A PROPOSAL TO

NORTH CARONLINA SMALL GRAIN GROWERS ASSOCIATION, INC.

FOR RESEARCH OR EDUCATION ENTITLED

Determining the Impact of Resistant Wheat Varieties and Foliar Insecticides on Aphid Populations, YDV Incidence, and Yield

COVERING THE PERIOD FROM **10/01/2023** TO **09/30/2024**

REQUESTING SUPPORT IN THE AMOUNT OF **$17,500**

SUBMITTED BY:

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Note: This is a fundamental research or scholarly project and, as such, the University shall be free to publish or disseminate the results of this research or otherwise treat such results as in the public domain, and it will conduct the research in an open forum consistent with the University's mission of research, instruction and public service.

Project #: 23-08 (2023-24 Funding Request)

OBJECTIVE(S): To determine the value of wheat varieties containing the *Bdv2* resistance gene and foliar insecticide sprays to reduce aphid numbers, yellow dwarf virus incidence, and protect yield.

PROJECT DESCRIPTION AND RELEVANCE:

The barley yellow dwarf virus and cereal yellow dwarf virus complex (YDV) cause disease that can stunt wheat plants, causing yellow and chlorotic leaves, and limit yield. It is transmitted by multiple aphid species that fly into wheat fields from other plant hosts throughout the growing season. Transmission and disease severity depends on many factors including aphid species, seasonality of transmission, the proportion of aphids that carry YDV, plant population, planting into corn residue, and environmental conditions both during the season before wheat is planted and while wheat is being grown.

Because very few aphids can cause widespread disease and because no single management method can eliminate disease, YDV is difficult to manage. Many factors can reduce YDV including later planting, reducing aphid numbers, high plant populations, colder winters, late cool springs, and resistant varieties. Even though some varieties have varying levels of resistance, not a lot is known about most of them, with a few exceptions.

Both insecticidal seed treatments and foliar sprays can reduce incidence from YDV in wheat. However, in the Southeast, these sprays need to be timed in the fall or early winter. Dr. Scott Stewart at the University of Tennessee has shown a consistent payoff (on average) for both insecticidal seed treatments (IST) and foliar sprays in February using a 10-year data set (**Fig. 1**). Another data set from Virginia showed the biggest payoff from foliar sprays in November and a smaller payoff from spraying in February, but no payoff from spraying at the end of March (**Fig. 2**). Insecticide seed treatment (Gaucho) was intermediate. Another study showed that yield protection for foliar sprays was higher when applied 30 days after planting compared to full-tiller and at heading (**Fig. 3**). A final study from South Carolina showed a slight payoff from spraying during the middle of March, but no impact on virus (**Fig. 4**). These data all say what is known from studies across the Southeastern US. Yield impacts for sprays targeting aphids that transmit YDV are greatest before March.

