SC Soybean Board Final Report

General Information
Principal Investigator(s) Name(s): Jeremy K. Greene
Organization: Clemson University
Date: 5 January 2023
Quarter: Final Report

Proposal Information
Title: Insecticide Efficacy and Initiation/Termination for Stink Bugs and Other Arthropods in South Carolina Soybeans
Amount Expended to Date: $12,000

Project Summary
Briefly summarize this project and your final results. Summaries should be brief (limit to one page) and should be written in a way that is easy for our farmer audience to interpret and apply.

Although pressure from insect pests was relatively light in the 2022 trials, some inference can be made from the data on insect counts and yield. In the trial investigating treatment thresholds for stem feeders, two applications of methoxyfenozide (Intrepid at 10 fl oz/acre) were made to control the defoliating caterpillar species; this insecticide has little effect on kudzu bug and threecornered alfalfa hopper (TCAH), the two predominant species of stem-feeding insects present in the trial. Kudzu bug and TCAH were controlled with applications of bifenthrin (Brigade at 6.4 fl oz/acre) at the various threshold levels (Figures 1-3), but no differences in yield (Figure 4) were observed. This indicated that full-season protection and aggressive control with insecticides (3-7 applications) did not result in increased yields. Furthermore, the recommended threshold was reached with kudzu bugs but not with TCAH, so one application was made at our recommended threshold for kudzu bugs. However, no improvement in yield was observed, suggesting that our threshold approach in this trial was conservative and unnecessary for kudzu bugs alone.

In the trial investigating treatment thresholds for defoliators, with grasshoppers, soybean looper, velvetbean caterpillar, and other defoliating caterpillars, numbers of insects (Figures 5-7) were all below threshold during the season. The cumulative defoliation estimates near the end of the season (Figure 8) were higher than in-season estimates, as insecticides controlled defoliators and reduced defoliation. Applications of methoxyfenozide (Intrepid at 10 fl oz/acre) were made to control the caterpillar species at the various threshold levels, but no insecticides were applied for grasshoppers, as populations did not exceed threshold. No statistical differences in yield (Figure 9) were observed, indicating that full-season protection and aggressive control with insecticides were unwarranted. Furthermore, because insecticide was applied in the recommended and relaxed threshold treatments when defoliation levels were

close to but not meeting threshold (15%), the lack of yield differences clearly shows that thresholds are conservative and overly protective and demonstrate the soybean plant's remarkable ability to compensate for loss of foliage.

In the trial investigating treatment thresholds for pod feeders, two applications of methoxyfenozide (Intrepid at 10 fl oz/acre) were made to control defoliating caterpillar species; this insecticide does not control podworm and stink bugs. Populations of podworm (Figure 10) and stink bugs (Figure 11) never approached treatment thresholds, but a range of spray dates were attempted to see if early or late sprays of bifenthrin (Brigade at 6.4 fl oz/acre) impacted yield. No differences in yield (Figure 12) were observed.

In the trials investigating various timings of terminating insecticide use for the major groups of insects pests (stem feeders, defoliators, and pod feeders), no differences in yield were observed (Figures 13, 15, and 16). This indicated that terminating at a specific growth stage was not important under the low pressure experienced in 2022. Although terminating insecticide use at R2 did result in significantly higher defoliation (Figure 14) later in the defoliator trial, there were no statistical differences in yield.

Trials conducted to evaluate insecticide efficacy indicated that caterpillar pest species were susceptible to a range of products providing selective control of lepidopterans with one active ingredient or premixed with two insecticides as a more broad-spectrum material. Intrepid Edge, Vantacor, Denim, Elevest, Besiege, or Steward provided excellent control of mixed species of soybean looper, velvetbean caterpillar, green cloverworm, and other lepidopteran species (Figures 17 and 18) and reduced defoliation levels (Figures 19 and 20). Other species, such as kudzu bug, TCAH, and stink bugs, were adequately controlled with the pyrethroid insecticides (Figures 21-23). The new insecticide plinazolin provided good control of stink bugs (Figure 23), as it did last year (coded as ISM-555) against redbanded, brown marmorated, brown, and southern green stink bugs (Figure 24).

Key Performance Indicators

What KPI(s) were used to measure project success? How were KPI(s) measured? Were KPI(s) not met? Were KPI(s) exceeded? Explain the key circumstances that impacted achieving or not achieving KPI(s).

Test locations were established at the Edisto Research and Education Center Blackville, SC, to allow for controlled experiments investigating insecticide efficacy of and timings for applications for pestiferous insects in soybeans. Replicated and randomized plots were used to address the project objectives. Experiments included insecticide efficacy trials for BMSB and RBSB, along with other species of phytophagous stink bugs, trials to address initiation of insecticide control of stink bugs and other important insects (treatment threshold trials), and trials to investigate terminating insecticide inputs for stink bugs and other major insect pests of the crop. Trials for insecticide efficacy included comparisons of different classes of chemistry (modes of action, MOA), with as many comparisons as possible.

Trials for addressing initiation or termination of insecticide use for major feeding groups were conducted at Edisto REC. Trial treatments were as follows:

Treatment Threshold Trial – Stem Feeders (kudzu bugs, threecornered alfalfa hoppers):

1. Untreated control
2. Full-season protection
3. Aggressive threshold for stem feeders (1st sign of kudzu bug or TCAH nymphs)
4. Recommended threshold for stem feeders (kudzu bug nymphs at 1 per sweep or easily observed on most canopy observations, TCAH at 3 per rowft or several per sweep)
5. Relaxed threshold for stem feeders (recommended threshold + 1 or 2 week delay)

Treatment Threshold Trial – Defoliators:

1. Untreated control
2. Full-season protection
3. Aggressive threshold for defoliators (first sign of measurable defoliation)
4. Recommended threshold for defoliators (30% before bloom or 15% after bloom)
5. Relaxed threshold for defoliators (50% defoliation or current threshold + 1 or 2 week delay, whichever comes first)

Treatment Threshold Trial – Pod Feeders (stink bugs, podworm):

1. Untreated control
2. Full-season protection
3. Aggressive threshold for stink bugs (1 bug per 12 rowft) or podworm
4. Recommended threshold for stink bugs (1 bug per rowft) or podworm
5. Relaxed threshold for stink bugs (3 bugs per rowft or current threshold + 1 or 2 week delay, whichever comes first) or podworm

Insecticide Termination Trial – Stem Feeders (kudzu bugs or threecornered alfalfa hoppers):

1. Untreated control
2. Full-season protection
3. Terminate applications for stem feeders at R7
4. Terminate applications for stem feeders at R6
5. Terminate applications for stem feeders at R4-5
6. Terminate applications for stem feeders at R3
7. Terminate applications for stem feeders at R2
8. Terminate applications for stem feeders at mid-vegetative stages

Insecticide Termination Trial – Defoliators:

1. Untreated control
2. Full-season protection
3. Terminate applications for defoliators at R7
4. Terminate applications for defoliators at R6
5. Terminate applications for defoliators at R4-5
6. Terminate applications for defoliators at R3

7. Terminate applications for defoliators at R2
8. Terminate applications for defoliators at mid-vegetative stages

Insecticide Termination Trial – Pod Feeders (stink bugs, podworm):

1. Untreated control
2. Full-season protection
3. Terminate applications for pod feeders at R7
4. Terminate applications for pod feeders at R6
5. Terminate applications for pod feeders at R4-5
6. Terminate applications for pod feeders at R3
7. Terminate applications for pod feeders at R2
8. Terminate applications for pod feeders at mid-vegetative stages

Non-target insects were controlled in each of the trials addressing treatment thresholds or insecticide termination with selective chemistries. For example, in the trials targeting stink bugs or stem feeders, Vantacor/Prevathon was applied to control lepidopterans, with no effect on stink bugs, kudzu bugs, or TCAH.

Next Steps

Explain the next steps of this project (if any) and the implementation of the findings from the project.

The results from this project will be used to develop a more intensive and robust research project to be worked on by an incoming PhD student. The new project will involve new threshold verification work with natural populations of insect pests but will also incorporate the simulation of insect injury to address treatment thresholds. The engineering group at Edisto REC (Dr. Kendall Kirk and his team) is developing a hand-held device that will allow us to administer varying levels of defoliation to soybean leaflets. With this automated and precise tooling, we should be able to address defoliation thresholds via a controlled mechanical process. In addition to addressing simulated injury from defoliating insects, we will also simulate injury from stem feeders, such as threecornered alfalfa hopper, lesser cornstalk borer, and Dectes stem borer, by excising plants at various levels and stages of growth. Finally, we plan to simulate injury from pod-feeding insects with selective cuttings of blooms and pods.

Additional Information

Provide any additional supporting information, facts or figures here.

