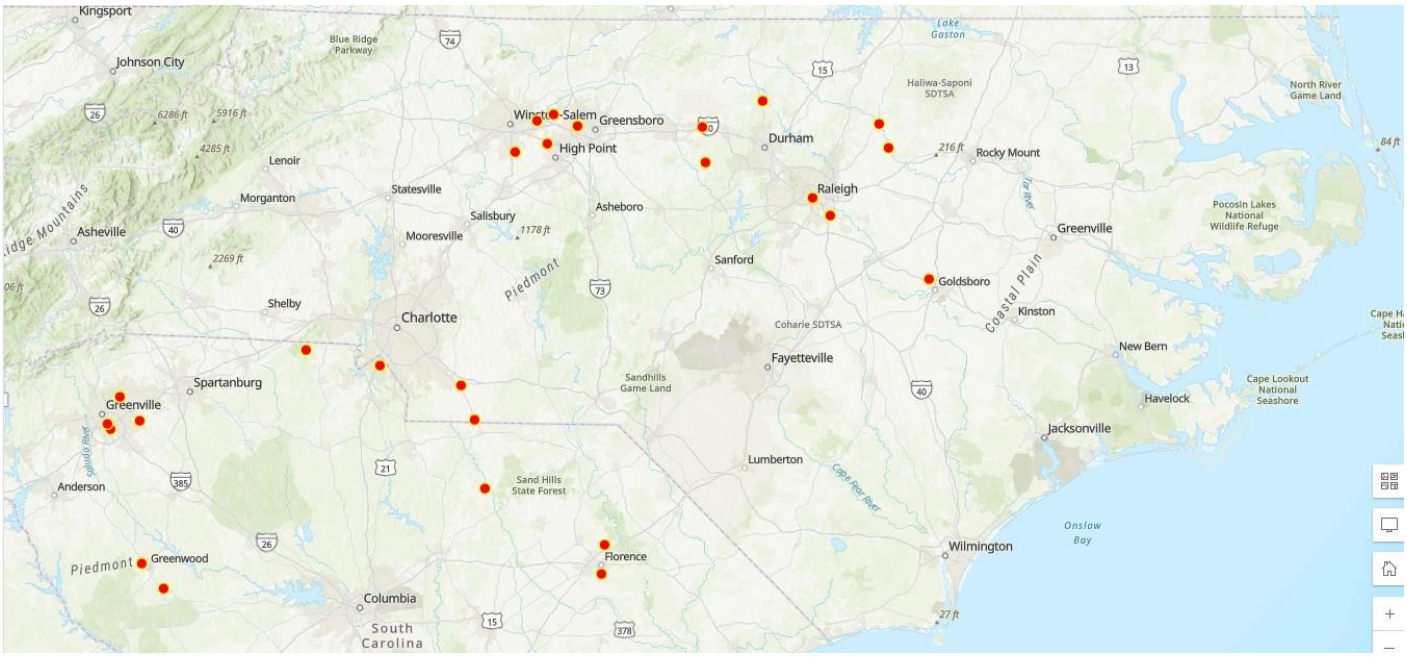

***Figure 7.2**, Sites of VSD survey in 2024.*

First report of *Ralstonia pseudosolanacearum* on ginger in North Carolina

September 2024, a sample of garden ginger (*Zingiber officinale*), from a high tunnel farm Watauga County, NC, was submitted to NCSU plant disease and insect clinic (PDIC). Wilted ginger with yellowish leaves symptoms was received. Bacterial streaming was observed from lesions in leaves. Using Agdia Immunostrip, the PDIC detected *Ralstonia sp*. from the ginger sample. The sample was sent to S&T PPCDL for confirmation and later confirmed positive for *Ralstonia pseudosolanacearum* (Phylotype I-30, strains are referenced to be of Asian origin) by molecular methods. It is the first reported detection of *Ralstonia pseudosolanacearum* on ginger in NC. Ginger wilt can spread on contaminated seeds, soil, or water. Ginger wilt bacteria infect through the roots or seed and then moves throughout the plant in the vascular system. The bacteria clog the vascular system, causing the plant to wilt. Infected rhizomes rot, releasing bacteria into the soil (Figure 7.3).

According to the grower, ginger seed was sourced Hawaii, which they observed diseased and otherwise unthrifty root pieces immediately upon receipt. Given that replacing seed stock at that juncture would have been impossible, they persisted in doing the best they could with the planting material they had, doing initial culture in trays of coir under lights in their greenhouse, and treating the roots with bio fungicide (*Trichoderma* sp.). Despite their treatments and careful management, they were only able to plant three out of the four beds planned for 2024 ginger production (i.e. - a 25% loss in the greenhouse ahead of even transplanting to in-ground high tunnel production). Then, throughout the growing season, another 25% - 50% succumbed to wilt. Overall, she estimates that more than 1/3 of the crop was damaged by disease symptoms consistent with the sample showing bacterial wilt, and season-long total mortality could have been closer to 50%.
On the Continental US, the disease has been reported in Florida, Louisiana, and Minnesota.

