RESEARCH REPORT 2024

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Gary's Insights

The North Carolina Soybean Producer's Association leverages the soybean checkoff to maximize the profitability of North Carolina soybean farmers. The majority of checkoff dollars go towards research to improve soybean production to benefit our local farmers. Throughout this report, you will read about studies performed by experts in the field hoping to provide you with tangible ways to increase soybean yield and quality on your own farm. Recent analysis suggests a return of $12.34 in value for every checkoff dollar invested by United States soybean farmers, and we want to make that return apparent to you by publishing reports like this one!

N.C. Soy is governed by a board of 38 directors from across North Carolina. Their goal is to ensure the needs of farmers in their local communities are being prioritized through the work of the checkoff. A committee of 11 grower members chooses which research projects should be funded by the checkoff every year. The Research Committee brings their recommendations before the full board for thorough discussion and approval. N.C. Soy strategically operates based on the recommendations of North Carolina farmers to ensure every dollar is optimally invested and that our research efforts can be practically applied to local farms.

The checkoff benefits from a robust research partnership with NC State University, N.C. Cooperative Extension agents, support from additional university partners, and third-party research partners. We also benefit internally from the support of Research Committee Chair, Forrest Howell, and N.C. Soy Research Coordinator, Jeff Chandler. Jeff offers technical support to soybean growers across the state and encourages growers to reach out to him to learn more about the multi-faceted research program of N.C. Soy. Archived research reports from the past are available on ncsoy.org.

Gary Hendrix, NCSPA President

Forrest Howell

Jeff Chandler

DRILLED NOT PLANTED? YIELD DIFFERENCES CAN BE MINIMAL

NEED TO KNOW: A PROPERLY MANAGED SEED DRILL CAN PRODUCE A HIGH-YIELDING STAND OF SOYBEAN. FOR GROWERS WITHOUT ACCESS TO A PRECISION PLANTER, A SEED DRILL IS MORE THAN CAPABLE OF EQUALLY HIGH YIELDS.

PRECISION PLANTING VERSUS DRILLING SOYBEANS

Due to the incredible advancements in planting equipment technology, soybean growers may wonder if they should switch from seed drills to the newest precision vacuum planters. Planting with a precision planter provides for more consistent seed placement and a more uniform plant stand, but that does not translate to a yield advantage versus using a seed drill. This may be due to the branching nature of soybean plants that allows them to make up for some inconsistency in the final plant stand with little or no yield reduction. The timing of planting could be a different consideration, however. If planting early, either planting system has the potential to provide similar results. As planting date is delayed, the advantage for narrower row spacing increases, such as with a drill. Planting in May? Use whatever you've got or like best. Planting in June/July? Use a drill or narrow row spacing planter.

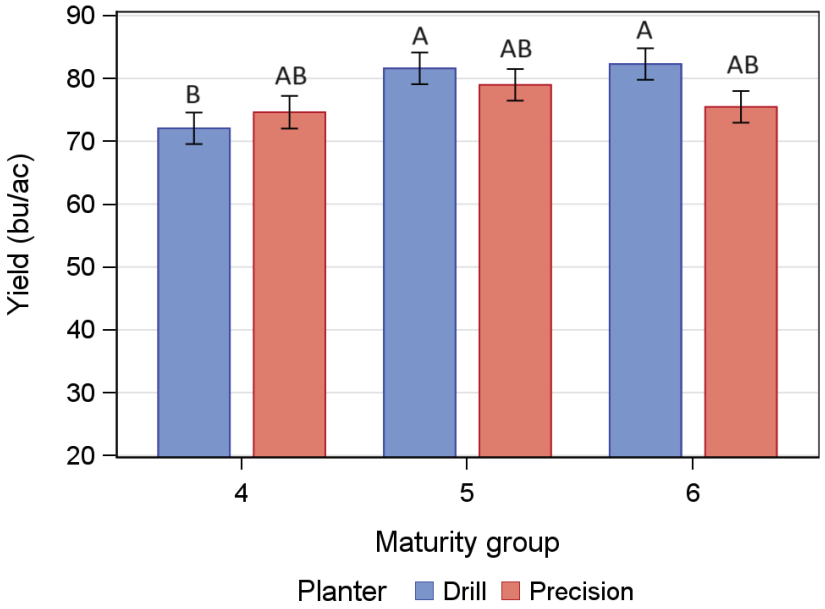


Figure 2. Impact of planting mechanisms on soybean yield combined over four environments for MG 4, 5, and 6 varieties.