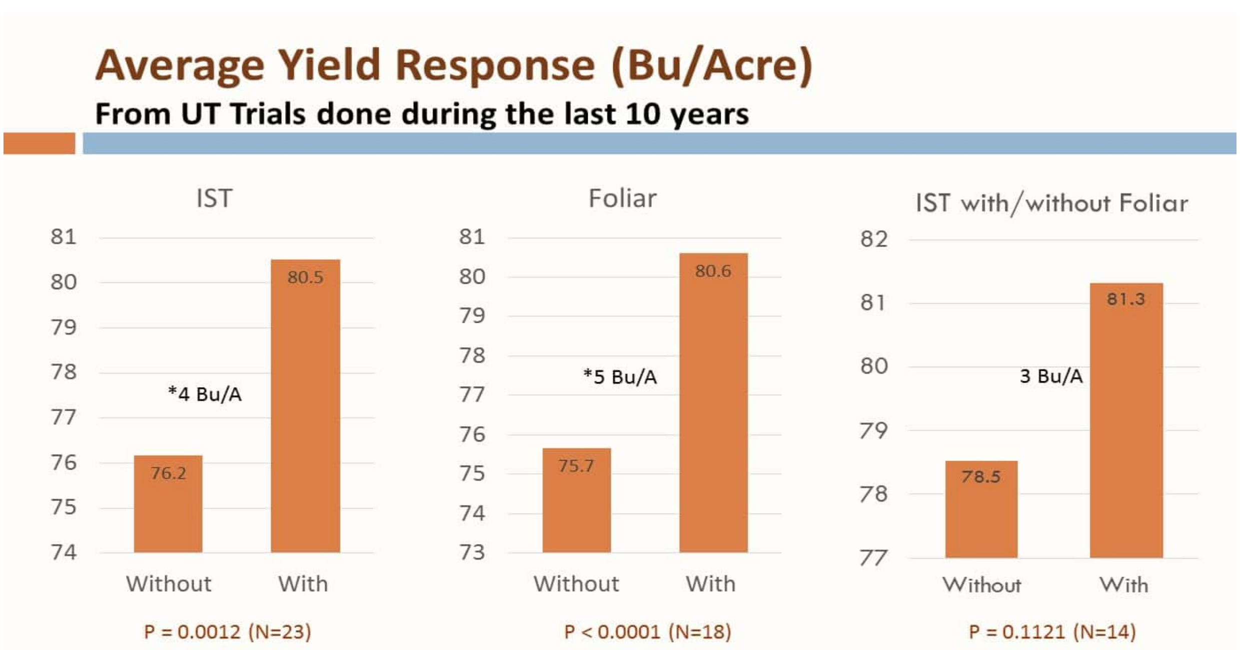

Fig. 1. Yield response to insecticidal seed treatments (IST) and foliar insecticide sprays averaged across 10 years.