Figure 7.3, *Plants infected with ginger wilt turn completely yellow, wilt, and fall over (left). The infected rhizomes look like water soaked. Rhizomes and the base of the stem are soft and mushy (right). Credit: Minnesota Department of Agriculture.*

Boxwood Blight

Boxwood blight, caused by the fungus, *Calonectria pseudonaviculata*, is a major disease issue for nurseries that are growing boxwood. No boxwood species (*Buxsus spp.*) or varieties are completely immune to the pathogen. Typical symptoms of boxwood blight include leaf spots or blotches, rapid defoliation, and stem lesions. Leaf symptoms are most abundant during the growing season, whereas stem lesions are visible year-round (Castroagudín et al. 2020). To prevent the disease from spreading further into landscaping, boxwood plants found in certified nurseries and nursery dealers that were infected by the disease were destroyed, along with all host plants within a 10-feet radius.

Reference: Castroagudín V.L., Yang, X., Daughtrey, M.L., Luster, D.G., Pscheidt, J.W., Weiland, J.E., and Chouch J.A. 2020. Boxwood blight disease: a diagnostic guide. Plant health progress. 21:291-300.

Figure 7.4, *Symptoms of boxwood blight (left to right): leaf spots on new growth, dark brown to black stem lesions, and underside of leaves with fungal sporulation*.

Boxwood Blight Statement Program

In February 2012, NCDA&CS developed an optional "Boxwood blight Statement Program". Under the program, an NC Nursery receives a statement to accompany shipments to other states. The participating nurseries are signees to a compliance agreement and follow best management practices. To facilitate this program, the NCSU Plant Disease and Insect Clinic assays samples collected during this process at no charge.

The stipulations of the compliance agreement focus on buy-in inspection and record keeping, and renewed list of the program participants. As of December 2024, there are ninety participants in the program. Currently, States with established external quarantine against the boxwood blight pathogen includes Tennessee and Pennsylvania.

Sudden Oak Death (SOD)/Ramorum blight caused by *Phytophthora ramorum*

Sudden oak death (SOD), caused by the fungal-like oomycete, *Phytophthora ramorum*, is a major threat for North Carolina nursery industry and natural forests. The pathogen has been identified on well over 100 diverse species of plants, hosts include hardwood and conifer trees, shrubs, herbaceous plants and ferns. An official list of host plants as of 2022 is maintained by the USDA APHIS as part of federal quarantine. *P. ramorum* establishment in eastern US forests could be devastating, as there are several important tree species that are susceptible. Hosts that are commonly found in container nurseries include rhododendron, camellia, viburnum, pieris, and kalmia.

Figure 7.5, *Symptoms of Phytophthora ramorum infection on common nursery hosts*.

The Plant Pathologist participates in bi-monthly, national conference calls pertaining to the Sudden Oak Death program and provides summaries to the Plant Pest Administrator. Bi-monthly conference call participants routinely discuss issues such as changes to national regulations, current trace-forward/trace-back investigations, updates from regulated states, on-going research, and workshop/training announcements.

For complete list of regulated hosts and plants proven or associated with *P ramorum*:
https://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/pdf_files/usdaprlist.pdf

For more information:
https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/phytophthora-ramorum/sod

SOD Trace-forward/trace-back notifications

Three trace forward notifications issued by USDA were received in 2024:

1. March 2024: Twenty locations were involved with the trace forward investigation that purchased plants from a California nursery through on-line ordering. Ninety were residential properties which received shipment of less than 5 plants, one was a community college that ordered 50 plants. NCDA sent physical mails and e-mail communications to all buyers about the information and symptoms of the disease and requested buyers to contact the pathologist or regional specialist if suspected symptoms were observed. Phone calls were made if the phone number was available. No diseased material was reported. Pathologists and regional specialists also inspected the community college for symptomatic plants. Samples were taken and tested for Phytophthora spp. No confirmed detection was found.
2. August 2024: Four nurseries were involved with the trace forward investigation that received material from an Oregon nursery. The nurseries were in Buncombe, Forsyth, Henderson, and Watauga County. Pathologists and regional specialists inspected each location for potential infected materials. Samples were collected from Forsyth and Buncombe County locations. In-house immunosorbent assay and qPCR were conducted. The samples all confirmed negative for *Phytophthora ramorum*. This is a successful application of the newly established molecular diagnostic laboratory.
3. December 2024: One nursery in Watauga County was involved with the trace forward investigation. The nursery was inspected by regional specialists for all host material and found no symptomatic plants.

As of today, no confirmed positive cases were found in North Carolina.

SOD Survey

The primary pathway for the pathogen is from the trade of infected ornamental plants. A survey was conducted to check plant materials that were likely to be imported from west-coast states. All suspect samples are screened for the presence of Phytophthora spp. using Enzyme Linked Immunosorbent Assay (ELISA) with positive samples forwarded to a USDA National Plant Diagnostic Network (NPDN) Lab for further diagnostics.

One hundred and seventy-six locations were surveyed during the calendar year 2024 *(*Figure 7.6*).* No target *Phytophthora sp.* was detected in 2024 because of this survey.