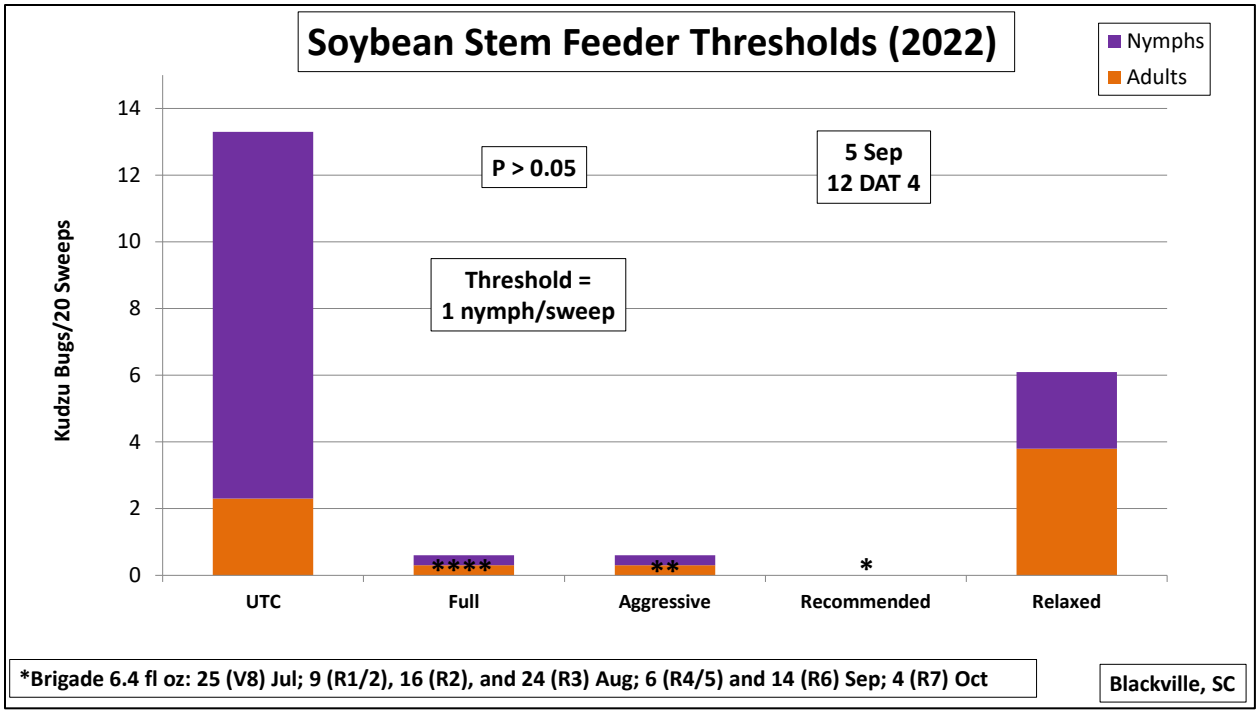
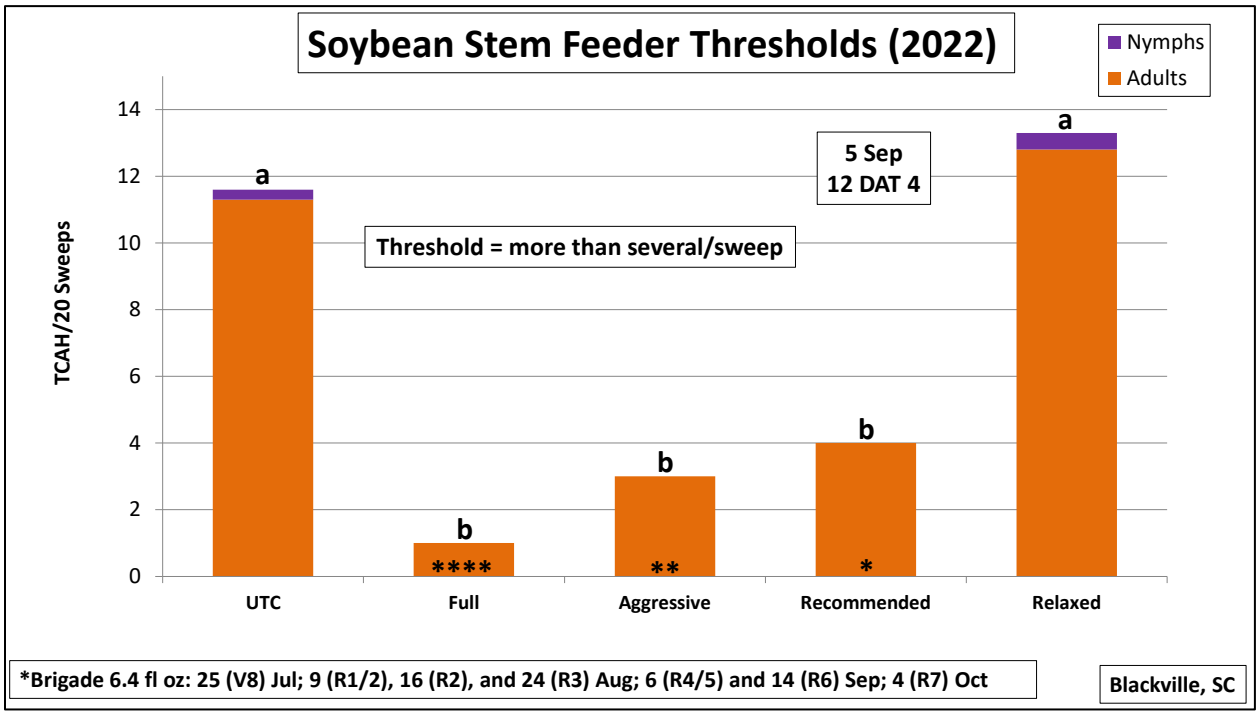


Figure 1.



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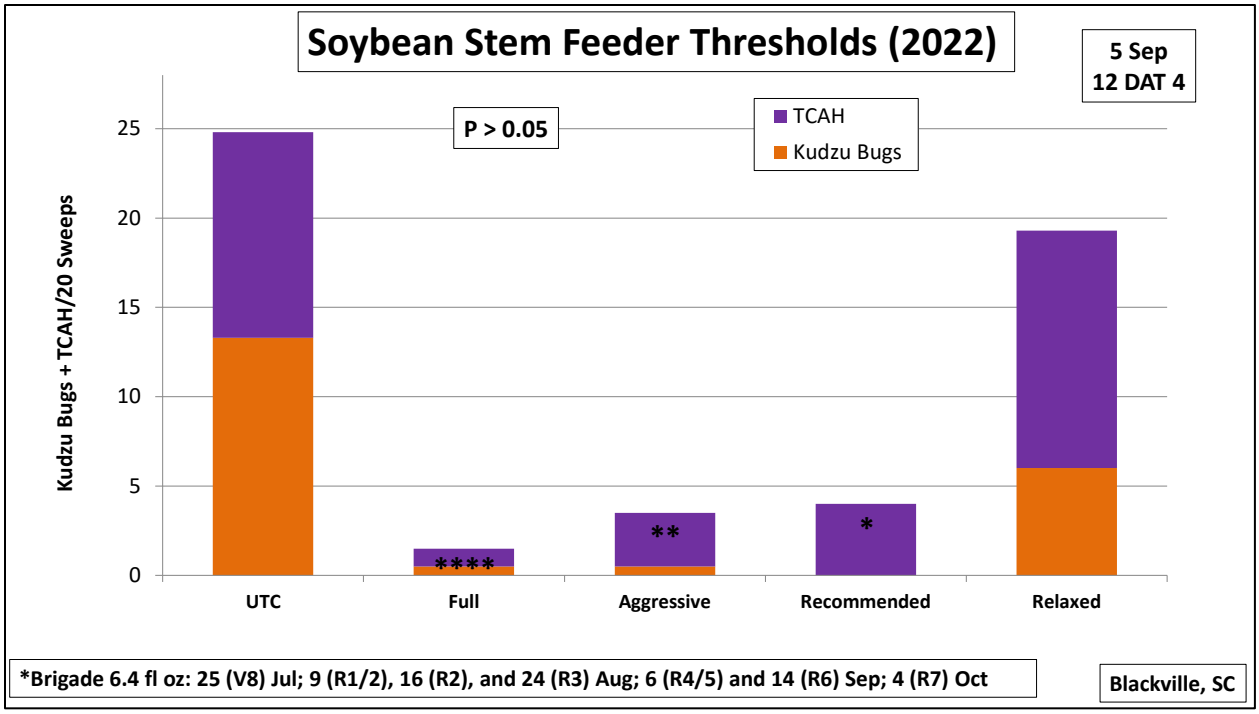

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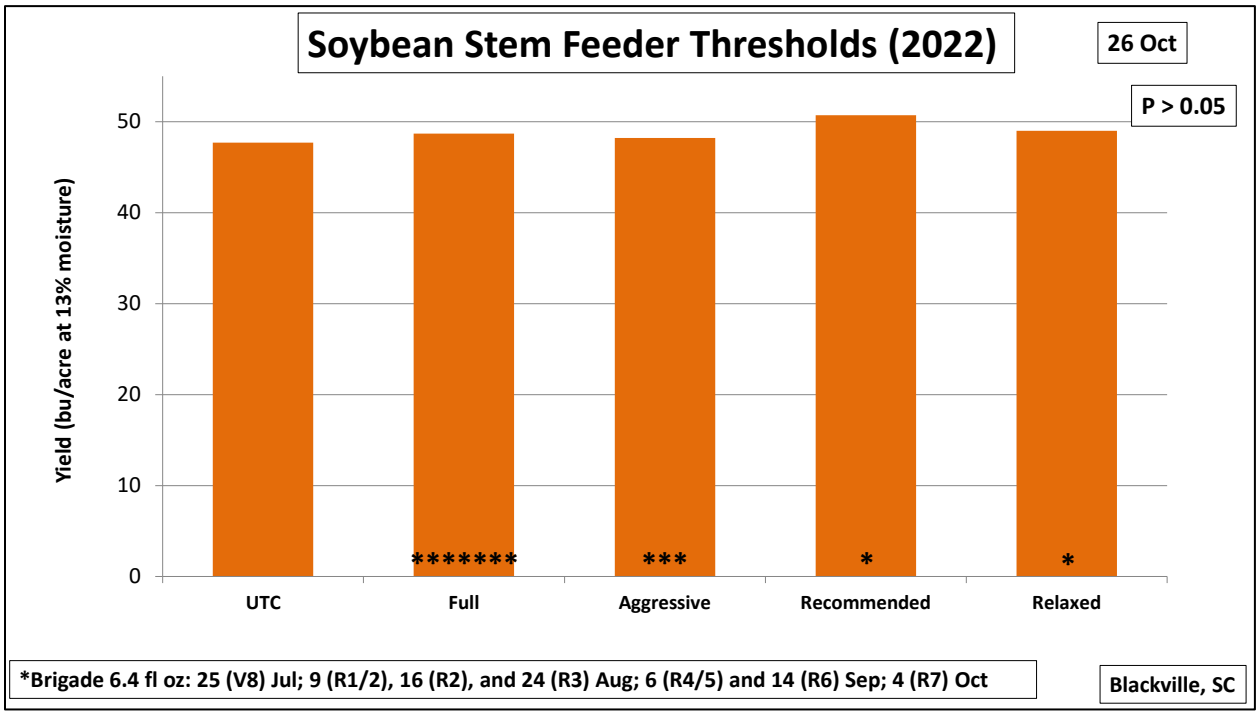