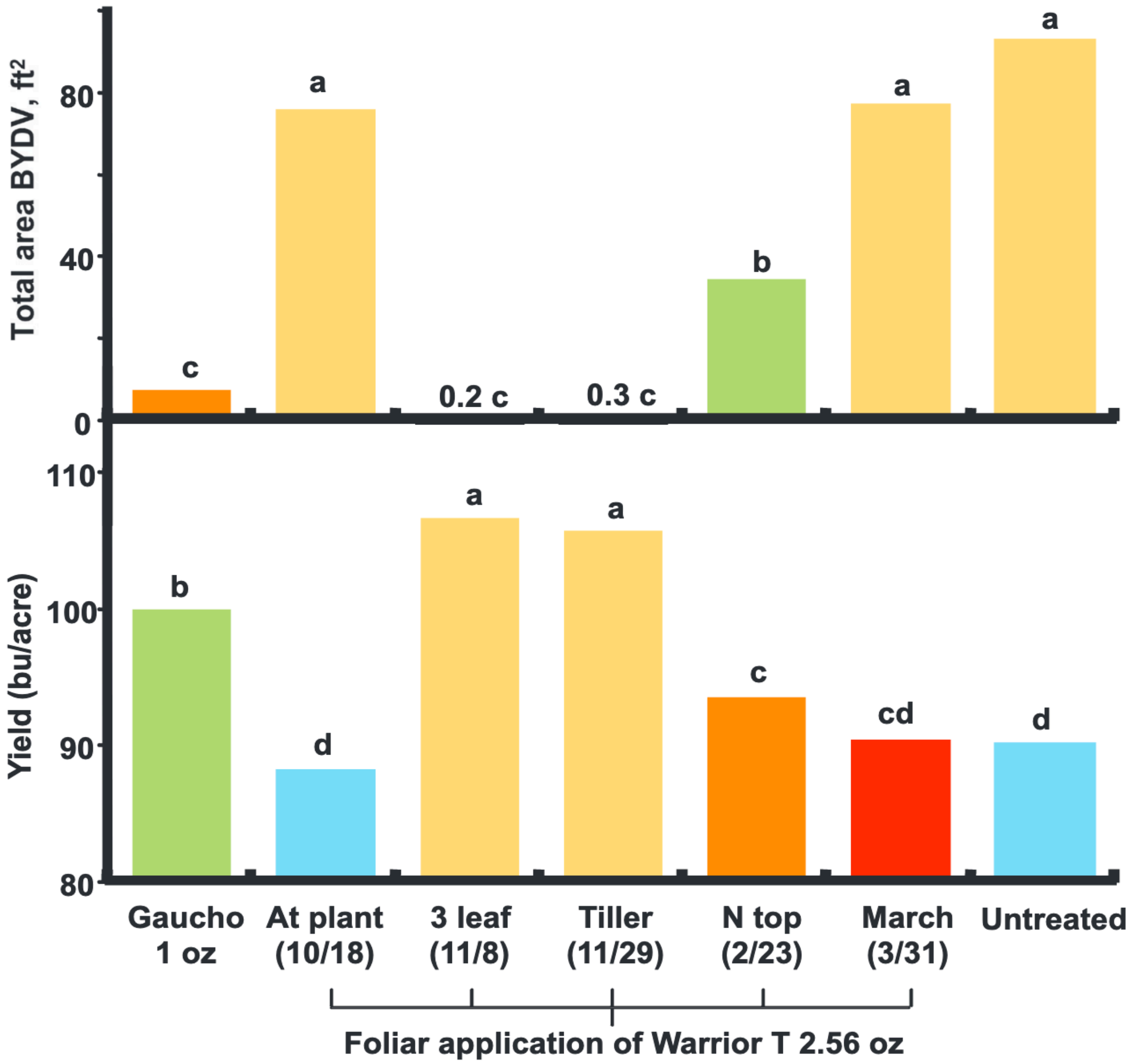

Fig. 2. Incidence of BYD and yield in winter wheat plots treated with insecticides, Aigner Farm, Henrico County, Virginia, 1999-2000.
Taken from [Barley Yellow Dwarf in Small Grains in the Southeast](https://entomology.ca.uky.edu/files/efpdf1/ef150.pdf) (https://entomology.ca.uky.edu/files/efpdf1/ef150.pdf).

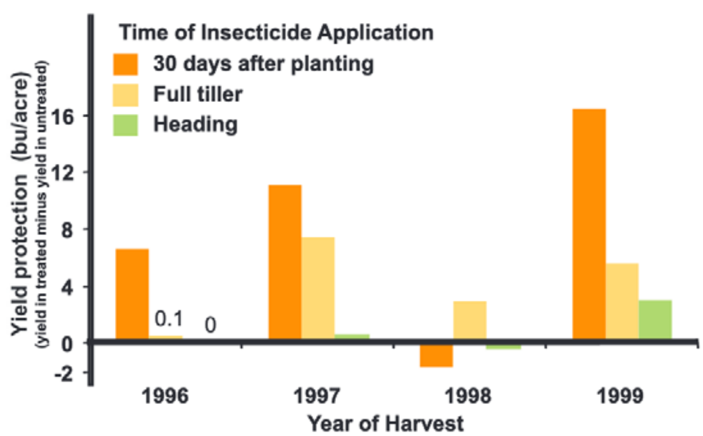

Fig. 3. Yield protection resulting from treatment with Warrior Insecticide at three stages in Griffin, Georgia. Wheat was planted in October each year. Taken from [Barley Yellow Dwarf in Small Grains in the Southeast](https://entomology.ca.uky.edu/files/efpdf1/ef150.pdf). (https://entomology.ca.uky.edu/files/efpdf1/ef150.pdf)