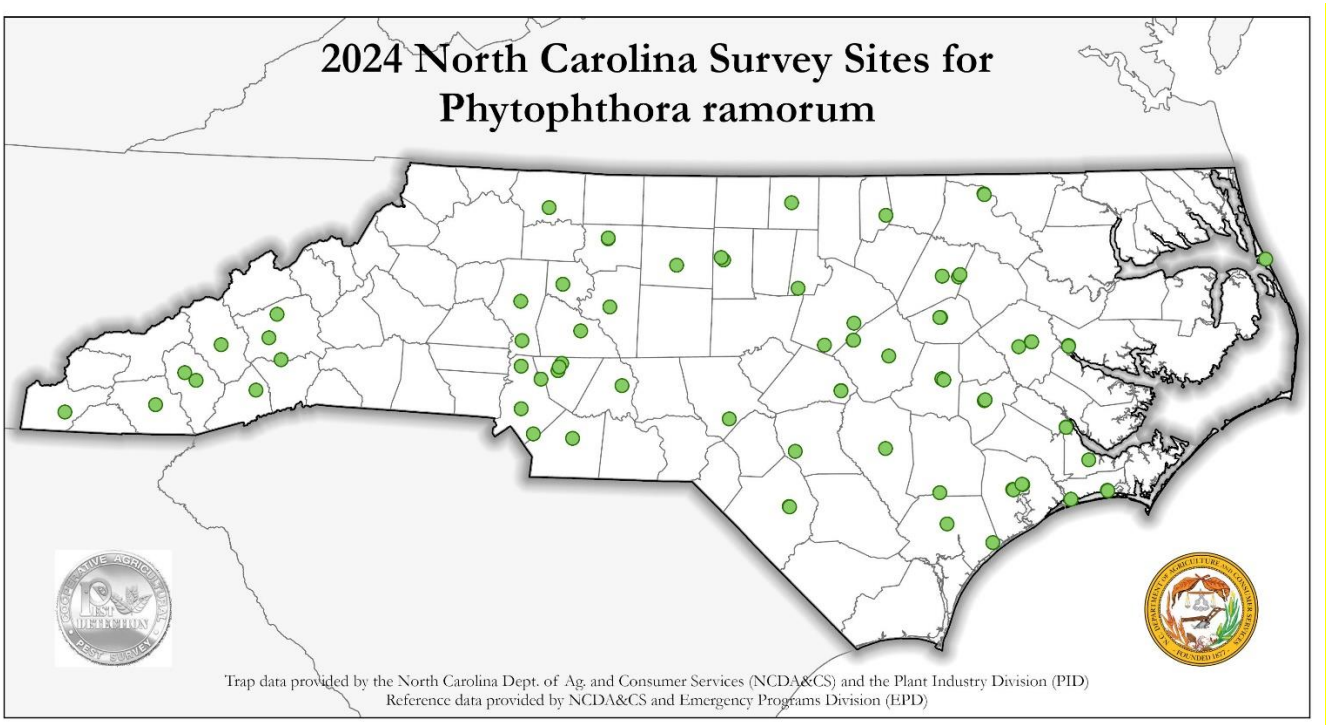

Figure 7.6, *Map of Phytophthora ramorum survey sites, 2024*.

Molecular diagnostic laboratory development

The Plant industry division has been continuously building up molecular diagnostic capabilities in the past year (Table 7.1). We have successfully adapted total DNA and RNA extraction processes and three real-time PCR protocols which greatly improved the response time for regulatory events. We have also acquired additional equipment to meet National plant disease diagnostic network (NPDN) standards, including PCR prep station, high-performance -20 degree C freezer, DNA electrophoresis and imaging system. We are in the process of acquiring NPDN accreditation.

Table 7.1**,** *Molecular diagnostic samples processed in 2024*

Target pest / Disease	Number of Samples Processed	Purpose
Tomato brown fruit rugose virus	5	Federally regulated
Phytophthora ramorum / SOD	8	Federally regulated
Ceratobasidium theobromae / VSD	10	Multi-State survey

Certified Seed Potato Program

In response to industry needs, a certified seed potato program was developed in 2023. North Carolina produced seed potatoes have the advantage of reduced shipping costs to Southeastern states and central America. The State of North Carolina is committed to participating in the State National Harmonization Program (SNHP) through the cooperative agreement between states and the federal government that establishes harmonized standards to control the spread of seed potato diseases. North Carolina Crop Improvement Association (NCCIA) is the authorized certifying entity. The North Carolina Seed Potato certification Program is a limited generation program consisting of a pre-nuclear generation grown in an enclosed facility and six field-grown generations. Pre-nuclear plants are propagated from disease tested micro propagated plants. Disease testing was conducted by North Carolina State University, Micropropagation and Repository Unit (NCSU MPRU) and NCDA&CS plant pathology program.

During the 2024 season, seventy acres of seed potatoes with five different varieties were produced, disease tested, and certified. The product was shipped to Cuba, Panama, and Nicaragua.

Export: Disease certification requirements and pathogen distribution information

Most agricultural commodities exported to foreign countries and to some U.S. states must meet certain requirements regarding plant pests. Countries and states differ as to what is perceived as a plant pest risk. The Plant Pathologist received and handled requests from Field Specialists for assistance with interpretation of plant disease and nematode certification requirements and determination of pathogen distribution.

Export: Nematode certification

California has important requirements concerning reniform and burrowing nematodes. To assist nurseries that wish to send plants to California, Field Specialists collect soil samples and submit them to the NCDA&CS Nematode Assay lab according to procedures developed by the Plant Pathologist, who also provides oversight for this program. A sampling table based on numbers of plants or area sampled was developed by the Plant Pathologist. Using this table enables growers to pre-determine costs prior to sample collection and submission. Reniform and burrowing nematodes have not been found in any NC nursery. Reniform nematode was found in eight NC counties under agronomic field conditions, but burrowing nematode has never been found at any location.