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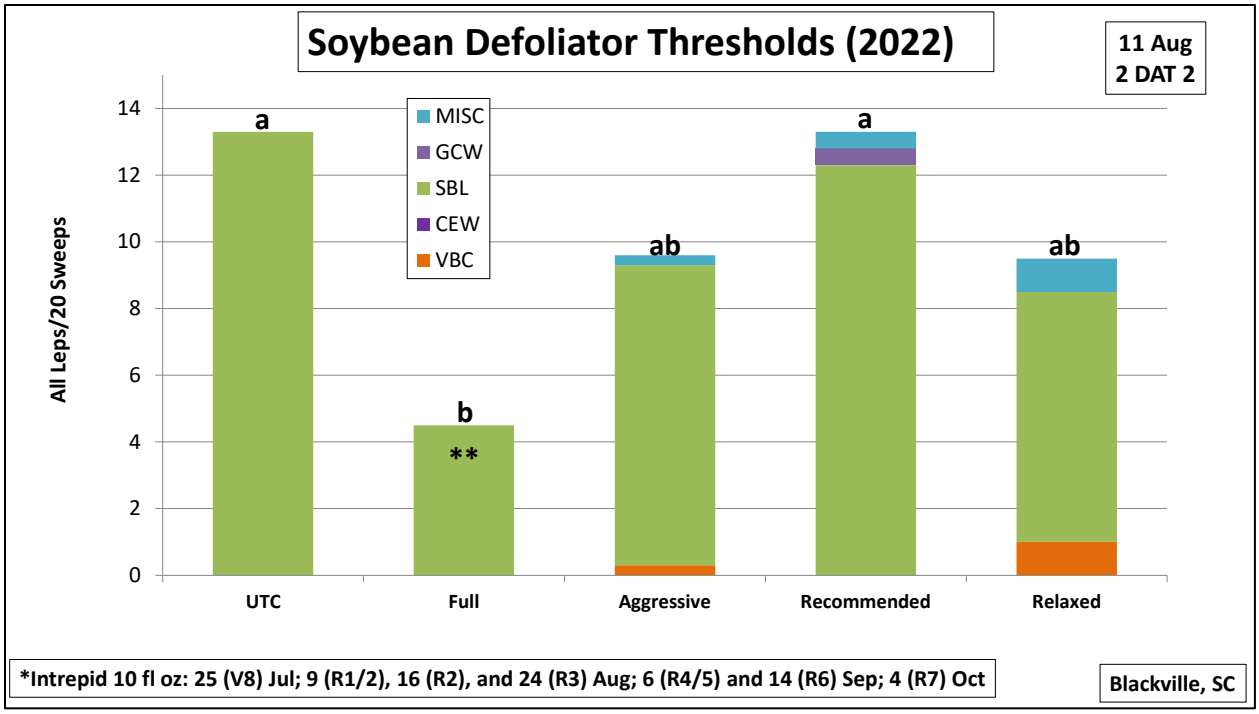

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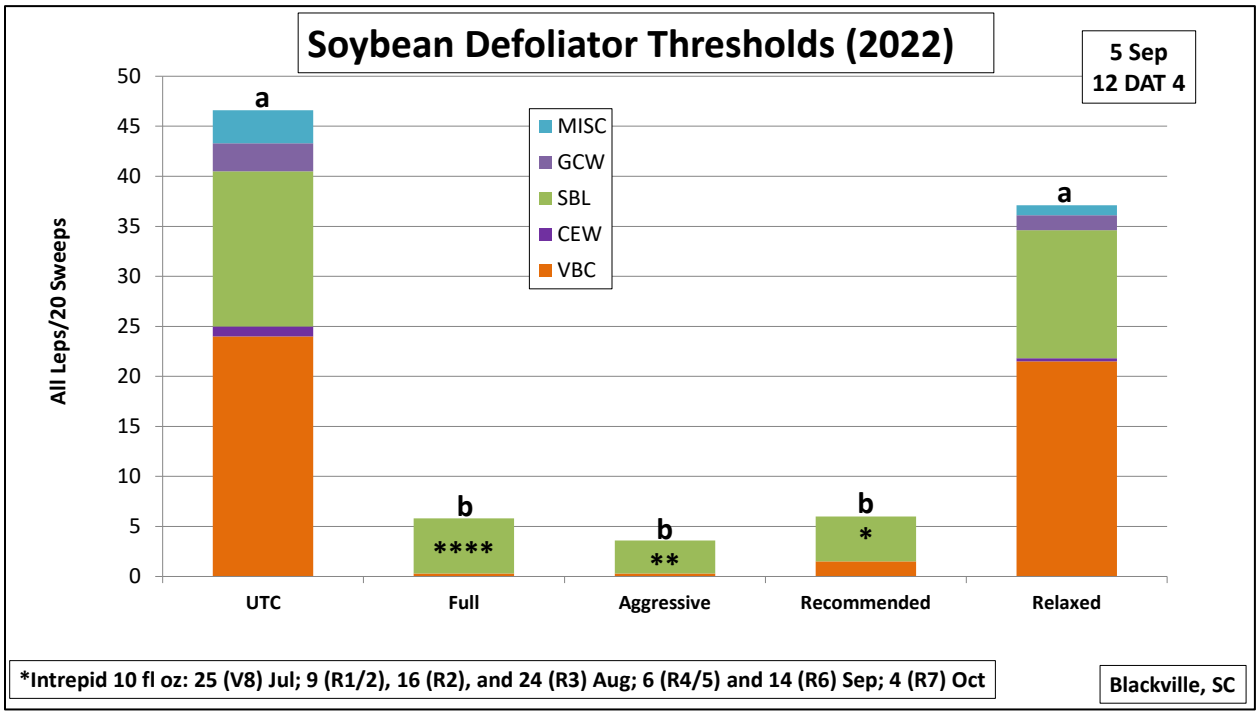

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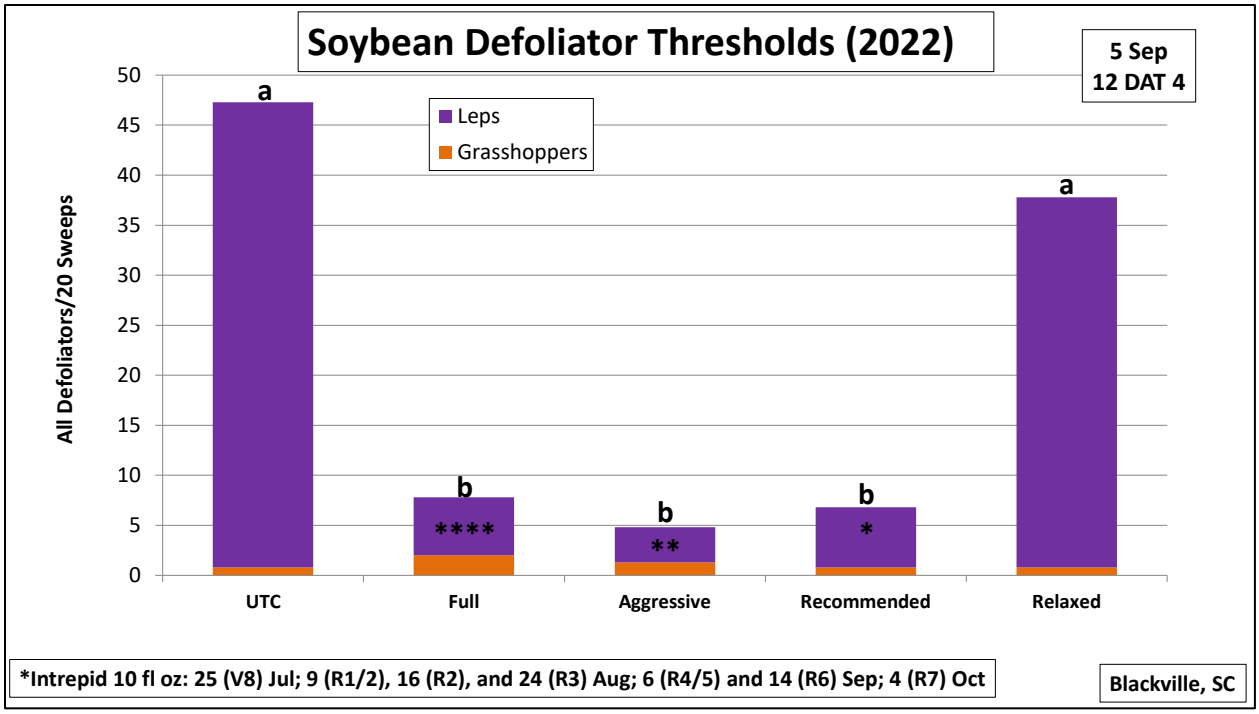