An NC State project conducted over three years evaluated how MG 4, MG 5 and MG 6 soybean varieties, planted at seeding rates from 75,000-175,000 seeds/A, responded when planted with a precision planter and with a mechanical drill. In the case of this study, the result was that the precision planter provided more uniformity of emergence than with a grain drill; however, it did not translate to a yield advantage. In fact, there were minimal differences in yield observed between the two planting mechanisms.

PROJECT LEADERS: Rachel Vann, Dwight Cauthen, DJ Stokes – NC State University

USE THE SAME CORN EARWORM THRESHOLDS FOR BOTH DETERMINATE AND INDETERMINATE SOYBEANS

NEED TO KNOW: CORN EARWORM MANAGEMENT THRESHOLDS ARE NOT LIKELY TO VARY BETWEEN DETERMINATE AND INDETERMINATE SOYBEAN VARIETIES. NO DIFFERENCES WERE FOUND IN ECONOMIC THRESHOLDS FOR TREATING SOYBEANS FOR CORN EARWORM.

Corn earworm is historically the most yield-limiting pest in North Carolina soybean production. The robust threshold recommendations developed to manage this pest effectively were developed with determinate soybean varieties; however, grower adoption of indeterminate varieties increases every year, and robust recommendations are needed to manage this pest in indeterminate soybean varieties. This need is especially critical as seed companies develop indeterminate soybean varieties in maturity groups where this growth habit has been traditionally unavailable (≥MG5). Preliminary work indicates that corn earworm management thresholds are not likely to vary between determinate and indeterminate varieties. However, infestation timing might differ, since corn earworms prefer to lay eggs in flowering beans and since indeterminate varieties flower over a longer time than determinate varieties. Growers might need to scout for earworms longer in indeterminate varieties and treat some fields more than once.

The research asked if the timing of corn earworm infestations varies for the indeterminate soybean varieties versus the determinate varieties. The research team compared data from both types of soybeans to assess corn earworm egg number, corn earworm larvae number, and soybean grain yield and soybean pod count.

The NC State Soybean Extension team plans to incorporate this finding into foundational management information for corn earworm in indeterminate soybean varieties in North Carolina.

Pod damage from corn earworm

For now, the economic threshold for corn earworm will remain the same for indeterminate and determinate soybeans. This preliminary study found no yield differences due to corn earworm pressure, but work on this question will continue. There has been a lot of talk among growers about the advantage of an indeterminate growth habit; however, this difference can likely be attributed to superior genetics in earlier maturing varieties in the current indeterminate varieties. As these genetics become widely available in later maturity groups, the preliminary research indicates that growers should be cautious about assuming that indeterminate varieties have an inherent yield advantage over determinate varieties within the same relative maturity. And growers should continue to scout for corn earworm larvae in soybeans during the blooming stage of the plants and until R5-R6.

PROJECT LEADERS: Dominic Reisig, Rachel Vann – NC State University

Population level	Total number of larvae	Soybean yield (Kg/ha)	Total number of pods	Total number of seeds	Total seed weight (kg)
High pressure	30.00 ± 0.66 a	2,318 ± 3.84 b	994 ± 0.80 b	2,184 ± 1.59 ab	258 ± 1.73 b
Medium pressure	18.45 ± 0.15 b	2,924 ± 0.51 a	1,292 ± 0.67 a	2,753 ± 0.90 a	360 ± 0.28 a
Low pressure	6.61 ± 0.11 c	2,571 ± 2.33 b	988 ± 0.50 b	2,074 ± 0.85 b	296 ± 0.49 b

Table 1. Corn earworm population level in soybeans in high, medium, and low pressure, and total number of larvae, soybean yield, total number of pods, total number of seeds, and total seed weight. Means (± SE) within each population level followed by the same letter are not significantly different.

		Yield		Yield components		
Soybean variety (Gh[1]. | Mg[2].)		Total number of larvae	Soybean yield (Kg/ha)	Total number of pods	Total number of seeds	Total seed weight (kg)
Determinate	5.2	30.5 ± 0.17 ns	2,306 ± 0.86 ns	988 ± 0.91 ab	2,210 ± 2.00 ab	254.7 ± 0.62 c
Indeterminate	5.2	28.3 ± 0.16 ns	2,288 ± 0.80 ns	994 ± 0.30 b	2,399 ± 1.91 a	262.0 ± 0.31 b
Determinate	5.5	35.3 ± 0.21 ns	2,202 ± 0.99 ns	1,176 ± 0.76 a	2,316 ± 0.98 b	275.8 ± 0.39 a
Indeterminate	5.4	24.8 ± 0.05 ns	2,502 ± 1.40 ns	819 ± 0.63 ab	1,810 ± 1.44 ab	238.5 ± 0.49 abc

[1] Growth habit | [2] Maturity group

Table 2. Agronomic characteristics of soybean growth habit and maturity group (soybean variety) for total number of larvae, yield, and yield components (total number of pods, total number of seeds, and total seed weight) with high corn earworm pressure. Means (± SE) within each population level followed by the same letter are not significantly different.