Permits: Movement of plant pathogens for research and other purposes

USDA-APHIS-PPQ Form 526 (“Application and Permit to Move Live Plant Pests or Noxious Weeds”) permits the movement of plant pathogens and other pests into NC for research, diagnostic identifications, or commercial uses. The Plant Pathologist has the responsibility of adding comments to address state-specific concerns regarding each application. USDA-APHIS-PPQ issues final approval or denial of each application. All plant pathogenic organisms are subject to this requirement. The risk associated with each organism is evaluated to ensure that adequate safeguards are listed in the conditions of the permits. During 2024, one hundred and fifty pathogenic species permit applications were evaluated which included fungi/oomycetes, bacteria, nematodes, and viruses.

The Regulatory Weeds Program

Prepared by Jarred Driscoll, Regulatory Weed Specialist

Program Objective

The North Carolina Regulatory Weeds Program protects North Carolina agriculture and native plant ecosystems from the harmful impacts of state and federal noxious weeds. The regulation of noxious weeds is authorized by North Carolina Plant Pest Law under Article 36 of Chapter 106, in conjunction with State Noxious Weeds Administrative Code (02 NCAC 48A .1700) which defines and lists our state noxious weeds. The NC Administrative Code is meant to interpret statutes set forth by the state legislature. The primary objective of the program is to eradicate, restrict movement, treat and/or manage regulated federal and state noxious weeds. This is accomplished by conducting surveys and enacting control measures, such as eradication efforts, that lead to effective management of areas associated with infestations. Additional programmatic activities may include the issuance of scientific permits for the movement of regulated articles, nursery inspections with Field Specialists state-wide and issuance of phytosanitary certificates.

Executive Summary

The 2024 Regulatory Weeds Program effectively identified and treated sites infested with regulated noxious weeds. The program targeted several invasive species, including beach vitex, yellow floating heart, purple loosestrife, tropical spiderwort, cogongrass, tropical soda apple, wooly frogsmouth, itchgrass, giant hogweed, small broomrape, and witchweed.
Collaboration among the Regulatory Weeds Specialist, Support Operations staff and Field Specialists were key to implementing strategic treatment schedules aimed at managing or eradicating these threats. The program's efforts contributed to protecting the natural environment and ensuring compliance with state and federal noxious weed regulations.

Cogongrass (*Imperata cylindrica*)

The NC Department of Agriculture and Consumer Services (NCDA&CS) collaborates with the NC Department of Transportation (NCDOT) to identify and control regulated weeds along roadsides throughout the state. In 2024, several locations were successfully cleared of infestations and released back to NCDOT for regular mowing operations.

A new cogongrass infestation was discovered in Sampson County in 2024 (Figure 8.1), bringing the total number of counties with known cogongrass presence to three: Brunswick, Pender, and Sampson. Through coordinated efforts, NCDOT treated roadside areas while NCDA&CS staff addressed infestations on private land.

***Figure 8.1**, New cogongrass site observed during the 2024 season in Sampson County. Cogongrass prior to treatments (A) and after (B).*

Notable progress was made in Brunswick County, where an infestation first identified in mid-summer 2023 (Figure 8.2) showed no signs of cogongrass by the end of 2024. This site will remain on the survey list for several seasons to monitor potential regrowth from viable rhizomes.

***Figure 8.2**, A new infestation of cogongrass identified in 2023 (A). The same infestation after one season of treatment in late 2024 (B).*

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife (PLS) is classified as a Class B State Noxious Weed, with management efforts in North Carolina dating back to 1997. Infestations are currently concentrated in Guilford and Henderson Counties, with Henderson County experiencing significantly higher density. Herbicide treatments, applied in three seasonal rounds, have proven effective in managing this invasive species, particularly when it is timed to catch late-emerging plants and prevent further seed dispersal.

Heavy infestations are commonly found in utility rights-of-way beneath power lines or other rights of way where there is a higher degree of ground disturbance. However, managing PLS in Henderson County remains challenging due to several factors. Recent surveys revealed new infestation pockets, some reported by the public and others newly discovered (Figure 8.3). Many of these pockets were dense, tall, and widespread across both public and private land. Additionally, the impact of Hurricane Helene, which brought over 15 inches of rain and high winds to the area, is expected to facilitate further seed spread.

Moving forward, extensive survey efforts and continued herbicide treatments will be critical to curb the spread of PLS. Complete eradication remains difficult due to the plant's prolific seed production and the longevity of its seed bank. However, annual herbicide treatments in infested areas continue to be the most effective method for control.

Figure 8.3, **A new cluster of purple loosestrife plants behind houses in Henderson County.**

Itchgrass (*Rottboellia cochinchinensis*)

This federally and state-listed noxious weed produces small, sharp hairs on its leaf sheaths (Figure 8.4) that can penetrate the skin and cause irritation, giving rise to its common name, itchgrass. It poses significant challenges along roadsides, ditches, rights-of-way, pastures, and row crops. As an annual grass, itchgrass spread primarily through seed, with each plant capable of producing over 3,000 seeds under optimal conditions. These seeds remain viable in the soil for 3 to 5 years and are primarily dispersed by wind, birds, and roadside mowing equipment. Additionally, itchgrass has demonstrated some level of allelopathy, further complicating control efforts. Allelopathy is a plant's natural mechanism for releasing chemicals that inhibit the growth of other plant species, giving it a competitive advantage and promoting its own spread. Not all plant species exhibit allelopathy, but this can be a common trait for some noxious weeds.