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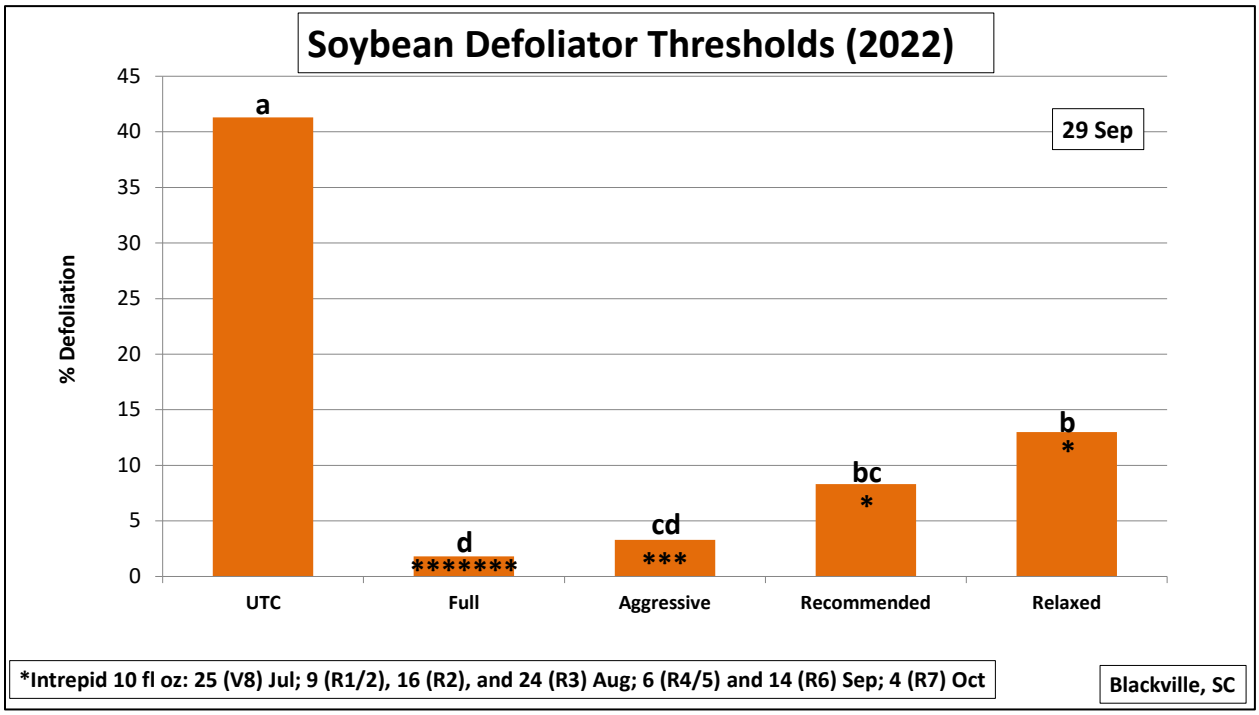

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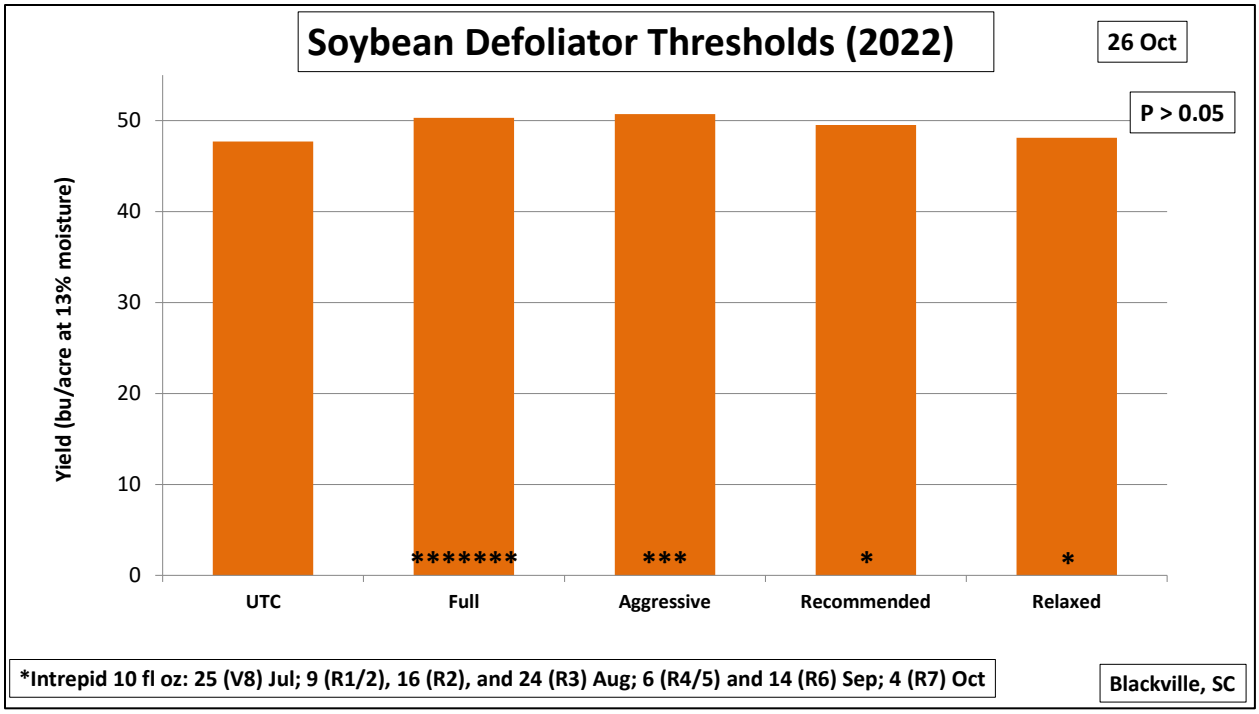

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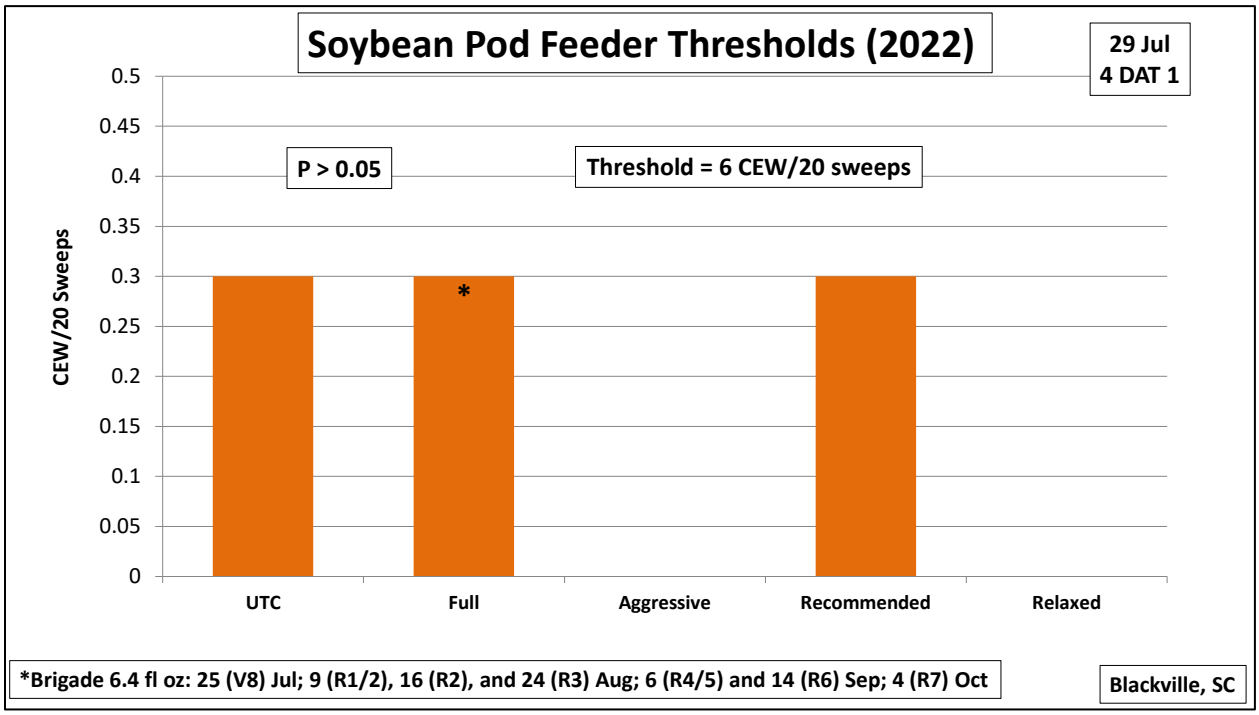

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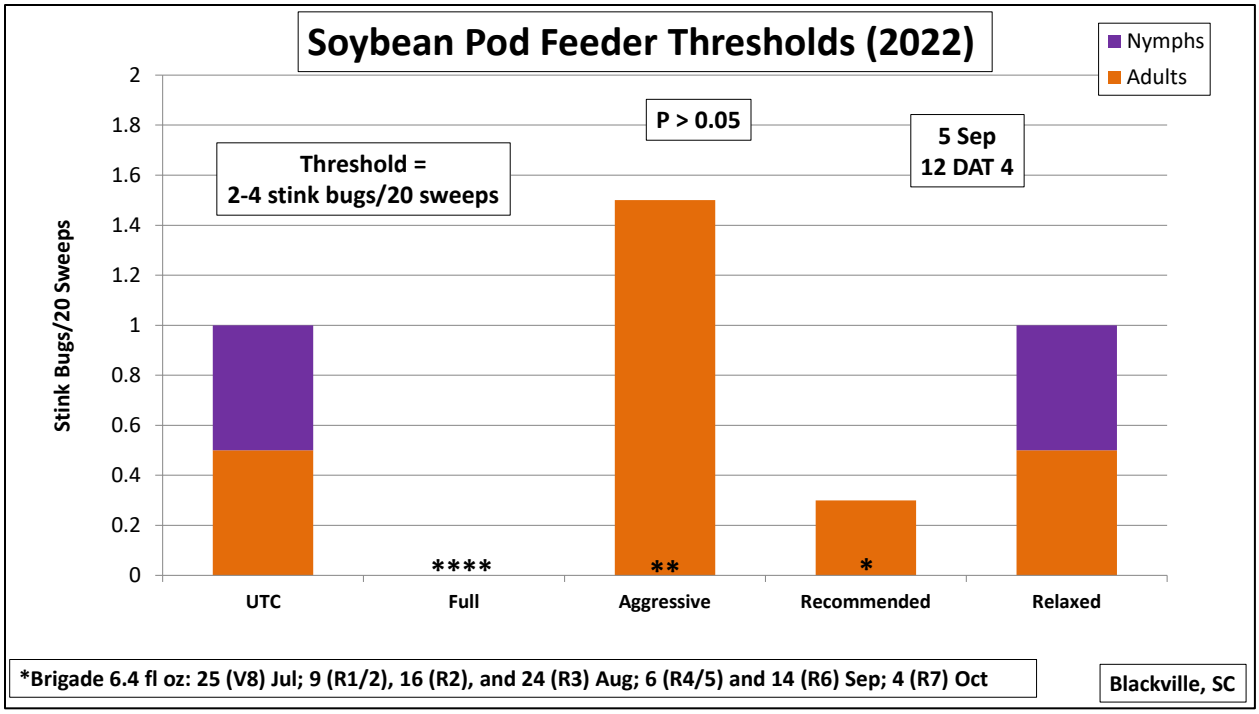