MICROBIAL BIOSTIMULANTS: DO THEY WORK?

NEED TO KNOW: WHILE PROMISING, FIELD PERFORMANCE OF MICROBIAL BIOSTIMULANTS IS HIGHLY VARIABLE, AS SHOWN IN THIS STUDY.

Microbial biostimulants are promising solutions for reducing agricultural inputs and for enhancing plant production. However, field performance is highly variable and local data is often lacking. This study evaluated microbial seed treatments in soybean across North Carolina production regions. Yields differed significantly between locations and between maturity groups. The study found no significant yield differences due to the application of microbial treatments versus the untreated controls.

In the study, soybean yields varied across all trial locations. The yield varied between varieties of different maturity groups. Yield patterns overall were consistent with NC State 2023 Soybean OVT[1] yield comparisons. The microbial biostimulant seed treatments did not influence yield (or early development leaf nutrients). There was no difference in yield between microbial treatments and non-treated controls.

Yield values within treatments (including non-treated controls) tended to vary in a wide range. Because of the small plots used in these trials, any significant impact due to the microbial products would show up as a consistent and large increase in yield between treatment and control. Yet that was not the case.

Some of the differences between the trial locations might be due to environmental variables including weather, soil biogeochemistry, and differences in soil microbiome diversity. That's a reason to continue work on these promising products.

With support of the North Carolina Soybean Producers Association, the Soil Microbiome Extension program will continue biological trials through 2026. The product evaluations & trials are to be expanded to additional locations and to incorporate more acres, as well as targeting products designed to provide enhanced crop production under environmental stress. The project overall is leveraged with data and insights gleaned from the small plot Official Variety Test (OVT) locations and the On-Farm Trials network within Extension.

PROJECT LEADERS: Mallory Choudoir – NC State University

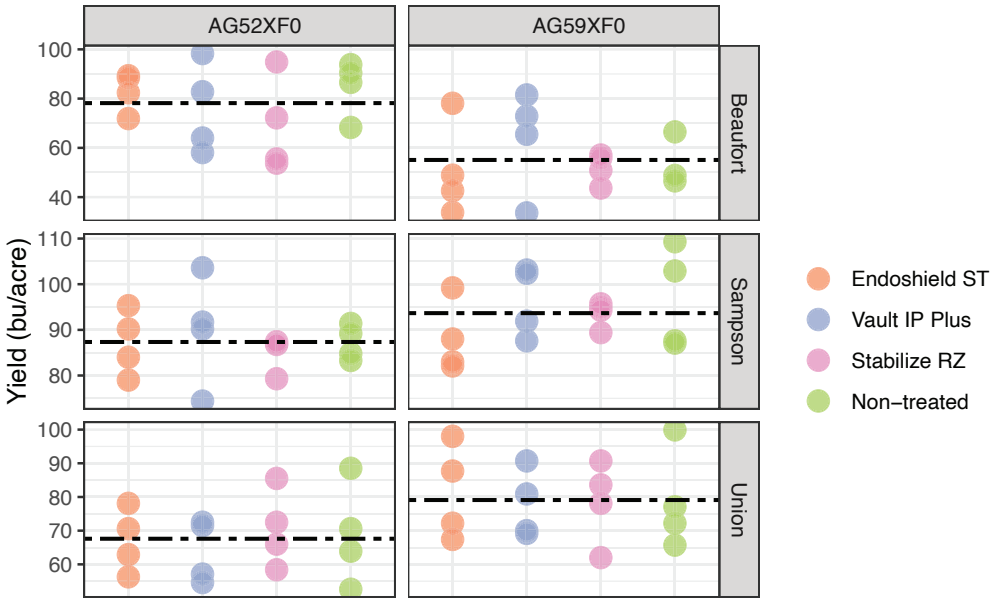


Figure 1. Soybean yield (bu/acre) by location and variety for all microbial seed treatments plus non-treated controls. Dashed lines show the average yield per location and variety.

[1] https://officialvarietytesting.ces.ncsu.edu/soybeans-2023/

RIPPING IN WIDE ROWS WILL NOT HELP – OR HURT!

NEED TO KNOW: RIPPING TO REMOVE A HARD PAN IN SANDY COASTAL PLAIN SOILS AND THEN PLANTING ON WIDE ROW SPACING DID NOT PROVIDE A YIELD ADVANTAGE OVER NARROW ROW SPACINGS WITHOUT RIPPING. BUT RIPPING DIDN'T HURT YIELDS EITHER.