***Figure 8.4**, Short hairs present along leaf sheaths (A). The seed heads of an itchgrass plant and independent seed (B and C respectively).*

Infestations have been ongoing in Robeson County since 1983, with particular focus on areas within the town limits of Rowland and Taunton. Management strategies involve the use of both pre-emergent and post-emergent herbicides. The NCDOT has been instrumental in applying pre-emergent herbicides along roadsides, while follow-up treatments are conducted throughout the growing season by NCDA&CS, especially where rights-of-way border private properties.

Local growers with infested fields have also played a critical role in reducing itchgrass populations by implementing herbicide treatments on their land, helping to suppress the seed bank, or those seeds left in the soil that could germinate in future years. Significant progress has been made since large-scale pre-emergent herbicide applications began in 2022, and continued collaboration between state agencies and private landowners remains key to reducing the spread and impact of this noxious weed

Tropical Soda Apple (*Solanum viarum*)

Tropical soda apples pose a significant threat to North Carolina agriculture by outcompeting vegetable crops and serving as an alternate host for several major pathogens affecting solanaceous species. These pathogens include potato leafroll virus, potato virus Y, gemini virus, cucumber mosaic virus, tomato mosaic virus, and tomato mottle virus. Additionally, the plant's large, thorn-like prickles make hand removal difficult and present a potential health hazard.

In 2024, three survey efforts were conducted at a known tropical soda apple infestation site in Sampson County, occurring in July, September, and early November (Figure 8.5). This remains the only confirmed location of the weed in North Carolina. Surveys targeted previous hotspots and covered the 7,000-acre area using ATVs.

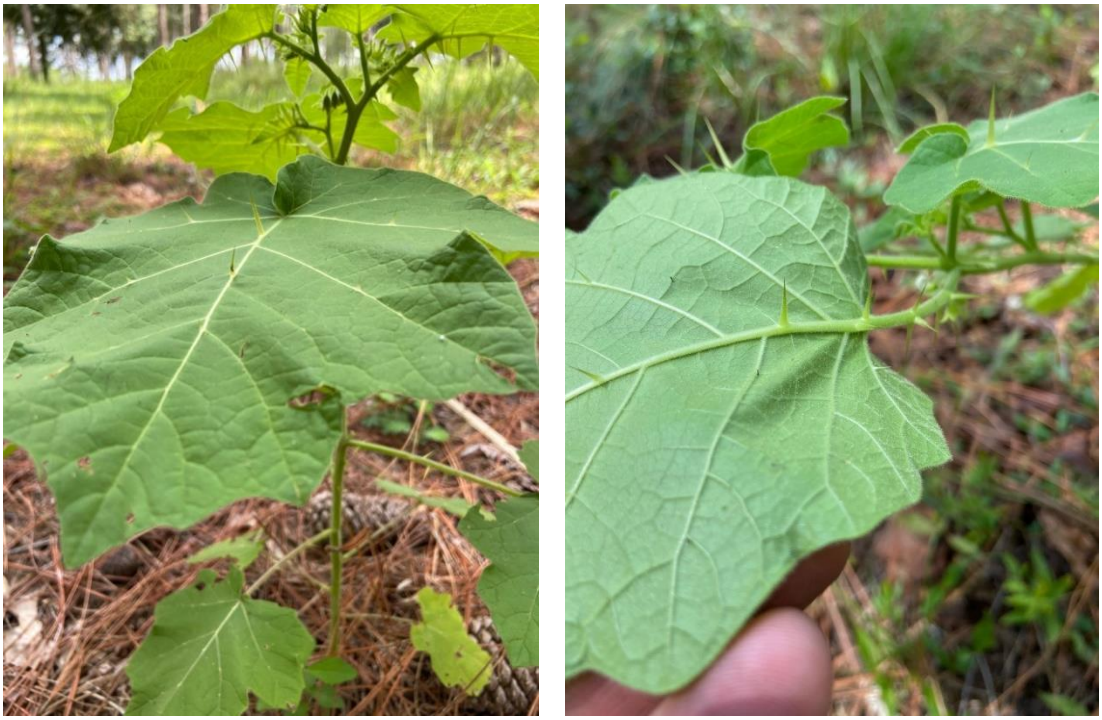

Figure 8.5, *A lone tropical soda apple plant showing off its large thorn-like prickles above leaf (left) and below leaf (right) surface.*

A total of 150 plants were identified and removed during the season. To prevent seed dispersal, plants were carefully rogued, placed in heavy-duty paper bags, and incinerated. Ongoing monitoring and removal will be essential to prevent further establishment of this noxious weed in the state.

Giant Hogweed (*Heracleum mantegazzianum*)

Watauga County remains the only county in North Carolina where giant hogweed has been positively identified. No new infestations were discovered in 2024. Annual surveys of all known locations are conducted by the area Field Specialist.

Giant hogweed has several lookalike species, including elderflower, poison hemlock, and cow parsnip, which often lead to mistaken identifications by the public. In 2024, none of the reported cases resulted in positive identification of giant hogweed. In most instances, identification could be confirmed through digital photos submitted by the public. However, when a clear determination could not be made remotely, an on-site visual inspection was conducted.

The ongoing combination of public reporting and annual surveys remains essential in preventing the spread of giant hogweed and ensuring early detection if new infestations arise.

Wooly Frogsmouth (*Philydrum lanuginosum*)

Two adjacent locations remain the only known infestations of this plant pest in the state. In 2024, the original site contained just one plant, while the neighboring site had over 100 plants (Figure 8.6). The larger infestation was treated with herbicide and later hand-rogued during the season.