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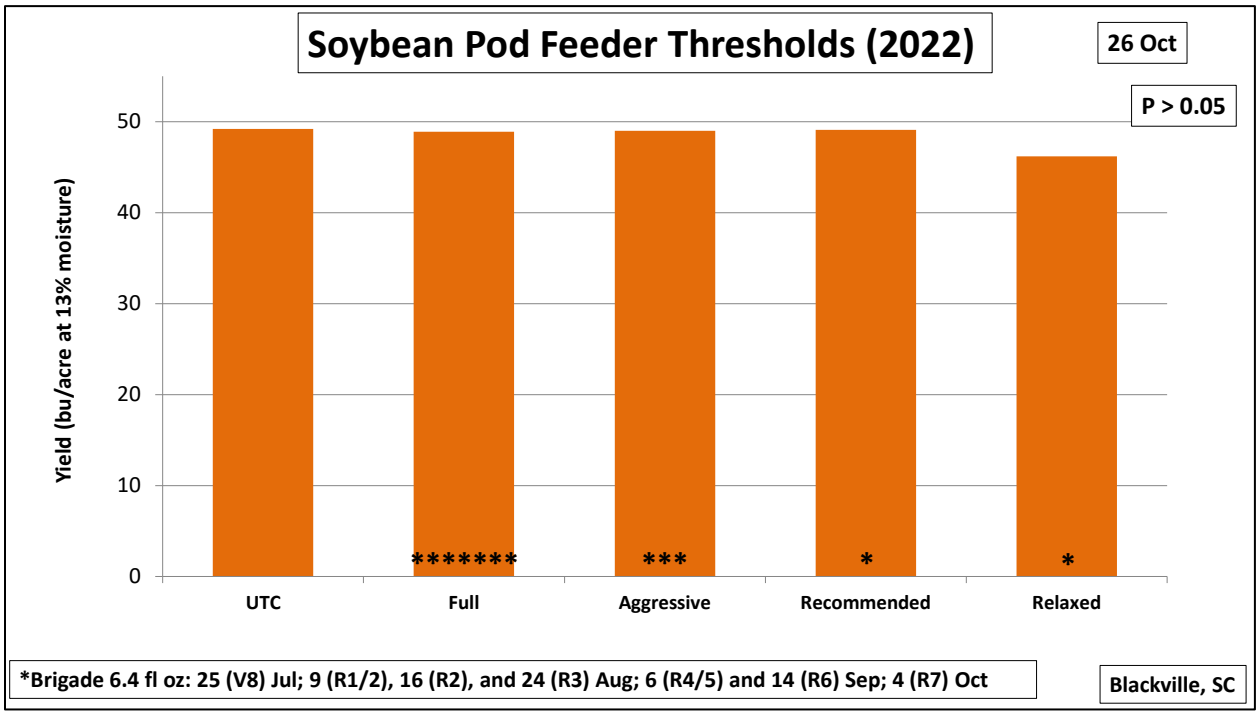

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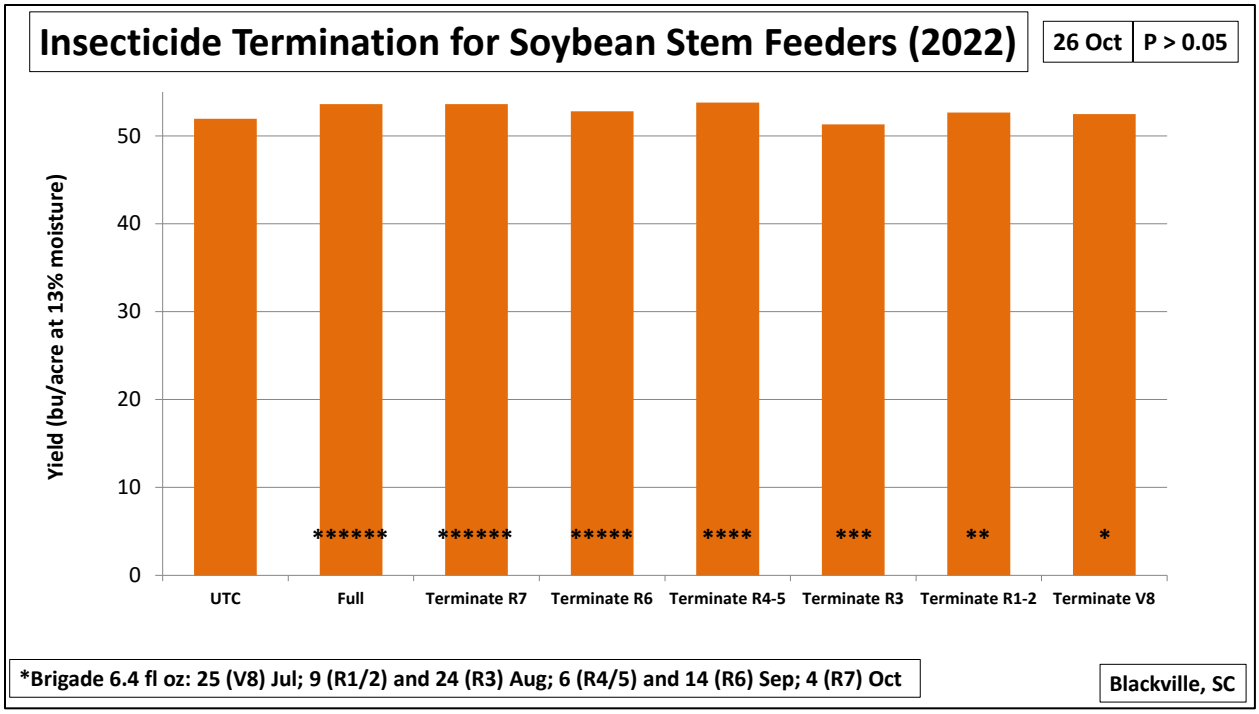

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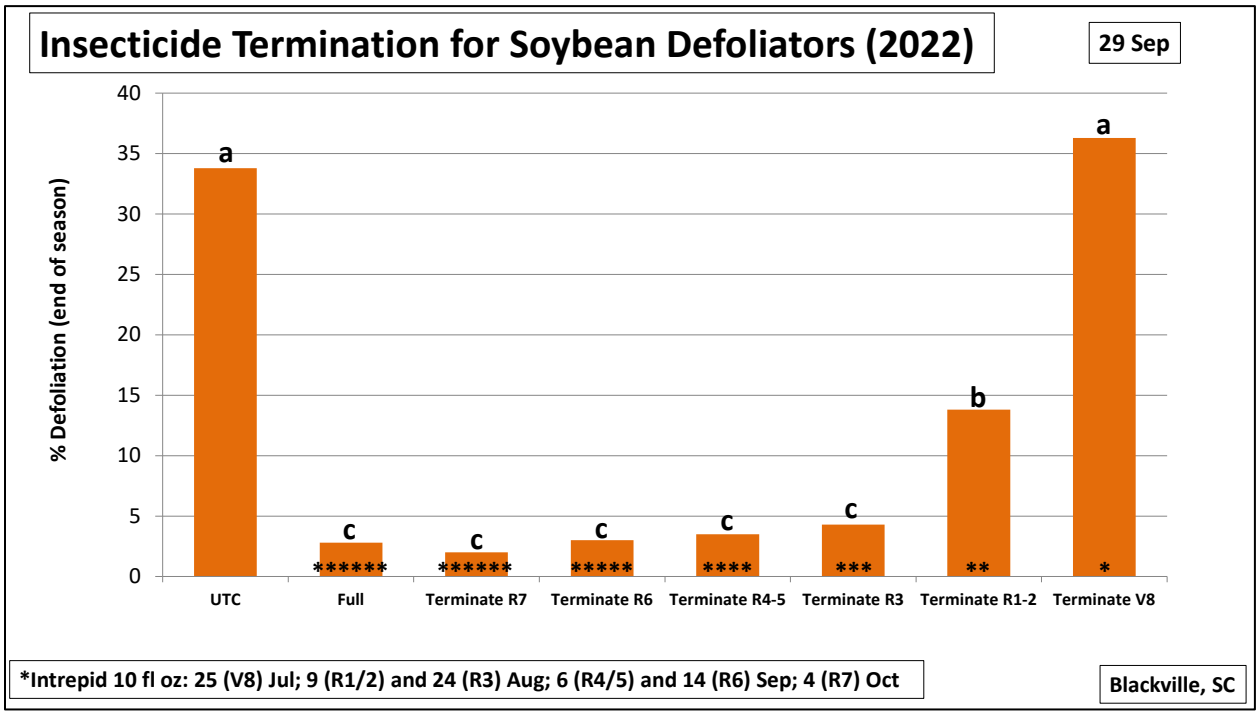