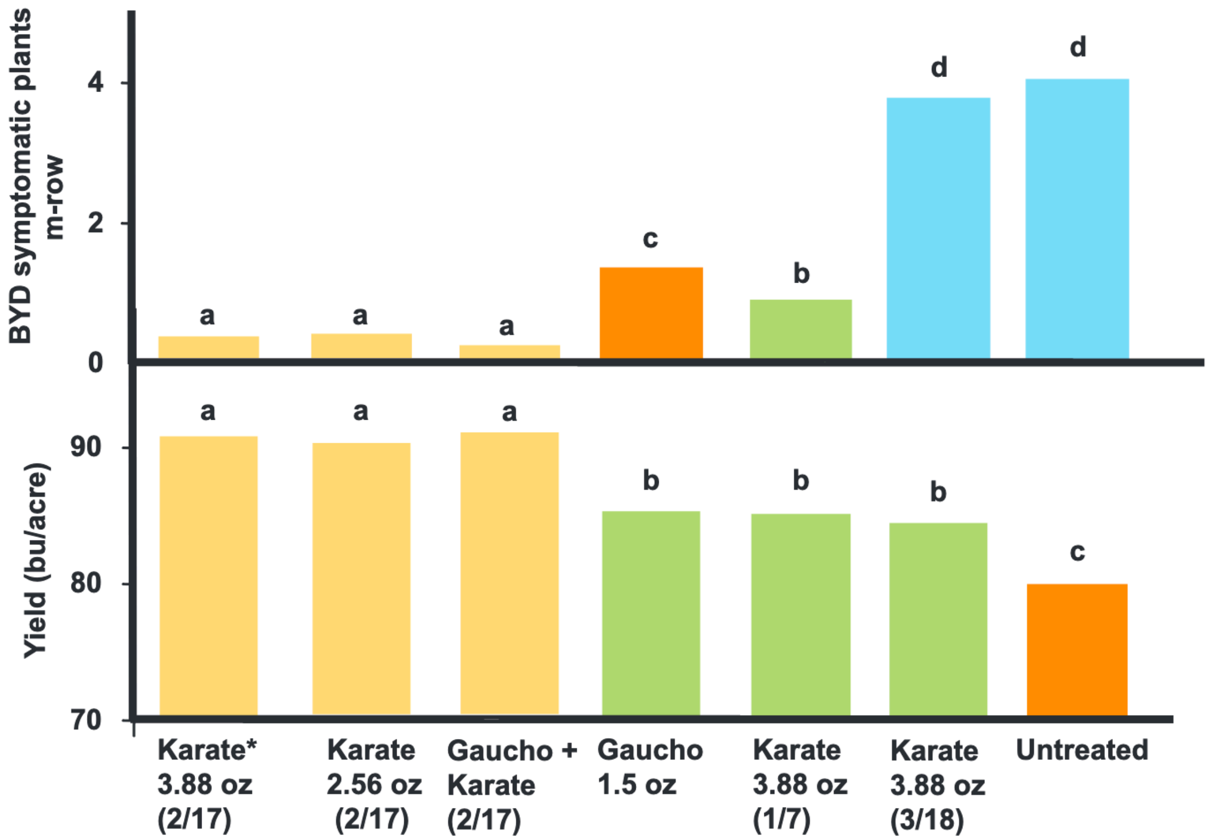

Fig. 4. Effect of insecticide treatment and timing on BYD incidence and yield of winter wheat in Blackville, South Carolina 1997 (wheat planted November 20, 1996) (*Karate IEC = Warrior T, data for two other nonpyrethroid insecticides omitted.) Taken from Barley Yellow Dwarf in Small Grains in the Southeast. (https://entomology.ca.uky.edu/files/efpdf1/ef150.pdf)

As mentioned before, not a lot is known about varietal resistance to YDV, with a few exceptions. Furthermore, **nothing is known about the interaction of foliar insecticide sprays and resistant varieties**. To test this, we planted two varieties containing the novel *Bdv2* resistance gene transferred from the wild intermediate wheatgrass with known resistance to YDV (NC15305-43 and NC20-22360) and one susceptible variety (SS8641) at both Plymouth and Raleigh during 2021. We added a factor of insecticide treatment, leaving some untreated, applying foliar spray in the fall, or applying a foliar spray in the spring (February). We sampled aphids at regular intervals.

Aphid numbers were very low in both locations. Throughout the season they ranged from 0-0.4 average aphids per tiller at Plymouth (**Fig. 5**) and 0-0.3 average aphids per tiller at Raleigh (**Fig. 6**). A fall spray only marginally reduced aphid numbers at Plymouth and reduced aphid numbers at Raleigh until February. A February spray nearly eliminated aphid numbers at both locations when the wheat was sampled during March.

