Managing early maturing soybeans in North Carolina

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Introduction: Growers across North Carolina are becoming increasingly interested in producing earlier maturing soybean maturity groups (III and IV). These soybean maturity groups typically have an indeterminate growth habit, which allows simultaneous vegetative and reproductive growth over several weeks. This is different than the determinate growth habit of most of the soybeans we produce in North Carolina (≥MG5), which largely stop vegetative growth when they start flowering. We have growers across the state very successfully producing early maturing soybeans who can find a nice premium for September delivery. The 2018 North Carolina Soybean Yield Contest results illustrate success with earlier maturing varieties, where 80% of the 24 entries were from MG III and IV varieties (below).

2018 North Carolina Soybean Contest Yield Results

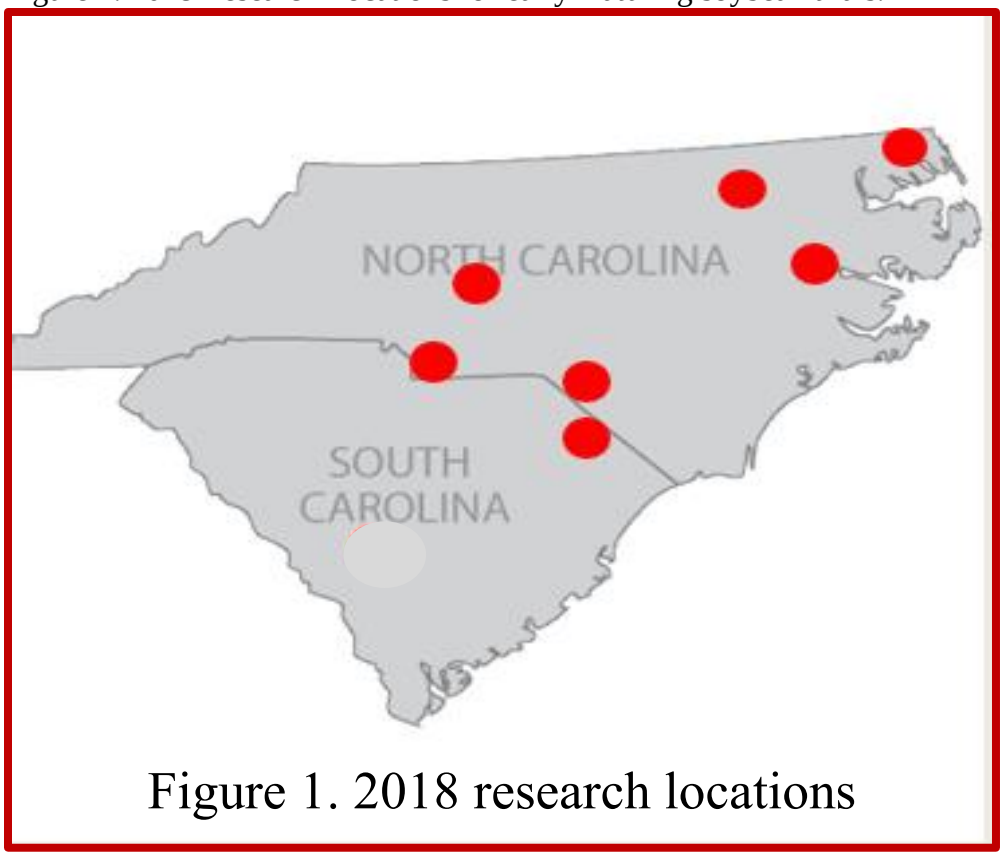
Entry Name	County	Region	Yield	$/Bu	Double Cropped?	Variety	Pounds of Seed	Row Width
MATTHEWS FAMILY FARMS	DAVIE	4*	104.5	$5.13	no	P46A16R	50	20
JOHNNY MOORE	IREDELL	5*	94.0	$5.54	no	USG 7487 XT	50	15
DOUG AND BILLY MERCER	PASQUOTANK	1*	91.5	$5.24	no	P38T42	36	15
JAMES ALLEN	WASHINGTON	1	91.5	$5.47	no	AgriGold 3520	45	15
JAMES ALLEN	WASHINGTON	1	86.9	$5.58	no	AgriGold 3410	45	15
JAMES ALLEN	WASHINGTON	1	85.9	$5.72	no	AgriGold 4380	45	15
JAMES ALLEN	WASHINGTON	1	85.3	$5.68	no	AG33X8	45	15
LOCKLEAR BROTHERS FARM	ROBESON	3*	84.0	$5.80	no	P52A26R	40	30
DAWSON PUGH	HYDE	1	82.6	$4.83	no	SH 3814 LL	41	38-Twin
SHARP FARMS INC	WILSON	2*	82.4	$5.40	no	DG48XS78	53	36-Twin
JAMES ALLEN	WASHINGTON	1	73.8	$5.56	no	AG39X8	45	15
JASON STARNES	ROWAN	5	73.5	$5.37	yes	P46A57BX	68	15
BLIZZARD FARMS INC	GREENE	2	71.6	$5.21	no	58RY78	40	20
WOOD FARM LLC	CHEROKEE	5	70.6	$7.22	no	AG39X7	46	7.5
WOOD FARM LLC	CHEROKEE	5	70.3	$7.32	no	AG39X7	46	7.5
JOHN MORGAN	PERQUIMANS	1	69.0	$5.83	no	Croplan RX48175	50	30-Twin
WEBB FAMILY FARMS	WILSON	2	68.5	$5.67	no	AgVenture 48E5R2STS	43	15
TEMPLE FAMILY FARMS	CAMDEN	1	64.5	$7.12	no	P48A60X	50	7.5
TERRY NOBLITT	CAMDEN	1	63.4	$6.04	no	P53T73SR	48	20
TEMPLE FAMILY FARMS	PASQUOTANK	1	62.9	$4.75	yes	P53T18X	46	7.5
TEMPLE FAMILY FARMS	PASQUOTANK	1	62.1	$5.58	no	AG39X7	50	7.5
CLAY KING	LENOIR	2	52.7	$5.49	no	AG49X6	30	30
ADAM BRUMMETT	DUPLIN	3	47.9	$7.30	no	P72A21X	36	15
TUNNELL FARMS INC	HYDE	1	35.7	$6.25	yes	DynaGro 43RY95	30	20