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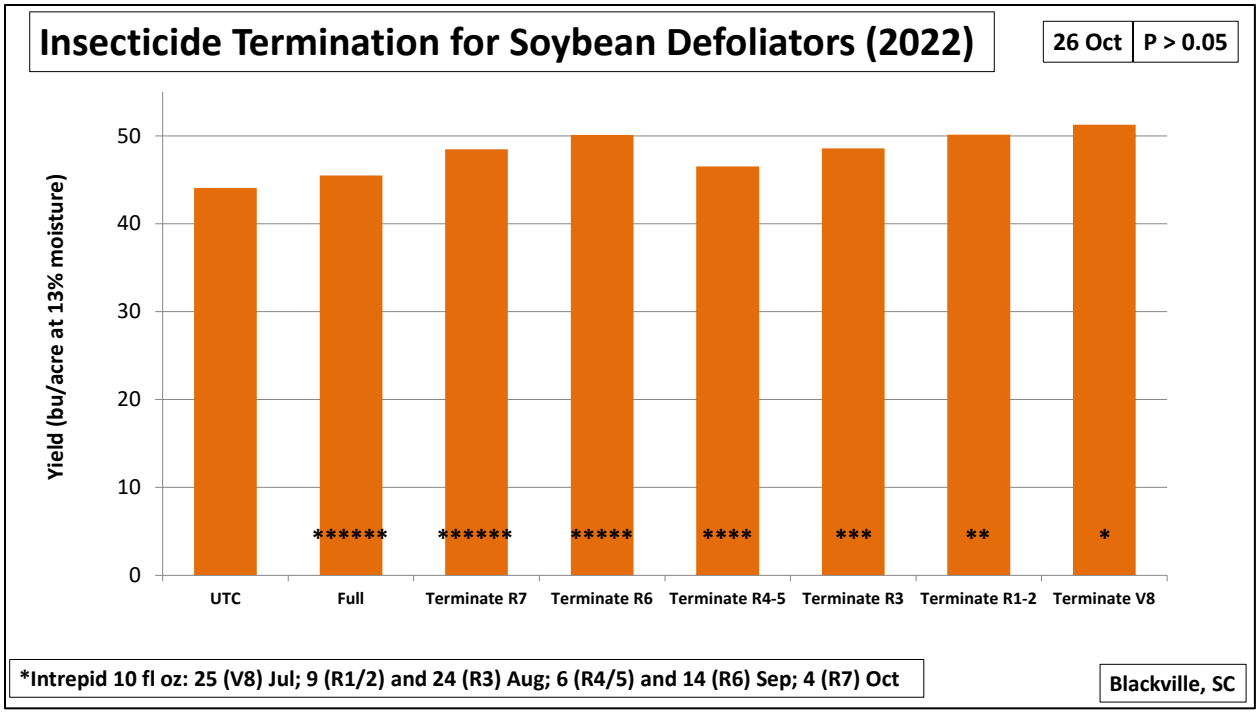

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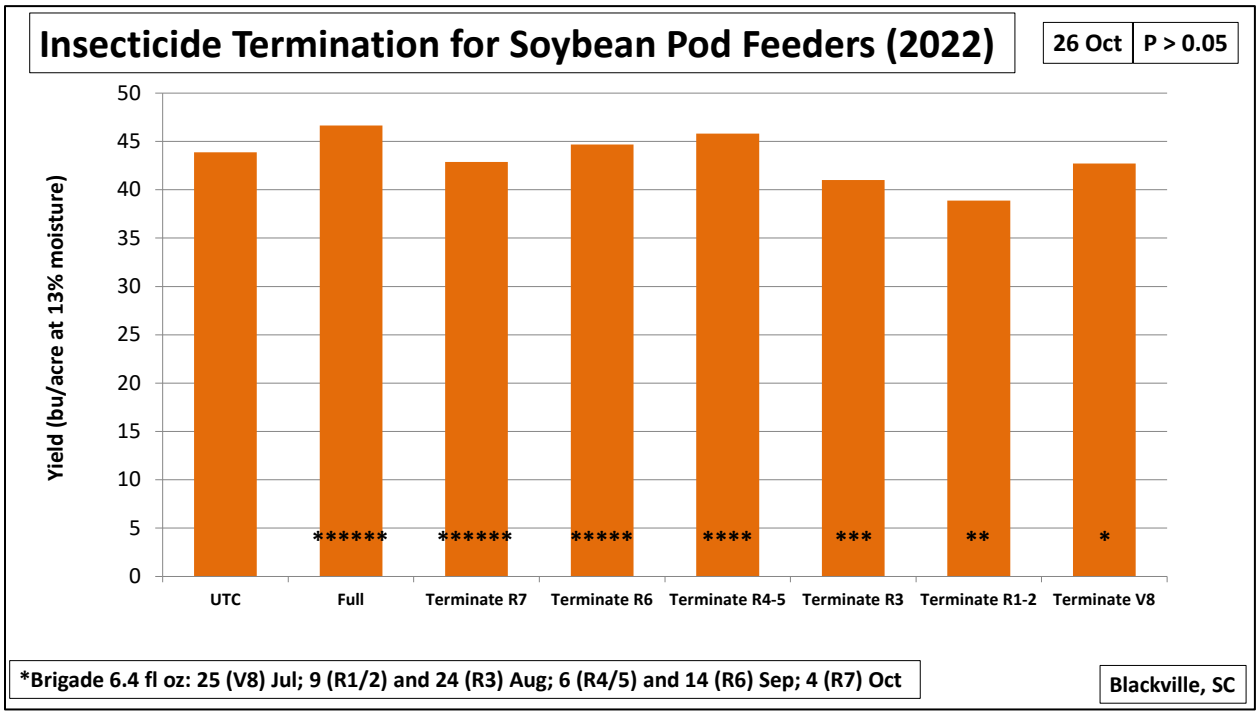

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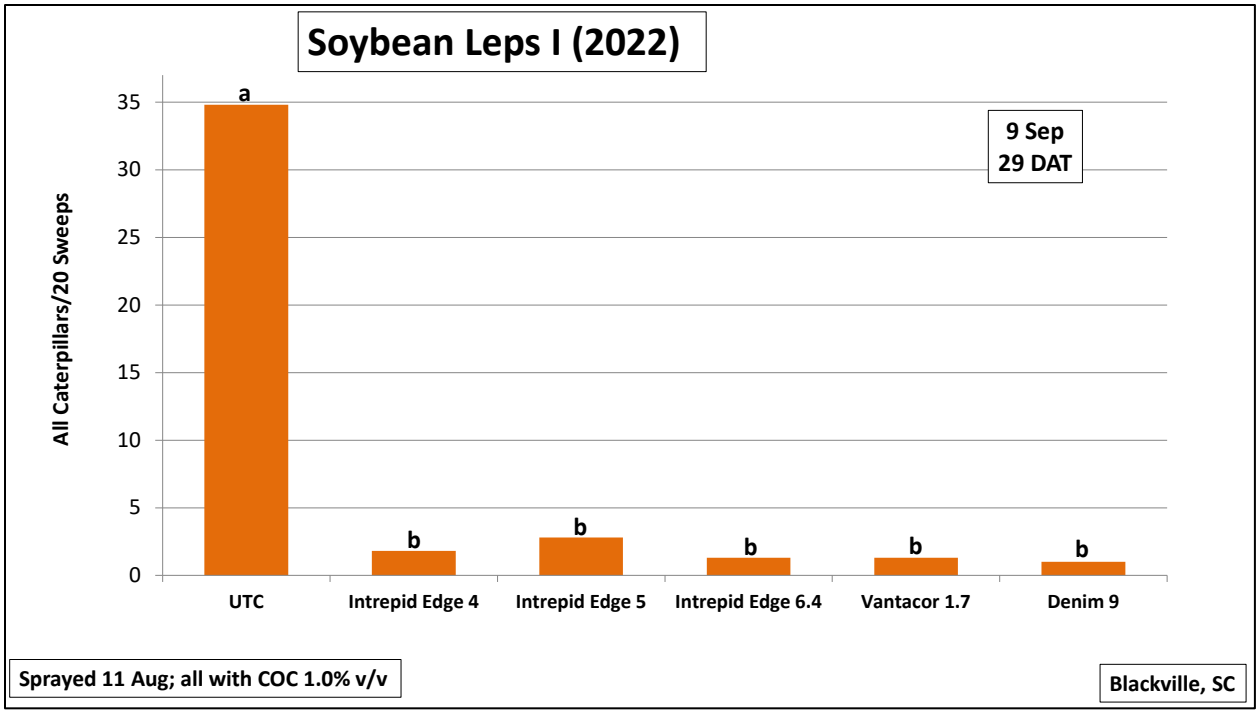