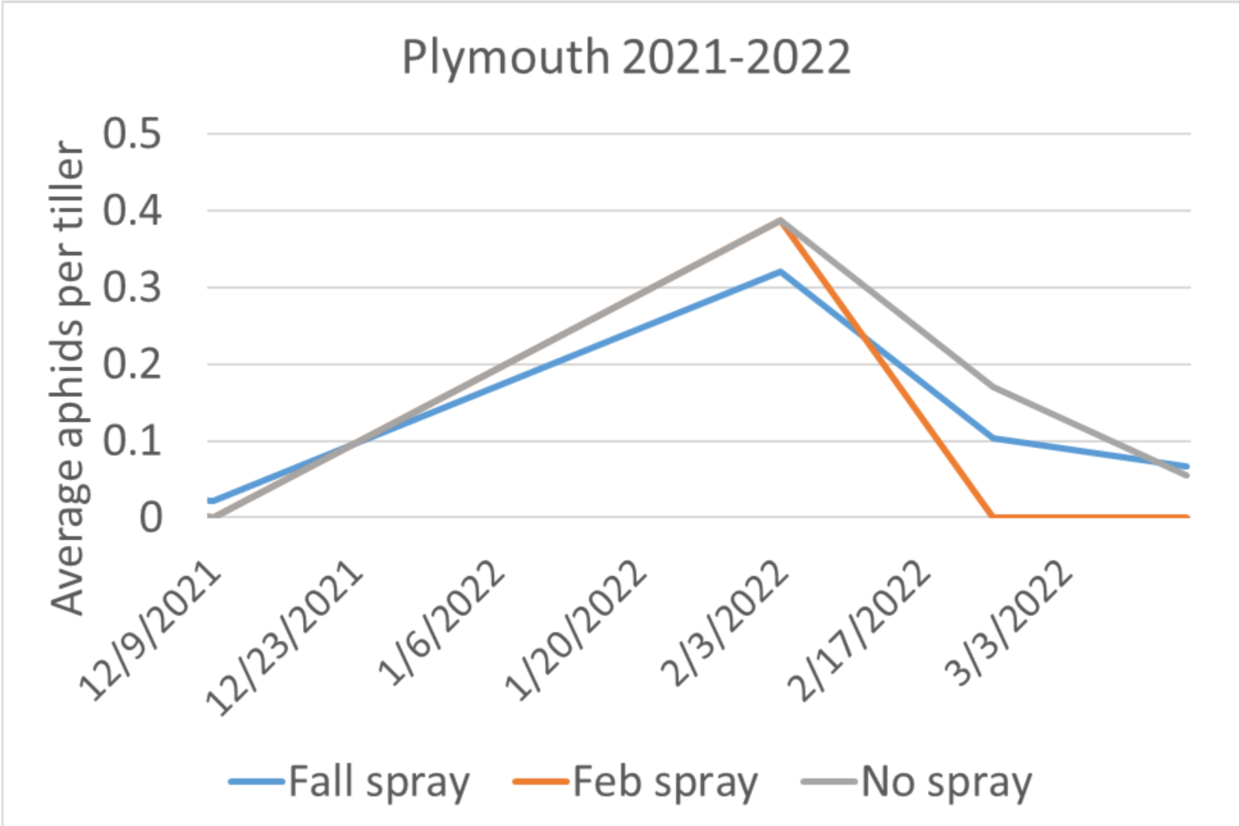
Plymouth 2021-2022
Average aphids per tiller
0.5
0.4
0.3
0.2
0.1
0
12/9/2021
12/23/2021
1/6/2022
1/20/2022
2/3/2022
2/17/2022
3/3/2022
Fall spray
Feb spray
No spray