* Highest yield in region

There has been limited recent research conducted by NC State Extension on the best management strategies for early maturing soybeans in North Carolina. In collaboration with County Extension Agents in Eastern North Carolina, the Soybean Extension Program has been investigating foundational agronomic management of early maturing, indeterminate soybean varieties across the state to compare findings to current agronomic recommendations generated largely from work with later maturing, determinate varieties. Our objective was to generate up-to-date production recommendations on managing early maturing soybean varieties in North Carolina.

Materials and Methods: Four different experiments were conducted across North Carolina and South Carolina in 2018 (Figure 1). At most research locations, two varieties were used (P38T42 and AG48X7).

Figure 1. 2018 Research Locations for early maturing soybean trials.



Row Spacing: At each research location, narrow (15 in or 18 in) vs wide row spacing (30 in or 36 in) were compared.
Seeding Rate: At each research location, the following seeding rates were compared: 60,000, 80,000, 100,000, 120,000, 140,000 and 160,000 seeds/A.
Planting Dates: The original intention was to compare planting dates from early April through early July, however wet weather prevented the earliest planting date. We tried our best to compare several planting dates. We are evaluating a wider range of planting dates in 2019.

R1 Fertility: Soybean fertility requirement for several nutrients drastically increases at R1 (beginning flowering). The following fertility treatments applied at R1 were compared to a nontreated control: 50 lbs N/A, 75 lbs P/A, 75 lbs K/A, 15 lbs S/A, and a combination of all nutrients.

