National Soil Dynamics Laboratory

Spring 2024

Highlights

USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

Weed Infiltration of Cotton Leaf Roll Dwarf Virus to Check Host Range

Cotton leafroll dwarf virus (CLRDV), a destructive pathogen, was first reported in Alabama in 2017. The virus has been detected across the U.S. Cotton Belt and is a potential problem in cotton production. The virus is transmitted by cotton aphids, the only known vector, from virus reservoirs (host plants) to non-infected plants.

Weeds can serve as host plants for pathogens and vectors, serving as a virus reservoir to aid in CLRDV transmission to the next season. Prickly sida and Palmer amaranth are suspected hosts for CLRDV. To find potential CLRDV weed hosts, we designed a laboratory study to test if predominant weeds of the southern U.S., such as Palmer amaranth, morningglory, sicklepod, velvetleaf, and prickly sida, can harbor CLRDV after infiltration (method to introduce a CLRDV-containing bacterial solution into plant tissues with a syringe).

Procedures include dissolving LB broth (nutritionally rich medium for culturing bacteria) in water and autoclaving. The mixture is poured into plates, and frozen agrobacterium containing CLRDV stock are streaked onto them and stored for bacterial growth (Fig. 1a). The agrobacterium with CLRDV is cultured with a green fluorescent protein (GFP). After three days, a new media was prepared using a buffering agent (MES) and $MgCl_2$. Bacteria collected from the original plates are dissolved in the new media. A spectrophotometer adjusts the bacteria density. After incubating for 2-3 hours, plant leaves are infiltrated with the mixture using a syringe (Fig. 1b). Ultraviolet (UV) light easily detects GFP to track CLRDV movement in plants after infiltration.

In the first run, 100% of cotton plants, 55% of velvetleaf, 50% of morningglory, 45% of sicklepod, 20% of Palmer am aranth, and 15% of prickly sida exhibited symptoms and fluorescence under UV light compared to the control (GFP without CLRDV). In the second run, 90% of cotton plants, 40% of velvetleaf, 35% of morningglory, 30% of sicklepod, 5% of Palmer amaranth, and 15% of prickly sida showed symptoms and fluorescence under UV light compared to the control. In the third run, 100% of cotton plants, 65% of velvetleaf, 60% of morningglory, 30% of sicklepod, 0% of Palmer amaranth, and 35% of prickly sida showed symptoms and fluorescence under UV light compared to the control.

Leaves of cotton (Fig. 2), morningglory, sicklepod, and velvetleaf weeds all showed fluorescence under UV light, indicating movement of CLRDV along leaf veins. Palmer amaranth, a suspected CLRDV host, produced low fluorescence compared to other species. Understanding the host range of different weed species will help improve management strategies to prevent CLRDV spread between seasons.

Figure 1. Streaked agar (a) and infiltrated leaf (b).

Dynamically Speaking

H. Allen Torbert
Research Leader

Spring is here and the National Soil Dynamics Laboratory's personnel are busy preparing for this year's experiments as another growing season begins. The lab has a long tradition of focusing on production agriculture and soil health and we are proud to continue our research efforts in developing sustainable cropping systems for the Southeast that are both environmentally conscious and economically profitable. We are also excited about our new areas of research that are beginning to yield results in the areas of improved animal waste management, cotton disease prevention, forage production improvement, and the use of biochar to improve soil health. I hope you enjoy reading about some of the research efforts we have included in this issue of the National Soil Dynamics Highlights.