Due to the presence of the endangered Gopher Frog at this site, herbicide applications are limited to the month of August to minimize environmental impact. Despite these restrictions, both sites continue to show steady progress toward eradication with each passing season as there are fewer plants each year.

Figure 8.6, *A flowering specimen of Wooly frogsmouth infesting a pond during treatment*

Tropical Spiderwort (*Commelina benghalensis*)

Tropical spiderwort, also known as Benghal dayflower, is an annual weed in temperate climates and has only been identified in a few locations within North Carolina. Its high tolerance to many herbicides, particularly glyphosate, combined with its ability to flower and produce seeds underground, makes it especially difficult to control. One of the key distinguishing features of *C. benghalensis* is the presence of subterranean spathes on its rhizomes, which sets it apart from other species in the genus (approximately 170 species). Both above-ground and below-ground flowers are self-fertile, further contributing to their persistence. Two common look-alike species include *C. communis* (Asiatic dayflower), a non-native, non-noxious weed, and *C. diffusa* (spreading dayflower), a native species.

Benghal dayflower is classified as a seriously regulated weed that can quickly become unmanageable without early intervention. In North Carolina, two primary infestations have been closely monitored and managed. The first, a small infestation discovered in June 2015 near North Carolina State University (Figure 8.7), has remained under active treatment. The second, a significantly larger infestation at the Cherry Research Station, has also been intensively managed. In 2020, a large-scale fumigation treatment was conducted at the station, resulting in substantial progress. Over the past four years, no positive identifications have been made at the site. As a result of these successful control efforts, the quarantine placed on the Cherry Research Station was officially lifted in late 2024. Continued monitoring and early detection remain critical in preventing further spread of this challenging noxious weed.

Figure 8.7, *Two tropical spiderwort plants growing. Plants are still present after years of managing the area. A steady decline in the number of plants found at this location has been noted. These were the only plants observed at this site in 2022.*

Beach Vitex (*Vitex rotundifolia*)

Reports of beach vitex re-infestations increased during the 2021 season compared to the previous year. One notable report came from Duck, NC, prompting a shift in our approach to managing this invasive species. In response, we partnered with a local coordinator who assembled a dedicated group of volunteers. Three of our staff members visited the area to provide hands-on training and education, sharing methods once used by the Beach Vitex Task Force in their eradication efforts. This collaborative effort proved highly successful, serving as a model for future community-driven management strategies.

Many coastal communities in North Carolina already have ordinances against beach vitexes, and we hope that by working closely with these towns — as demonstrated in Duck — residents will become active participants in controlling this weed. Encouraging community involvement increases the likelihood of long-term success. New contacts are being established annually using this approach.

Building on the success in Duck, we expanded our outreach efforts in 2022. We worked directly with the towns of Carova, Corolla, Southern Shores, Kitty Hawk, North Topsail Beach, Surf City, and Topsail Beach, conducting hands-on site visits and training sessions like our initial approach in Duck. These "seaside seminars" allowed us to provide educational materials, demonstrate treatment methods, and empower local citizens and municipal employees to take an active role in eradication efforts (Figure 8.8).

Figure 8.8, *Beach vitex infesting a property on Topsail Beach. Photo on left was taken in early July when we made an initial treatment. The photo on right is from early September. Both photos are from 2022. Notice the decline in beach vitex health.*

Our work continued in 2023 and 2024 with visits to the coastal communities of Carteret and Brunswick Counties. Our goal is to standardize this approach, ensuring that any town observing a beach vitex infestation has access to information, training, and support for effective treatment and long-term management. By fostering community involvement and equipping local municipalities with the necessary knowledge, we aim to significantly reduce the spread of beach vitexes along North Carolina's coastline.

Small Broomrape *(Orobanche minor)*

Orobanche minor, commonly known as lesser broomrape, is a parasitic weed that targets a wide range of broadleaf plants. Native to North Africa and the Middle East, this herbaceous annual is an obligate parasite, meaning it derives all of its nutrients from host plants and therefore needs a host in order to live. A related

species, *Orobanche ramosa*, was first detected in Texas in 1981, and by the early 1990s, *O. minor* (Figure 8.9) had been confirmed in Virginia, as well as two locations in South Carolina and Georgia. The pathway by which *O. minor* reached North Carolina remains unclear, but by the mid to late 1990s, an eradication program had been initiated within the state.

Figure 8.9, *Orobanche minor plant in flowering phase, parasitizing clover.*

This species poses a significant threat due to its prolific seed production, with each plant capable of producing between 5,000 and 50,000 dust-like seeds that can remain viable in the soil for 7 to 10 years or longer. In North Carolina, *O. minor* has been primarily parasitic to clover in Haywood and Mitchell Counties, where movement of hay from infested fields and pastures is strictly prohibited to prevent further spread. The potential also exists for this species to become a serious pest in broadleaf row crops, including tomatoes and tobacco.

In 2024, more than 100 *O. minor* plants were discovered and destroyed at a livestock market in Haywood County. Additional plants were hand-pulled from all known infested sites, followed by chemical treatments designed to eliminate clover from affected pastures to reduce the host availability. Ongoing annual surveys and repeated follow-up treatments remain essential to prevent the establishment and spread of this noxious weed.