In North Carolina, growers plant soybeans in a wide range of row spacings, largely dependent on the grower's equipment. Previous research at NC State has identified a narrow row spacing of 15 inches as optimal for maximum soybean yield in most environments. In the Coastal Plain region of North Carolina, growers produce a wide diversity of crops, many on wide row spacings of 36-38 inches. The requirement for heavier machinery for producing some of these crops often leads to soil compaction. Growers in the region may opt for a ripper shank to break the hardpan in these situations. Recently, growers and Extension specialists have questioned the value of this practice compared to planting on narrower row spacing in their fields. Beginning in 2021, the Soybean Extension Program investigated row spacing in the Coastal Plain Region, comparing wide row, ripped soybeans, planted on 36–38-inch rows, to narrow row soybeans on 15-inch rows. The experiment was conducted for two years at four locations. Across all four environments, the wide row, ripped soybeans provided no yield advantage over the soybeans planted on narrow row, 15 inch spacing.

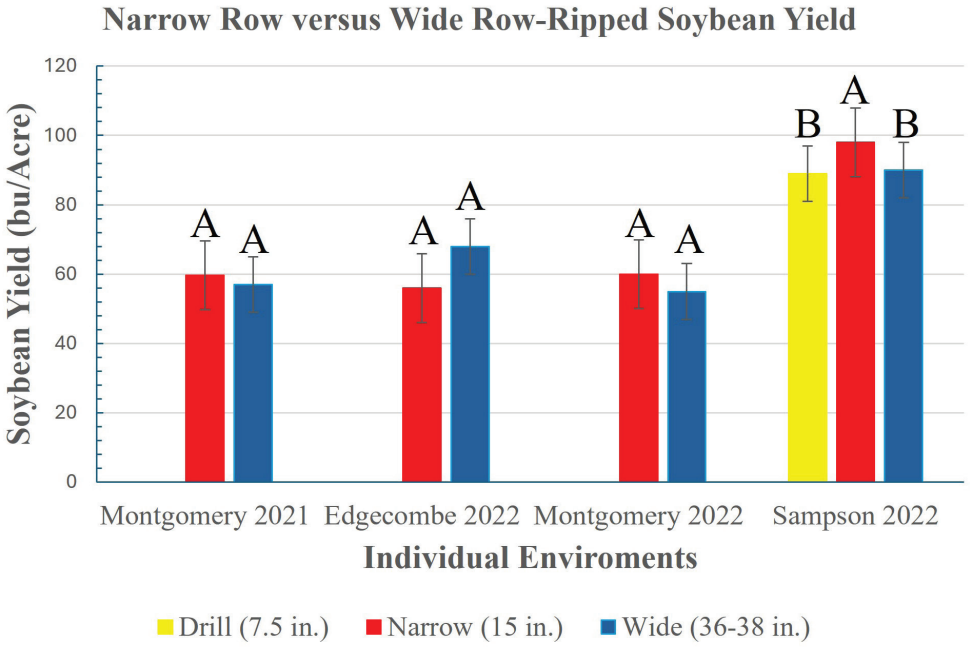


Figure 1. Impact of soybean row spacing on soybean yield at four environments across North Carolina

PROJECT LEADERS: Rachel Vann, Dwight Cauthen, DJ Stokes – NC State University

PALMER AMARANTH RESISTANCE HOTSPOTS BY LOCATION

NEED TO KNOW: FOLLOWING COMPREHENSIVE SURVEYING OF PALMER AMARANTH IN NORTH CAROLINA, RESEARCHERS HAVE IDENTIFIED WHERE RESISTANCE TO GLYPHOSATE, GLUFOSINATE, FOMESAFEN, 2,4_D AND S-METOLACHLOR OCCURS MOST.