Fig. 5

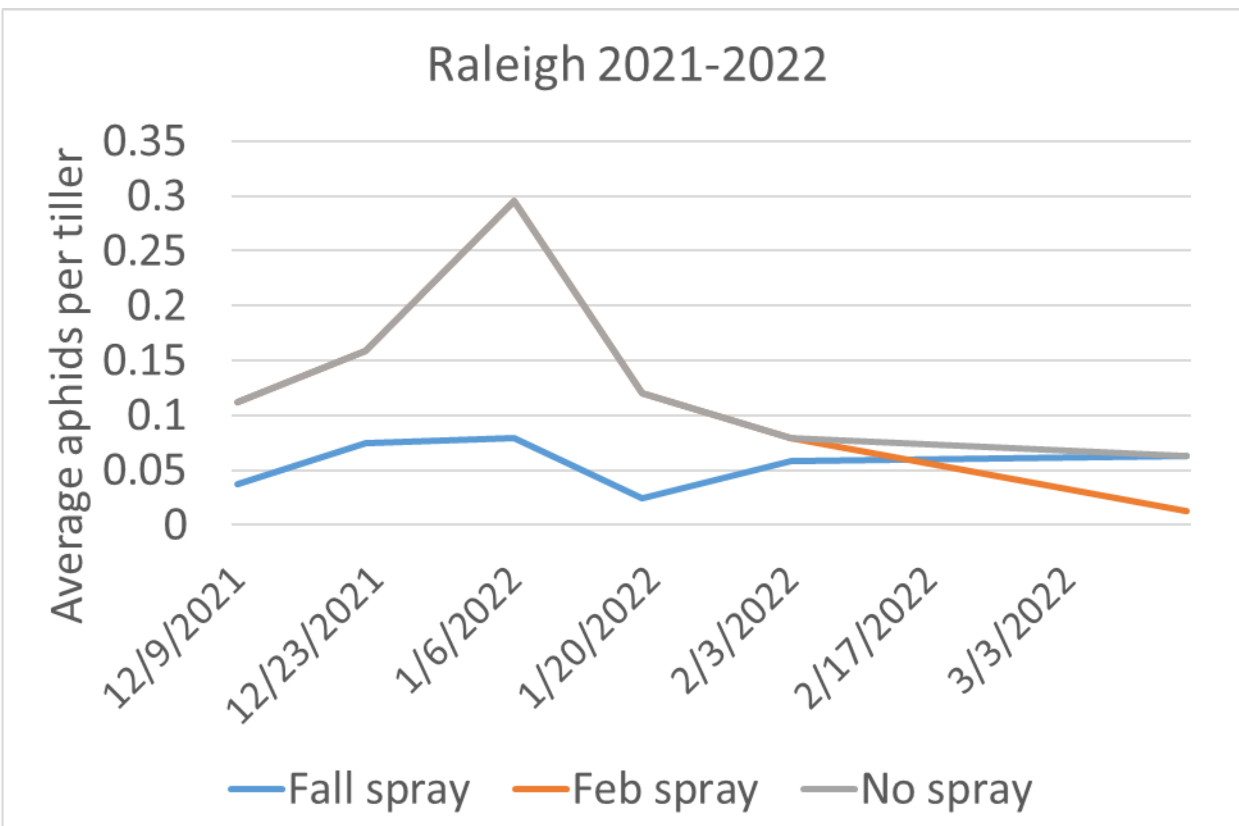
Raleigh 2021-2022
Average aphids per tiller
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
12/9/2021
12/23/2021
1/6/2022
1/20/2022
2/3/2022
2/17/2022
3/3/2022
Fall spray
Feb spray
No spray

Fig. 6

While no fall infections and therefore no stunting occurred, spring YDV infection (discoloration) was visible at both locations. At Plymouth, the percent of plants that were YDV symptomatic was highest in the susceptible variety (55-73%) and much lower in the resistant varieties (1-6%). Insecticide spray did not influence the percent of plants that were YDV symptomatic. At Raleigh, the percent of YDV-symptomatic plants was also highest in the susceptible variety (23-50%) and lower in the resistant varieties (1-11%). The percent of plants symptomatic for YDV was higher in plots that were not sprayed (4%) compared to those sprayed in February (2%) and intermediate for those sprayed in the fall (3%).

Disease severity was influenced by the interaction of both variety and insecticide spray at Plymouth (**Fig. 7**). In general, there was more severe disease in the susceptible variety (SS8641), less in the resistant variety NC20-22360, and even less in the resistant variety NC15305-43. In general, there was more severe disease in the no spray plots, less severe disease in the fall spray plots, and even less severe disease in the February spray plots.