Yellow Floating Heart (*Nymphoides peltata)*

In 2024, we conducted our traditional three treatments at each known infestation for yellow floating heart. There remains roughly one dozen locations that receive such treatments. Several sites showed no presence of yellow floating heart during part of the season, and one location, having remained plant-free for the past few years, was officially declared eradicated and released from treatment (Figure 8.10). Under our current protocol, a site is considered eradicated after three consecutive years with no further detections.

Figure 8.10. *A previously infested yellow floating heart site in 2020 (left). Same site in 2024, with yellow floating heart eradicated (right).*

A new infestation was discovered in 2024 within the natural environment of a nursery. The nursery uses a catchment pond, where yellow floating heart is actively growing, as a water source for irrigating its nursery stock, making control efforts particularly challenging. We are working closely with the nursery to ensure compliance and to implement strategies aimed at reducing the presence of this plant over time.

The Witchweed (*Striga asiatica*) Eradication Program

The first U.S. detection of witchweed occurred in North Carolina in 1956. This noxious weed parasitizes grasses, particularly corn and sorghum, and can significantly reduce yields by more than 30%, sometimes causing total crop loss if left unnoticed. Concerns over its potential spread to the Midwest corn belt led to its classification under federal and state regulations and subsequent quarantine. From 1956 to 1995, the USDA managed and funded the eradication program. In 1995, day-to-day operations were transferred to the NCDA&CS, though the USDA has remained the program's sole source of funding. Their continued support ensures forward progress is made as we continue to march down a path towards eradication of this plant. The USDA has been a long-standing and committed partner in the effort to eradicate this federally and state-listed noxious weed (Figure 8.11). Their continued support is essential to making progress toward complete eradication.

Figure 8.*11,* *A witchweed plant parasitizing a nearby corn host. Each flower has the capability of producing 50,000 dust-like seeds that can remain viable upwards of 20 years.*

The Witchweed Program utilizes a point-based system to determine field treatment schedules, categorized into three phases: Infested, Release, and Terminated. Newly identified witchweed-infested fields begin in the Infested phase with a point status of 0–4.9. Once a field reaches 5 points, it enters the Release phase, during which the likelihood of reinfestation decreases as additional points are accrued. In the final phase, Termination, a field is deemed eradicated and no longer requires survey or treatment.

The 2024 Witchweed Program had full staffing for the first time in nearly three years. This included three field staff, two mechanics, an Information Processing Technician and 10 seasonal field staff. The most significant weather affecting the quarantine area was unnamed cyclone number 8, which brought approximately 15” of rain. This kept crews out of the field for more than a week and has the potential for moving seeds into new locations.

Field data indicates continued progress toward the eradication of witchweed. Table 8.1 reflects a net decrease in infested acres from 1,004 in 2023 to 941 in 2024. As in previous years, Bladen County remains the most affected, though it saw a reduction of more than 20 acres compared to last year.

***Table 8.1**, The number of farms, fields and infested acres per county for 2023 and 2024.*

County		No. of Farms	No. of Fields	Infested Acres
Bladen	2023	30	53	557
	2024	28	52	525
Cumberland	2023	8	8	96
	2024	7	7	48
Pender	2023	3	3	31
	2024	3	3	31
Robeson	2023	5	10	241
	2024	7	12	257
Sampson	2023	2	2	80
	2024	2	2	80
Total	2023	48	76	1004
	2024	47	76	941

***Table 8.2,** The number of acres infested and their point values per county for 2023 and 2024.*

County		0-0.9 Acres	1-1.9 Acres	2-2.9 Acres	3-3.9 Acres	4-4.9 Acres	Infested Acres
Bladen	2023	0	69	336	70	82	557
	2024	4	20	210	177	114	525
Cumberland	2023	0	0	0	0	96	96
	2024	0	0	0	0	48	48
Pender	2023	0	0	4	13	13	31
	2024	0	0	0	17	13	31
Robeson	2023	0	13	38	9	182	241
	2024	0	26	15	76	140	257
Sampson	2023	0	80	0	0	0	80
	2024	0	80	0	0	0	80
Total	2023	0	163	378	92	372	1004
	2024	4	126	225	271	315	941

Table 8.3, *The number of acres released and their point value per county for 2023 and 2024.*

County		*5-5.9 Acres*	*6-6.9 Acres*	*7-7.9 Acres*	*8-8.9 Acres*	*9-9.9 Acres*	*Released Acres*
Bladen	2023	35	54	82	51	68	290
	2024	**45**	**0**	**131**	**40**	**41**	**257**
Cumberland	2023	54	15	90	104	171	434
	2024	**112**	**0**	**71**	**92**	**61**	**336**
Pender	2023	0	0	6	0	30	36
	2024	**0**	**0**	**6**	**0**	**0**	**6**
Robeson	2023	130	33	0	0	60	223
	2024	**114**	**0**	**33**	**0**	**38**	**186**
Sampson	2023	0	0	0	16	8	24
	2024	**0**	**0**	**0**	**12**	**4**	**17**
Total	2023	219	102	178	171	336	1007
	2024	**271**	**0**	**241**	**144**	**145**	**801**

The program achieved a net termination of 243 acres, reducing the total quarantined area to 1,742 acres across five counties for both infested and released acreage (Tables 8.2 and 8.3). Surveyed acreage continues to range between 25,000 and 30,000 acres (Table 8.3). This is a critical effort in preventing the spread of infestation beyond current quarantine boundaries and detecting new or recurring cases early to minimize future time and money spent on eradication efforts. Much of this work is carried out by experienced seasonal staff who are well acquainted with existing infestations. One new field was identified in Bladen County, adding four additional acres to its total.