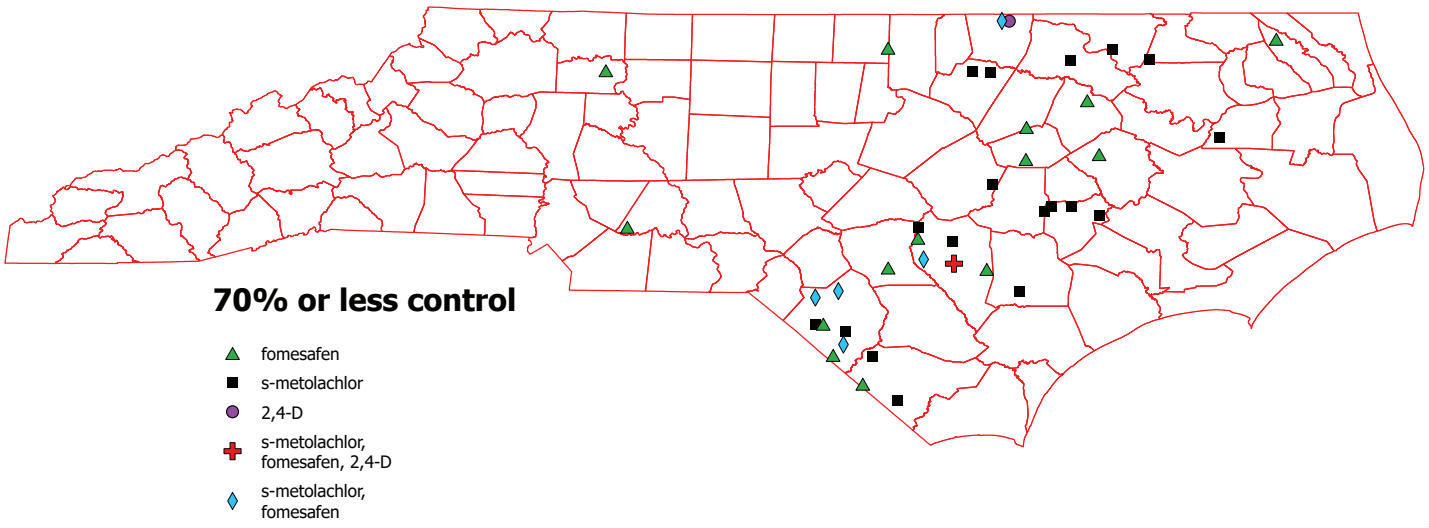
Generally speaking, all the common POST herbicides used to control Palmer Amaranth are widely effective and provide great utility to growers. Although weed populations of concern are present in several locations, including resistance to PPO-inhibitors and glufosinate, growers have effective options for managing resistant Palmer Amaranth. Studies show that 2,4-D herbicides achieve only 80% or less control over a handful of these populations when applied at a reduced rate. These studies demonstrate that full application rates are necessary to prevent rapid development of resistance in Palmer Amaranth. The poor control achieved with fomesafen at multiple hotspots should raise warning flags for growers in the southeastern region of the state.

Growers rely heavily on the PRE herbicide S-metolaclor and others classed in the Group 15 family of herbicides. Be aware of the challenges that will confront growers if the Group 15 herbicides are no longer accessible. The ability to rotate among herbicides with multiple modes of action is critical in avoiding future resistant populations. Growers should refer to the fact sheet and other resources posted to the Extension soybean portal on the website https://soybeans.ces.ncsu.edu/.

The Palmer Amaranth survey results give county Extension agents and NC Extension weed scientists an enhanced ability to tailor management programs to specific areas, to raise awareness of effective herbicides for POST control, and to reach out to growers and share information more effectively.

It is recommended to use the full labeled rates on weeds when they are small to maximize control and reduce the chance for escapes. Genetic variability creates a range of responses to herbicides, especially when they are applied below the labeled rate. NC State studies show that post emergence herbicides still have widespread efficacy and utility in North Carolina. While growers need to be mindful of resistant populations, several effective herbicide tools continue to do a great job of keeping resistance at bay. Extension specialists emphasize that growers should rotate their POST herbicides to preserve this utility and allow for control in future years. Genetic variability creates a range of responses to herbicides, especially when applied below the labeled rate.

PROJECT LEADERS: Wesley Everman – NC State University



HARVEST MANAGEMENT HAS MORE IMPACT ON SEED QUALITY THAN PEST MANAGEMENT

NEED TO KNOW: IN THE STUDY, MID-SEASON PEST MANAGEMENT HAD LITTLE IMPACT ON FINAL SEED QUALITY OR PURPLE SEED STAIN

North Carolina growers are shifting production practices to take advantage of higher soybean yields with early maturing varieties planted in early or mid-May and are encountering seed quality issues more frequently. Planting early varieties early in the season results in soybeans reaching maturity in warm summer months when conditions are favorable to seed damage. In the study, Extension specialists investigated the impact of pesticide management on soybean seed quality. The study showed that aggressive mid-season pest management had minimal impact on soybean seed quality issues. At one site where stinkbug pressure exceeded the threshold, some combinations of a fungicide and insecticide at R3 and R5 did reduce seed damage and purple seed stain, but not in an economically significant way. A fungicide applied at R3 and R5 did not reduce seed damage, but foliar fungicide use did protect against foliar disease and increase soybean yield. Environmental conditions, not pests, remain the strongest driver of seed quality declines in these early planted, early maturing situations. The results do not rule out the need for more work on the impact of late season insecticide application targeted at stink bugs to minimize seed damage.