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Continued on p.2

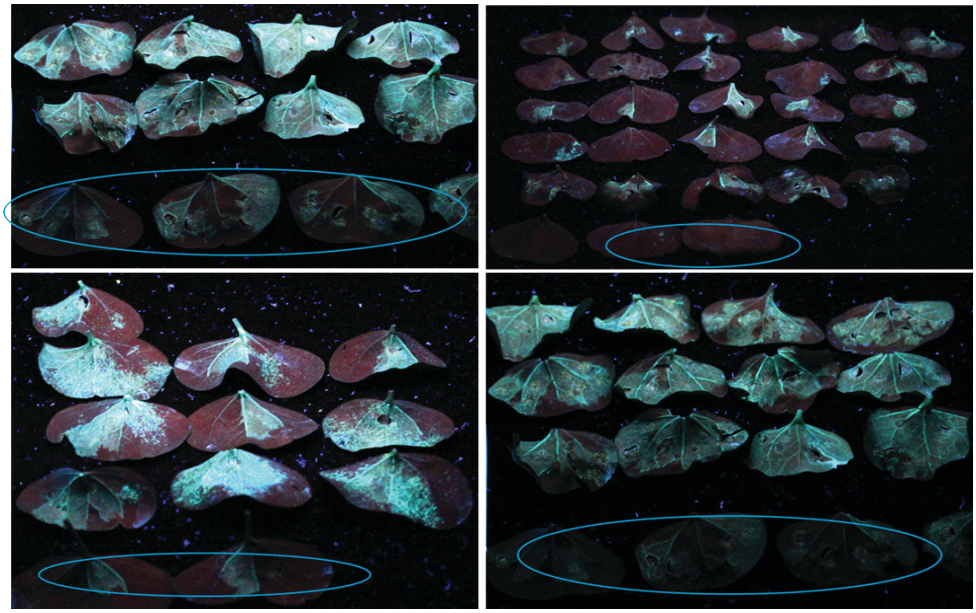

Figure 2. Pictures of cotton plants showing the green fluorescent protein (GFP) glowing under a UV light representing CLRDV on the leaves. The ovals respresent control plants not glowing under the UV light (GFP without CLRDV).

Response of Marigold to Biochar Type and Rate

Biochar - a pyrolytic byproduct of bioengery production - has been used for land reclamation, water treatment, sanitation, and to improve soil nutrient availability and enhance C storage. Biochar research in agricultural systems has examined effects on growth, greenhouse gas (GHG) emissions and N loss, but little work has examined its use in horticulture container production systems.

We investigated how adding biochar to container media affected plant growth, loss of phosphorus (P), ammonium (NH_4), and nitrate (NO_3) as leachate, and GHG (CO_2, CH_4, and N_2O) emissions in an outdoor marigold study (Fig. 3). The medium was a 6:1 pinebark:sand mixed with 0, 3.75, 7.5, 11.25, or 15% biochar from three sources (pine wood [PW], sugar cane residue [SC], and coconut shell [CS]). There were few effects of biochar type on growth. In general, SC had higher tissue N levels. Higher biochar rates produced larger plants. Lower rates had higher tissue N levels, but larger plants at higher rates led to higher total N content.

Biochar type had no effect on CO_2 flux; however, higher rates tended to have higher flux but only on a few sampling dates. Methane emissions also showed few significant effects. Nitrous oxide emissions were more frequently impacted by biochar type with PW having greater flux early in the study and CS higher through the rest of the study. Higher biochar rates tended to have higher N_2O emissions. Biochar type by rate interactions indicated that emissions did not vary with rate in SC and PW but in CS higher rates had greater emissions. Further, at the higher rates, CS > PW and/or SC.

Upcoming Events 2024		
Dates	**Meeting**	**Location**
Apr. 18, 2024	AL Invasive Plant Council	Montgomery, AL
July 9-11, 2024	American Peanut Research and Education Socieity	Oklahoma City, OK
July 17-19	Southern Peanut Growers Conference	Savannah, GA
July 21-24	SWCS Conference	Myrtle Beach, SC
Oct. 15-17, 2024	Sunbelt Ag. Expo	Moultrie, GA

Figure 3. Marigold 'Bonanza Orange' grown in the biochar study.

Continued on p.3

Leachate P loss early in the study followed the pattern CS > SC > PW, while later it was CS > SC = PW. Loss of P was greatest with higher biochar rates through most of the study. In contrast, NH_4 loss was highest in SC and lower for higher rates. Leachate NO_3 loss was greatest for SC early in the study, CS > PW in the middle; and not different among types at the end of the study. Ammonium loss followed the same rate pattern as NO_3 (lower rates had higher losses). This indicates that biochar kept more N from leaching from containers and may help explain why higher rates had higher N_2O flux. Going forward, more biochar sources should be identified and tested as substrate amendments for other ornamental species.

Gypsum holds Promise as a Bedding for Broiler Production

The US broiler industry produces more than 9 billion fryer chickens each year. Traditionally, wood shavings and sawdust have been used as inexpensive readily available sources of bedding for the broiler industry. Cost and availability of sawdust and wood shavings have affected the growing industry in recent years, resulting in the search for alternative bedding sources. Consequently, the broiler industry has started using diverse types of bedding for raising chickens that are dependent upon local availability of materials to production facilities. These bedding materials include peanut hulls, rice hulls, hard wood shavings, pine shavings, sawdust, etc.