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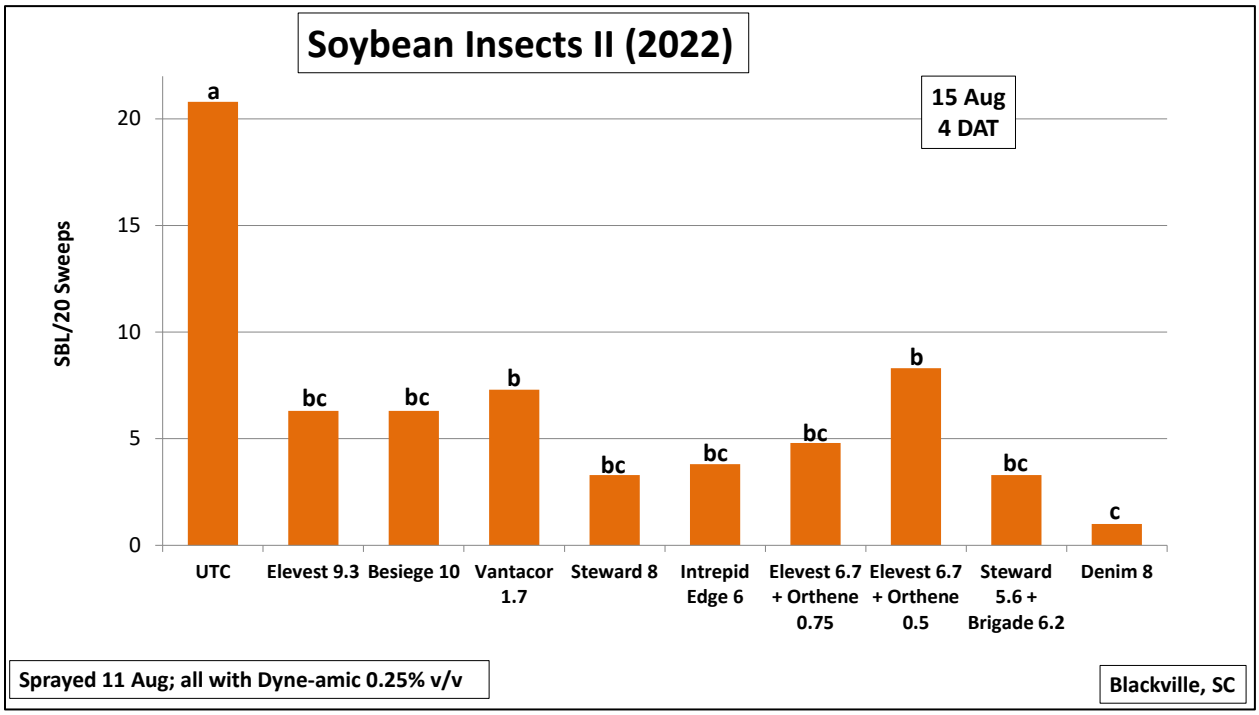

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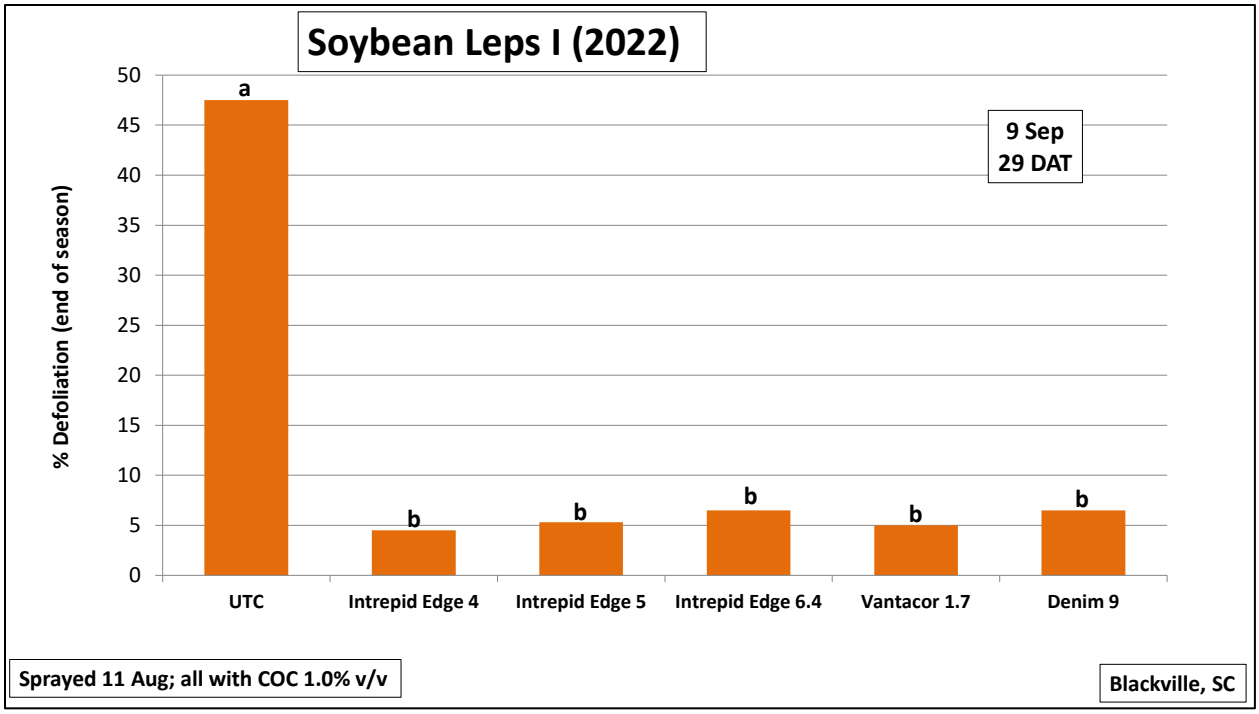

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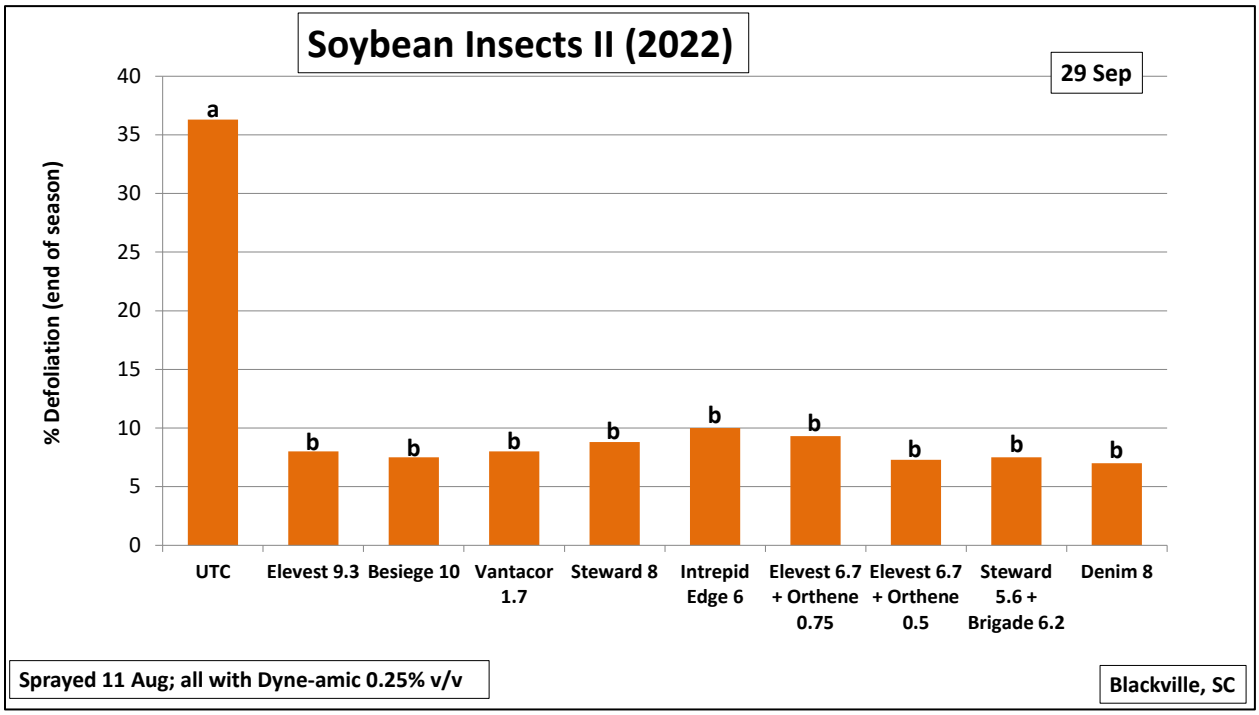

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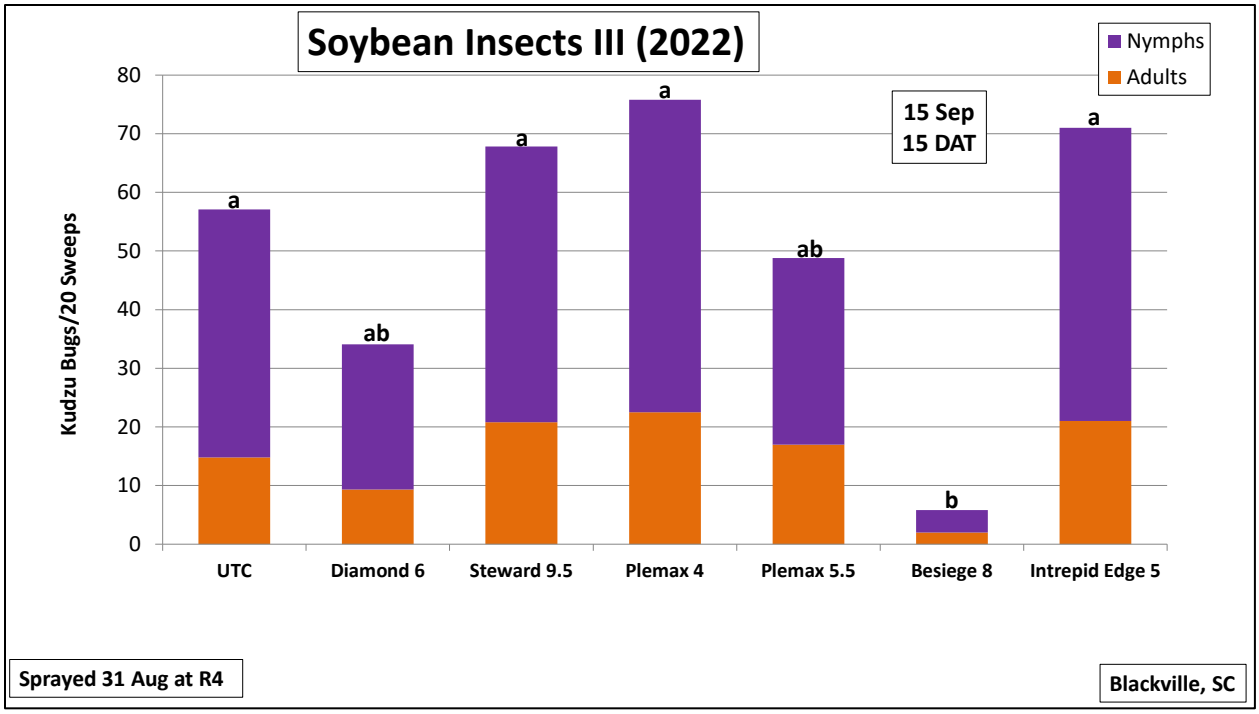