PROJECT LEADERS: Rachel Vann, Dominic Reisig, Kelly O'Reilly – NC State University

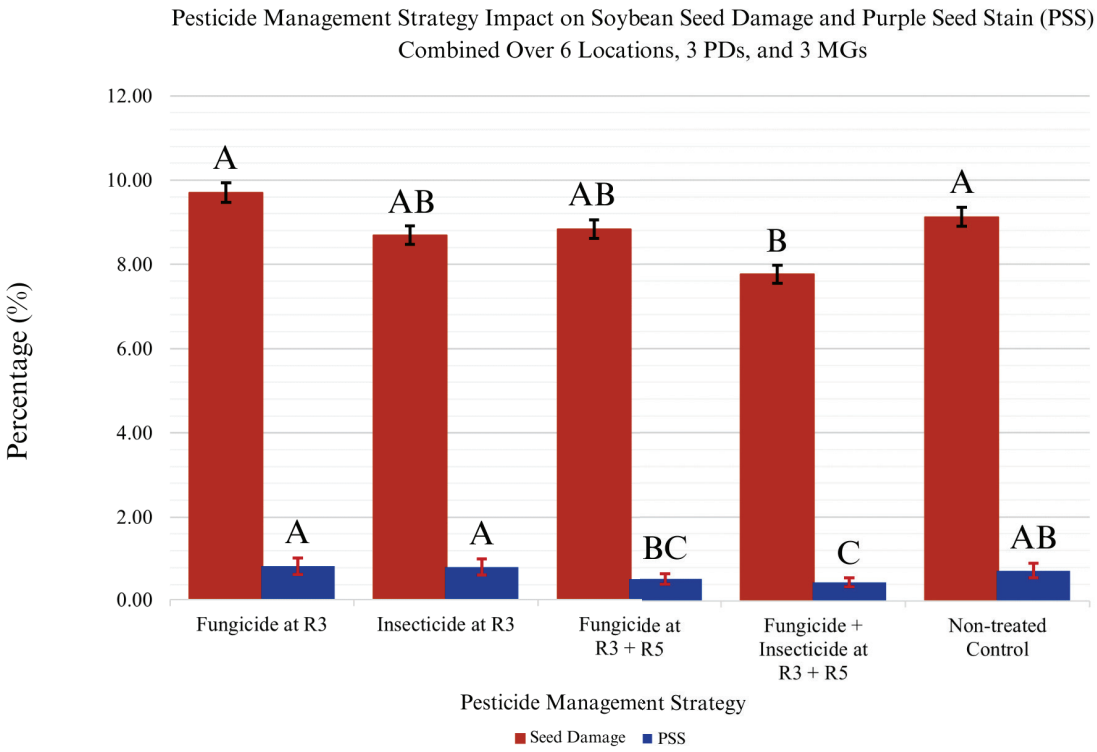


Figure 3. When combined across all sites, maturity groups, and planting dates there was no significant reduction in damage from mid-season pest management. PSS was reduced with two applications of fungicide. Treatments with different letters are statistically significant.

SALT TOLERANT VARIETIES CAN MITIGATE RISK OF SALTWATER INTRUSION ON COASTAL SOILS

NEED TO KNOW: VARIETIES OF SOYBEANS SEGREGATE ON THEIR ABILITY TO EXCLUDE CHLORINE. CHLORINE EXCLUDER VARIETIES PERFORM BETTER ON SALT-AFFECTED SOILS.

In coastal plain counties including Hyde, Tyrrell, and across the Albemarle-Pamlico peninsula, saltwater intrusions can cause substantial damage to agriculture. In this region of North Carolina, drainage canals are the main source of saltwater exposure. Fields in the region are susceptible to seawater intrusion during storm surges and wind events. Saltwater penetrates the soil and diminishes the productivity of crops grown in the fields, resulting in failure to germinate and poor yields.

Salt-tolerant soybean varieties are often the only answer for dealing with the impacts of saltwater intrusion. In the study, Extension researchers selected eleven soybean fields in Hyde, Pasquotank, and Beaufort counties. Each field was assessed a grade for salt damage ranging from no damage to severely impacted, based on composite soil samples drawn from ten to twelve cores. At the end of the season, the Extension researchers hand-harvested the soybeans from designated spots in the field.

As predicted, soybean yield was reduced in proportion to the increase in the soluble salt index (measured from 0 to 300), indicating the high impact of saltwater intrusion on yield. Soybean varieties identified for their salt tolerance (chlorine excluders) performed much better in places higher on the soluble salt index. Soybean varieties not identified as chlorine excluders were highly impacted by a soluble salt index of 68 or greater. But the chlorine excluders were highly impacted only when the soluble salt index reached 116 or greater. All soybean varieties were highly impacted above this threshold, leading to yield reduction of 90% or more.