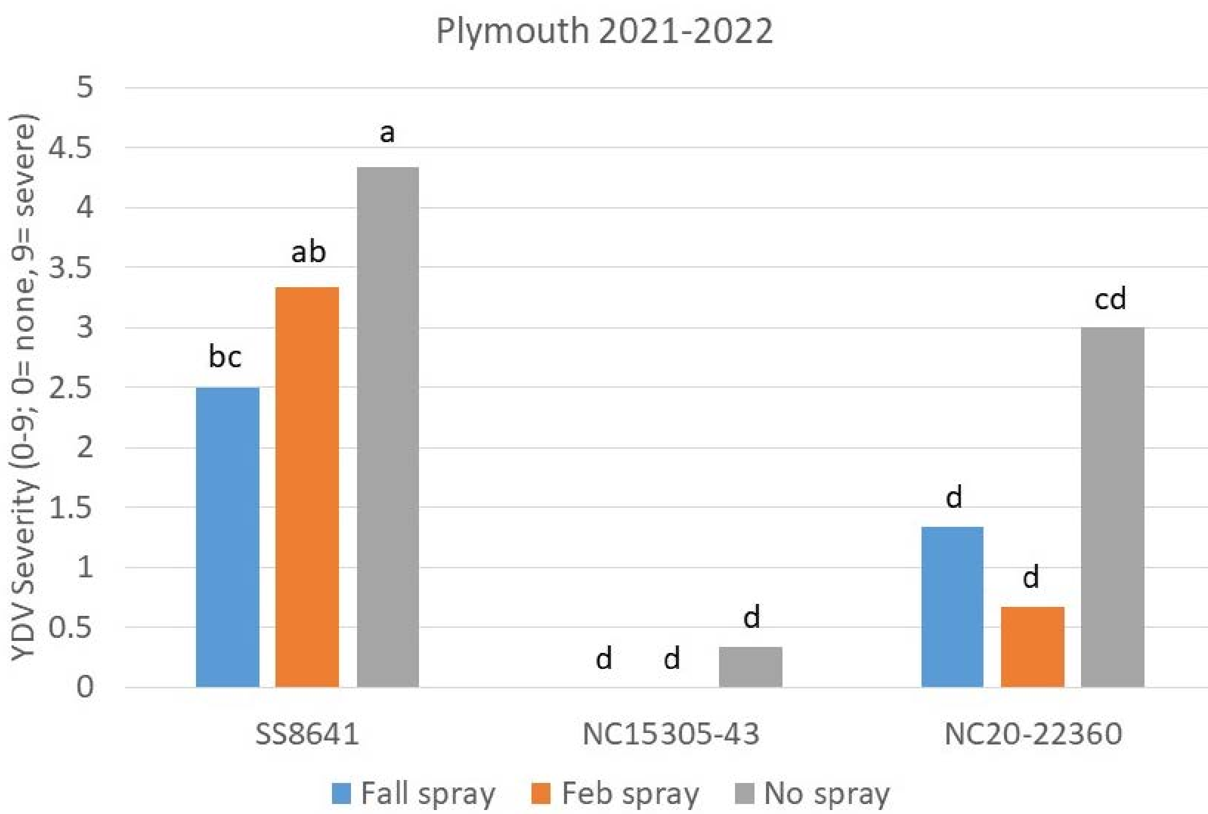

Fig. 7

Disease severity was influenced by both variety and insecticide spray at Raleigh. There was more severe disease in the susceptible variety (5.8 on a 0-9 scale) compared to the resistant varieties (1.5 NC15305-43; 1.1 NC20-22360). There was also more severe disease in the no spray plots (3.9) compared to the spray plots (2.5 fall spray; 2.0 February spray).

Yields were influenced by both variety and insecticide spray at Plymouth. Yields were lowest in the susceptible variety (63.8 bu/A), intermediate in the resistant variety NC20-22360 (65.5 bu/A) and highest in the resistant variety NC15305-43 (73.0 bu/A). Yields were higher in the February (71.3 bu/A) and fall (69.6 bu/A) spray plots compared to the no-spray plots (61.2 bu/A). Therefore, **there was approximately a 10 bu/A yield penalty from YDV at Plymouth**. There was no difference in test weight across treatments, and yields were not estimated at Raleigh due to deer damage.

Results from 2021-2022 suggest that either a resistant variety or a foliar insecticide spray in the fall or spring (February) might provide equivalent protection from YDV yield loss.

We replicated this trial during 2022-2023. In one location, we sprayed the plots incorrectly. In another location, we lost the trial due to bear feeding. **As a result, we did not spend any of the funds in 2022-2023**. We propose to replicate this experiment during 2023-2024 to see if the results are stable between years. We will move the Plymouth location to Rocky Mount to avoid bears.

RELATIONSHIP TO SIMILAR PROJECTS, IN NC AND OTHER STATES:

No other similar projects are being researched.

FUNDS REQUESTED:

2023-24 .... **$17,500**

2024-25 ....$18,250

Previous funding:

2022-23 .... $17,500*

* – This project was awarded funding for 2022-23, but could not be conducted due to problems with the field sites. Funds will be returned to the NCSGGA.