Table 8.3, *A summarization for total acres managed in 2024.*

Total Acres in Infested Category	**941**
Total Acres in Released Category	**801**
Total Acres Managed by Program	**1,742**
Total Acres Treated	**352**
Total Acres Surveyed	**25,522**
Acres Transferred from Released to Terminated	**247**
New Acres in Program	**-4**
Net Terminated Acres (Term. Acres – New Acres)	**243**

Seed Section

Prepared by Dr. Dianne Farrer

Seed Section:

- Number of containers sold in the state from tonnage report: **6,199,667**
- Number of companies that submitted seed tonnage reports: **155**
- Number of seed licenses issued: **5,472**
  - Retail: **5203**
  - Wholesale: **269**

Though these are numbers reported, they don't represent very solid entities. Containers are not strictly defined in state statutes, so companies can self-determine what a container is defined as.

NCDA Seed Laboratory Summary:

Official Seed Samples submitted = **2,007**

Service Seed Samples submitted = **8,072**

Total Seed Samples submitted to the seed lab = **10,079**

Table 9.1, *Summary of laboratory test number performed for the year 2024*

Test	Official	Service	Total
Purity	187	1,737	1,924
Germination	2,007	8,072	10,079
TZ	56	19	75
Seed Count	0	33	33
Cold Germ.	242	91	333
Cool Germ.	322	67	389
Sand Germ.	21	6	27
Endophyte	0	25	25
Total	**2,835**	**10,051**	**12,886**

The numbers in the table above (Table 9.1) only represent the number of tests performed by the seed lab, but do not reflect the quality of the seed being shipped into the state. One measure of quality of seed is to do a germination test. That is the test performed the most by the seed lab. Purity is another measure of quality and that is the second highest number of tests performed. Below in Table 9.2 is a summary of germination results for the 2024 crop year for the crops grown in the most acres in the state. From this table and historical data, the cotton seed coming into the state is improving in its germination numbers.

Table 9.2, *General germination results for common crops grow in NC, samples comprised of service and official samples*

Kind	100-95%	94-85%	84-70%	69-60%	<60%	Sample count
Corn	240	130	29	2	22	423
Cotton	26	236	184	106	268	847
Oats	100	53	6	1	3	163
Peanut	36	449	158	19	23	658
Soybean	254	515	97	15	14	895
Wheat	522	291	27	5	24	869

It should be noted that the data in the cotton germination is co-mingled in table 9.2 with both warm and cool germination test. The warm germination test is the test used to regulate cotton seed in the state, but the cool germination data is a vigor test for cotton. In the table below the cool and warm germ data is separated (Table 9.3)

Table 9.3*, Germination totals and vigor test results for cotton for the 2024-year, official samples only.*

Kind	100-95%	94-85%	84-70%	69-60%	<60%
Cotton – cool germination	0	2%	17%	26%	55%
Cotton – warm germination	6%	66%	25%	3%	0

Fertilizer Section

Prepared by Dr. Dianne Farrer

Fertilizer Section:

- Amount sold in the state, fertilizer: **1,246,642 tons**
- Amount sold in the state, lime: **520,469 tons**
- Amount sold in the state, land plaster: **97,207 tons**

The numbers of fertilizers, lime, and land plaster were down from last year. It was also a very tough year for growing crops with limited funds, increased input costs, and a few natural disasters. This is what is reflected in the decreased tonnage reported for 2024.

- Number of fertilizer dealer licenses issued: **693**
- Number of fertilizer products registered: **7,523**
- Number of fertilizer penalties collected: **234**
- Number of lime/landplaster products registered: **170**
- Number of lime/landplaster penalties collected: **68**

Part of the mandate with registering and licensing products and business in fertilizer, lime, and landplaster distribution is also regulating those products. This is accomplished by field inspectors that visit places of business in the selling and distribution of fertilizer and lime/landplaster products. Once samples are taken of fertilizers or lime or landplaster, those samples are submitted to the NCDA Food and Drug laboratory where they are analyzed for the contents. The analysis will indicate whether the registered product is true to its labeling. If the contents are found to be below the labeled amounts, penalties are assigned (State Statutes 106-664 and 106-665).

Soil Additives:

The number of products registered this year was **827**. This was a large increase from last year, with almost 200 more products registered. There appears to be a trend with more and more products in this category of products we register. There seems to be a push for more products that increase soil health to provide increased nutrients for growing crops. Though many of the claims from these products cannot be substantiated.

Personnel in Seed & Fertilizer Section:

Number of full-time employees: 20

Number of part-time employees: 0

Number of temporary employees: 2

Number of vacancies: 2 (by end of year)

Seed & Fertilizer Administrator: 1

Administrative Assistant:1

Field Staff

- Supervisor Western Regions:1
    - Inspectors: 2
- Supervisor Eastern Regions:1
    - Inspectors: 4

Laboratory Staff

- Laboratory Supervisor:1
    - Germination Lead: 1
    - Purity Lead: 1
    - Seed Analyst: 6
        - Administrative Associate: 1

Summary:

In summary, natural disasters (June drought, Tropical Storm Debbie, Hurricane Helene) ruined many crops, so inputs like fertilizers, lime, and land plaster were down. The quality of the seed being sent into the state is relatively good, but seed quality could be reduced for the year 2025 if grown in NC because of natural disasters. We see an uptick in the number of fertilizer products registered and the number of soil additives registered, and more seed sold in the state.