Chloride excluder varieties of soybean perform better than non-excluder varieties on salt-affected soils

For additional information, see the article "Adapting to Saltwater Intrusion: Profitability of Salt-Tolerant Soybeans in Eastern North Carolina", N.C. State Economist, Sept.-Oct. 2023, by Greg Ferraro, Roderick M. Rejesus, Luke Gatiboni, and Andrea Gibbs.

PROJECT LEADERS: Luke Gatiboni, Robert Austin, Matthew Ricker, Ekrem Ozlu – NC State University

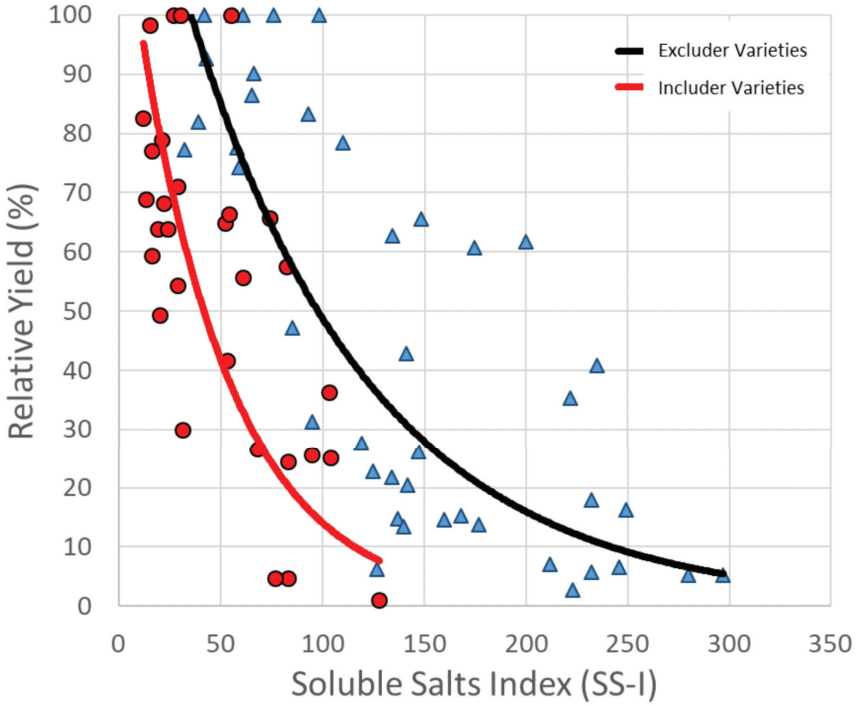


Figure 2. Impact of soil soluble salts on yield reduction of include and excluder varieties in nine on-farm sites in Hyde and Pasquotank sites.

SOYBEAN IN HIGH-YIELDING ENVIRONMENTS MAY NOT BENEFIT FROM SUPPLEMENTAL NITROGEN

NEED TO KNOW: IN MOST CASES, BIOLOGICAL NITROGEN FIXATION AND THE NITROGEN IN SOIL ORGANIC MATTER IS SUFFICIENT FOR HIGH YIELDS (>50 BU/AC). IN THE STUDY, SOYBEAN YIELD WAS NOT INCREASED BY ADDING MORE FERTILIZER WHEN SOILS HAD ADEQUATE FERTILITY STATUS AT TIME OF PLANTING.

North Carolina farmers have proven that best management practices allow for some soybean fields to yield greater than 70 bu/A, double the historical statewide average. Due to intensive management, these fields usually have adequate soil nutrients. The official recommendations for fertilizers for these soils calls for very little, or no, additional fertilizer, regardless of yield expectations. Only if soybeans in these fields are removing more nutrients than available, due to high demand, is there is a chance that the plants will respond to supplemental fertilization.

Soybean has a high demand for nitrogen because of the high protein content in the grain (~40%). Fortunately, soybeans can obtain 50% to 60% of the demanded nitrogen through biological nitrogen fixation (BNF) in association with rhizobia bacteria in the soil. The remaining nitrogen required by the plant is taken up from soil organic matter. In almost all situations, these two sources provide all the nitrogen the soybean needs. Consequently, soybeans rarely respond to nitrogen fertilization. It's true that in some cases, BNF and nitrogen in the soil may not provide all the nitrogen required. If that's the case, an increased grain yield might be expected due to mineral fertilization.