Research at NSDL has shown that using flue gas desulfurization (FGD) gypsum as a bedding for chicken production holds promise as an alternative replacement for wood shavings. In addition, our research has shown that negative impacts associated with land application of chicken litter can be abated when FGD gypsum is applied on top of litter or mixed with it, thereby lessening the broiler industry's environmental footprint. FGD gypsum is produced as a by-product of removing sulfur from combustion gases at coal-fired utility plants. Current markets for FGD gypsum are unable to utilize all of the by-product gypsum being generated. Thus, utility companies are exploring environmental and economically feasible options to replace on-site storage and disposal of FGD gypsum in landfills.

Multiple tests from our lab have shown that footpad quality was improved and ammonia levels and phosphorus solubility are reduced when FGD gypsum litter is used, compared to wood shavings, during chicken production (Fig. 4). Recently, emphasis on animal welfare has become an important aspect of broiler production. A recently completed

National Soil Dynamics Laboratory
411 S. Donahue Drive
Auburn, AL 36832-5806
334-844-4741
http://www.ars.usda.gov/sea/nsdl

Recent Publications

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Continued on p.4

Happenings

Mr. Carter Bonnell presented a live experiment to 130 students (6th - 9th grade) of Southern University Lab High School. A tabletop rainfall simulator and slake test demonstration was used to explain the benefits of no-till agriculture and cover cropping. Small soil bins were also planted and displayed side-by-side showing the efficacy of cover cropping for weed suppression.

Dr. Kip Balkcom presented information about cover crop management considerations to participants that included growers, scientists, and industry representations at the Mississippi State University Extension Row Crop Short Course in Starkville, MS.

Dr. Kip Balkcom presented a conservation tillage demo that showcased different equipment and discussed how tillage equipment alleviates soil compaction to participants at the 4R Nutrient Stewardship Field Day in Shorter, AL.

Dr. Chaoyang Zhao presented an invited seminar to the Department of Entomology and Plant Pathology, Auburn University titled "Host-Manipulating Effector Genes in Plant-Galling Insects".

Dr. Andrew Price, Mr. Jeffrey Walker and Mr. Carter Bonnell presented "What We Do" to 70 stakeholders at the 2024 Wiregrass Cotton Expo to highlight research conducted at NSDL.

Dr. Anthony Adesemoye presented an invited seminar to the Auburn Univ Dept of Entomology and Plant Pathology titled "Disentangling the Activites of Root Microbiome Mediators Through Metabolomics".

In celebration of African American History month, the Auburn location's special emphasis program organized a tour of the Jule Collins Smith Museum of Fine Art in Auburn, AL. The group viewed multiple exhibits called "Radical Naturalism-Elizabeth M. Webb: a bearing tree is a witness; an oak is an echo", Black Codes: Art and Post-Civil Rights Alabama", amongst others.

Dr. Kip Balkcom spoke at the 2024 Escambia County Field Day in Brewton, AL about cover crop seeding rates.

NRCS personnel invited Drs. Kip Balkcom and Ted Kornecki along with Mr. Corey Kichler to speak to participants of an Alabama Soil Health Tour in Headland, AL. Dr. Balkcom shared research results from on-going studies about N timing for cover crops and cover crop seeding rate research, while Dr. Kornecki and Mr. Kichler demonstrated conservation tillage equipment for small-scale farmers they developed at the NSDL.

study, in conjunction with Auburn University, showed that no differences in fear response were observed among chickens raised on FGD gypsum litter when compared to pine shavings (Fig. 5). Overall, results on the use of FGD gypsum as a bedding material for broiler production has been promising. Currently, we are evaluating the influence that different FGD gypsum bedding practices have on litter nutrients and whether it can be inhouse composted (Fig. 6). Results from these studies will provide useful information for prescribing the alternative use of FGD gypsum bedding and help improve agriculture's environmental footprint.

Figure 4. Baby chicks placed on fresh wood shavings and FGD gypsum bedding.

Figure 5. Fear response being evaluated during the wood shavings and FGD gypsum bedding study.

Figure 6. FGD gypsum litter and wood shavings litter in compost piles.

Send updated contact information, questions, comments, and/or suggestions to: NSDL-Highlights@ars.usda.gov