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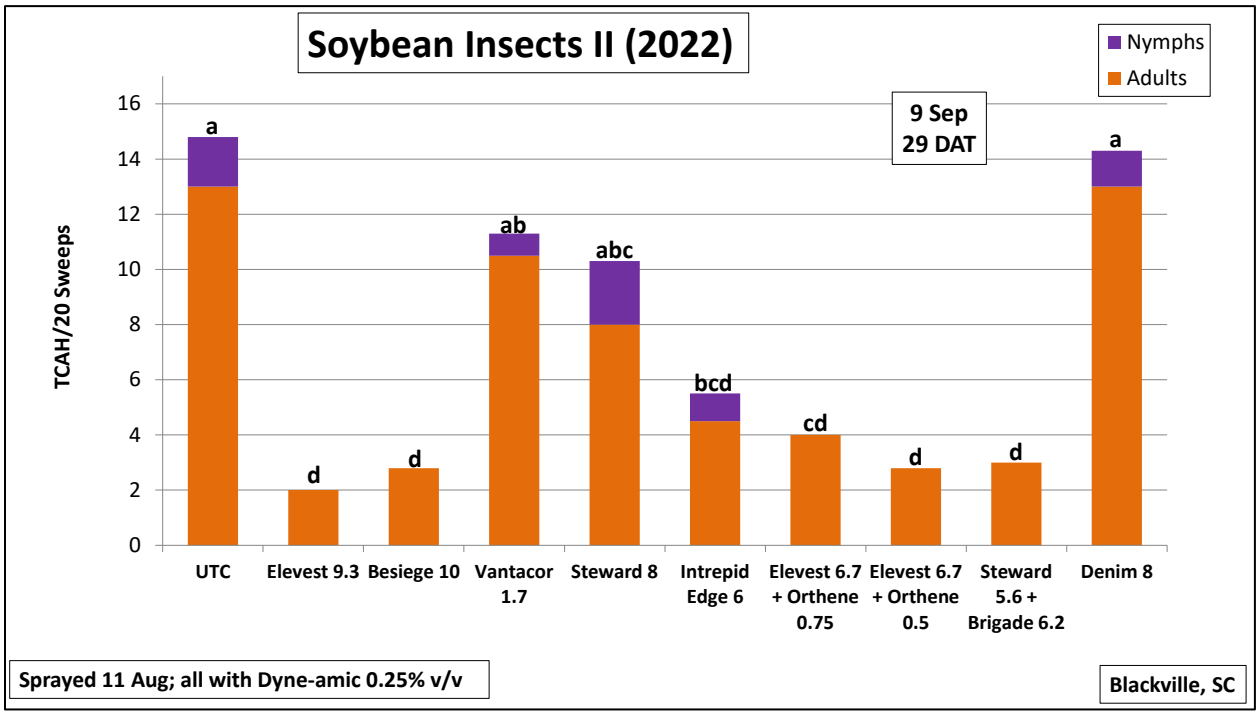

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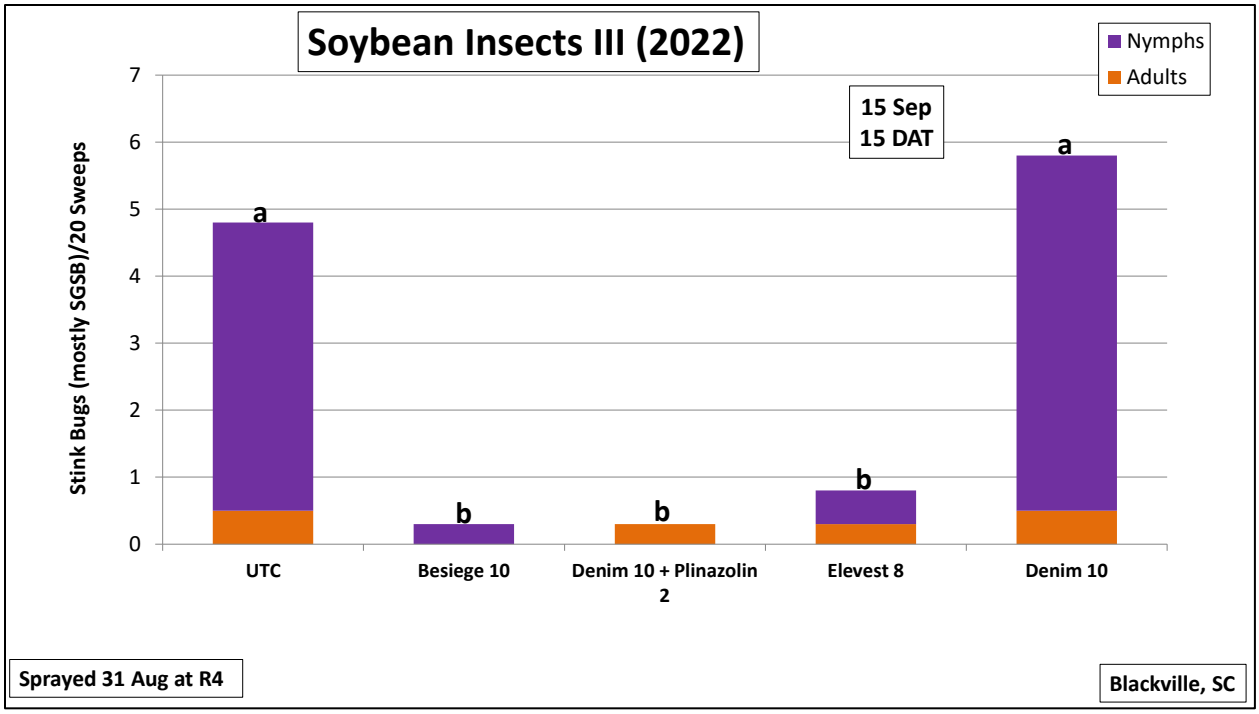

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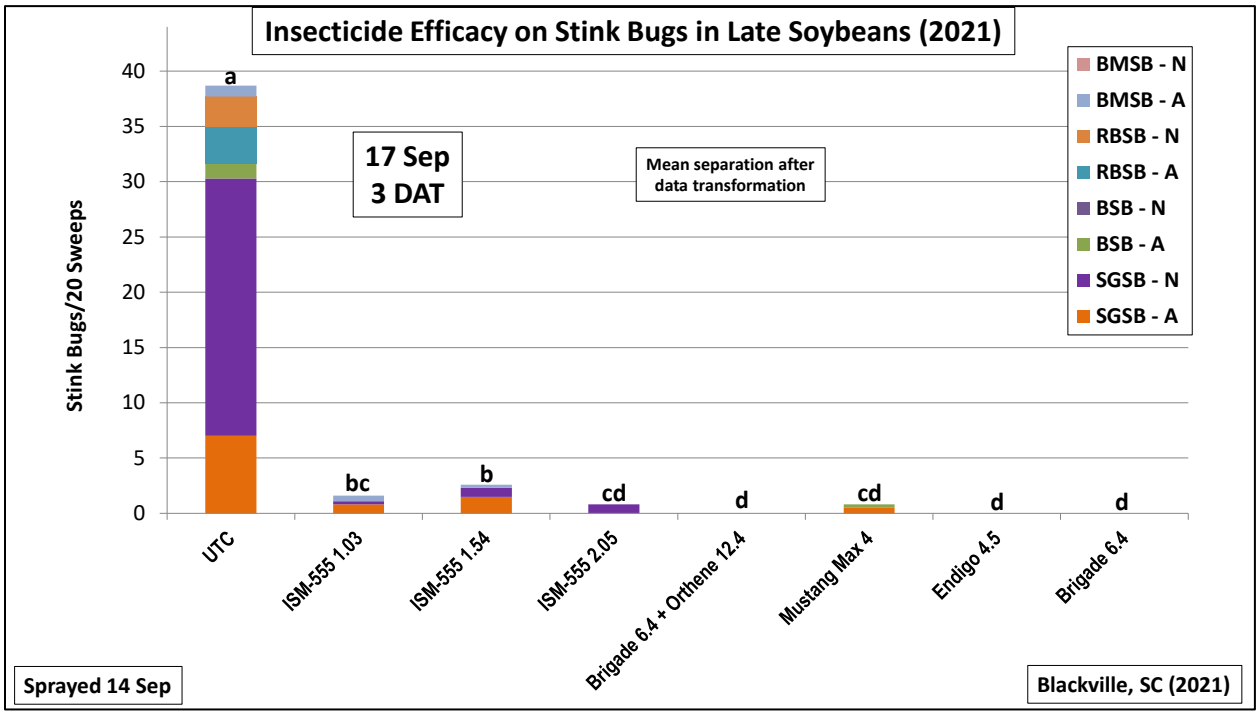

Figure 24.

Prior to submission, reports should be saved as a pdf document using the following naming convention; 2023Date(MMDD)_(PI Last Name)_(Abbreviated Proposal Title)_Final.