

***Progress Report to NC Small Grain Growers Association, 2020-21***  
***Improving Small-Grain Disease Management in North Carolina -- C. Cowger, USDA-ARS***

Christina Cowger, USDA-ARS Research Plant Pathologist, appreciates the funds provided to our program for small-grain disease research and education to benefit the North Carolina small-grain industry in 2020-21. Funds were used as follows:

**(1) Supported the North Carolina Small Grain Industry**

Our program supported the industry with education, diagnostics, and decision support. This past year, we provided:

- **research-based advice** to county agents, agronomists, crop consultants and growers
  - Sent out 4 timely updates on scab risk via national risk forecasting website (Mar. 30, Apr. 12, Apr. 23, May 7)
  - Provided diagnosis and decision support by phone, email and in person to ~20 county agents, NCDA specialists, and private crop consultants regarding biotic and abiotic problems, fungicide & other management decisions for specific farms and fields across the state
- **talks at field days and agent trainings** on small-grain disease management
  - Spoke on “Diseases to Watch For” at Wheat Webinar organized by Jenny Carleo (Jan. 29)
  - Spoke at statewide NCSU Small Grains Zoom Meeting (March 9)
  - Spoke on fungicide decision-making at Piedmont Research Station Field Day (May 5)
- **diagnosis and recommendations** to clients of the NCSU Plant Disease & Insect Clinic (PDIC).
  - Diagnosed 22 wheat, barley, oat and rye samples submitted to PDIC; provided management recommendations

**(2) Screened advanced wheat and barley breeding materials for resistance to Fusarium head blight (FHB, or scab) and Septoria nodorum blotch (SNB).**

- Provided Drs. Murphy, Marshall, Griffey (Virginia Tech) and Baenziger (Nebraska) with scab severity data and DON ratings for advanced experimental wheat and barley lines under misted, inoculated conditions.
- Provided breeders with SNB resistance ratings for 393 advanced experimental lines from wheat breeding programs in NC, VA, SC, GA, and surrounding states.

**(3) Provided growers and crop advisors with data on efficacy and timing of fungicides for reduction of Fusarium head blight in wheat and barley.**

- Successfully conducted a 4th year of a field experiment to compare Miravis Ace to Prostaro and Caramba at the same timings. Against FHB, Miravis Ace provides equivalent symptom and DON reduction to Prostaro or Caramba in barley at early full spike emergence, and also at 6 days after early full spike emergence. However, none of the fungicides reduced symptoms and DON as well when applied early, at 50% spike emergence. Multi-location research shows similar results in wheat.

**(4) Advanced our ability to combat Pythium root and crown rot of wheat.**

- We have found that the soilborne fungus *Pythium* can cause severe rotting of roots and crowns, especially when wheat plants are subjected to prolonged soil saturation.
- We have determined that 3 particular species of *Pythium* are most frequently infecting stunted plants.
- We have obtained seed of Pacific Northwest wheat varieties shown to have tolerance or resistance to *Pythium*, to serve as controls for screening North Carolina wheat lines. We are running these tests, using a protocol for infecting wheat in growth chambers with those three species of *Pythium*.

**(5) Management of wheat powdery mildew with fungicides and wheat resistance genes**

- By studying the powdery mildew pathogen’s response to fungicides, we have learned:
  - Triazoles (DMIs): there is some loss of efficacy against wheat powdery mildew in the eastern U.S. compared to the central U.S., although triazoles are still more effective against powdery mildew here than they are in the UK, Europe or Australia.
  - Strobilurins (QoIs): the key mutation that makes wheat powdery mildew completely resistant to strobilurins in the UK, Europe and Australia is still absent from the U.S. mildew population. However,

U.S. wheat powdery mildew does vary in strobilurin sensitivity, making it important not to further push the population toward resistance by over-using this chemistry.

- We are studying the wheat powdery mildew population that mutated to overcome the resistance of DG Shirley, which was originally immune to this disease due to the gene *Pm1a*. The strains of the fungus that emerged here in response to widespread planting of Shirley and broke down Shirley's resistance appear to have a different mutation from strains in other parts of the world that can overcome *Pm1a*. We believe that from genetic data, and because these local virulent strains have disappeared again following the recent reduction in Shirley acreage in North Carolina. These strains may be less fit due to their unique mutation. This suggests that *Pm1a* is a good gene to use in wheat breeding -- along with other sources of resistance -- because it will be relatively durable. In other words, *Pm1a* may be a special gene that can be periodically "reused" in wheat varieties because strains that can overcome it are weakened and do not persist well in the population.