In the two-year study, supplemental fertilization treatments were provided to soybeans planted at eight sites in the Coastal Plain and Piedmont of North Carolina. The study incorporated 10 different fertilization strategies, at planting and at R1. The treatments included nitrogen at planting, nitrogen at R1, in-furrow starter P, sulfur at planting, micronutrients (Mn and B) at R1, and combinations of these. None of the tested strategies proved to be economically feasible.

To produce 52 bu/A, soybean demands approximately 254 lb/A of nitrogen, 46 lb/A of phosphorus, 161 lb/A of potassium, and small amounts of zinc, copper and manganese. At 52 bu/A yield, the soybean plants will remove 183 lb/A of nitrogen, 36 lb/A of phosphorus, and 70 lb/A of potassium. If the yield increases from 52 bu/A to 70 bu/A, the nutrient demand should increase in the same proportion. However, be careful. Nitrogen fertilizer applied at planting and at R1 decreased the biological nitrogen fixation caused by rhizobia bacteria, by decreasing the number and weight of the root nodules. Several studies have shown that fertilization not exceeding 30 lb N/A at planting does not affect the BNF and could potentially create benefits early on, if environmental factors like wet or cold weather interfere with the BNF. Other studies indicate a possible response in high-yielding soybean to nitrogen during pod development, when nitrogen requirements are higher than the BNF and the soil can supply. This suggests that supplemental nitrogen applied at the R2 growth stage will have a positive impact when the nitrogen demand surges at R4.

The benefit of applying starter phosphorus on early-season corn in cold and wet soils, even soils with high phosphorus levels, is well known. In contrast, phosphorus is not recommended for soybeans in North Carolina. Research studies have shown there is no need. (However, it's worth looking at whether a small amount of starter phosphorus might help early maturing varieties get off to a faster start, when planted in wet and cold soils in mid-April to early May.)

Regarding micronutrients, the most recent research trials do not support their use EXCEPT when soil nutrient deficiencies are detected. University research teams continue to examine the impact of supplemental fertilization practices using micronutrients in high-yielding fields under intense management. It's possible that real impacts can be achieved through supplemental fertilization. The micronutrients manganese and boron are thought to have the best potential to impact yields in intense management conditions.

Project Leaders: Luke Gatiboni, Rachel Vann, Deanna Osmond, Alex Woodley – NC State University

COVER CROP SELECTION CAN INFLUENCE SUPPRESSION OF GUAVA ROOT-KNOT NEMATODE

NEED TO KNOW: GRASS AND CEREAL COVER CROPS ARE NON-HOSTS TO GUAVA ROOT-KNOW NEMATODE, BROADLEAF CROPS CAN BE HOSTS AND RESULT IN HIGHER GALLING SEVERITY ON SOYBEAN

Different cover crops were assessed for their host status to M. enterolobii, and their ability to suppress populations of the nematode in a following soybean crop. This was done through a greenhouse pot test. It was found that the broadleaf cover crops tested (including crimson clover, yellow mustard, and hairy vetch) were a direct host to M. enterolobii and supported a high population of the nematode. Grass and cereal cover crops were non-host to the nematode and did not support a high population of the nematode. In the following soybean "crop", soybean plants had significantly higher galling severity following crimson clover, yellow mustard, and hairy vetch. The results of this research will be used to direct future field trials for evaluating cereal winter cover crops for suppression of M. enterolobii under field conditions.

Table 1. Cover crops assessed in a greenhouse bioassay to determine host status and quantify suppressive effect on the root-knot nematode Meloidogyne enterolobii. Letters within the same column denote significance groups at the 0.05 level. ns = not significant. '+' = host, '-' = non-host

PLANT SPECIES	COMMON NAME	ROOT GALLING IN COVER CROP	SOYBEAN SHOOT WEIGHT (G)	SOYBEAN ROOT WEIGHT (G)	SOYBEAN ROOT GALLING SEVERITY
Hordeum Vulgare	Barley	–	14.92 (ns)	31.59 (ns)	0.25 d
Trifolium Incarnatum	Crimson Clover	+	10.09	16.20	26.71 b
Guillenia Flavescens	Yellow Mustard	+	10.09	18.83	14.63 c
Avena Nuda	Streaker Hulless Oats	–	11.39	20.32	0 d
Lolium Multiflorum	Ryegrass	–	6.35	17.71	0.25 d
Secale Cereale	Winter Rye	–	12.65	22.15	0.25 d
Vinca Villosa	Hairy Vetch	+	5.03	13.58	46.17 a
Triticum Aestivum	Spring Wheat	–	8.31	20.01	0.25 d
Lolium Multiflorum	Ryegrass (non-inoculated)	–	11.99	20.12	0 d
Trifolium Incarnatum	Crimson Clover (non-inoculated)	–	11.47	17.41	0 d

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