Results and Discussion:

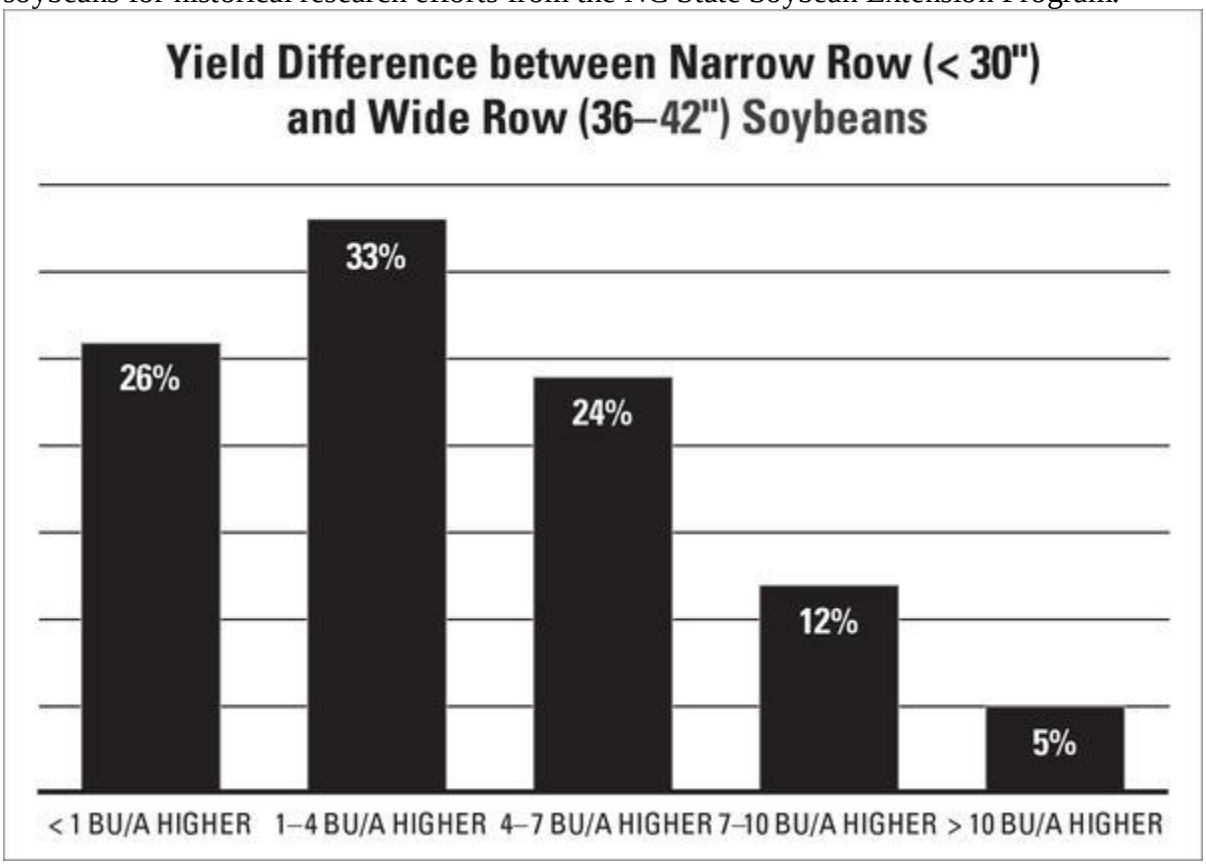
Row Spacing: In a combined analysis across locations and varieties, the narrow row spacing provided a 7 bu/A yield advantage over the wider row spacing (Table 1). At individual locations there was often no statistical yield difference among the two row spacings (Table 1). The narrow row spacing tended to provide more of a yield advantage in high yielding situations (Dillon Co/P38T42, Rowan Co/P38T42), but not always (Pasquotank/AG48X7). These results are aligned with what Dr. Dunphy found over the years with narrow row spacing sometimes increasing soybean yield (Figure 2). In environments where drought is prevalent, such as was observed at the Union Co location in 2018, it is thought that these environmental conditions reduce the advantage of narrow row spacing.

Table 1. Soybean yield across 2018 research locations as impacted by narrow (15-18 in) vs wide (30-36 in) row spacing.

Location	Variety	Row Spacing (in)	Yield (bu/A)
Combined*	Combined	15	53A
Combined	Combined	30	46B
Beaufort Co	P38T42	15	45A
Beaufort Co	P38T42	30	41A
Beaufort Co	AG48X7	15	50A
Beaufort Co	AG48X7	30	45A
Bertie Co	AG48X7	18	42A
Bertie Co	AG48X7	36	40A
Dillon Co	P38T42	15	76A
Dillon Co	P38T42	30	60B
Dillon Co	AG48X7	15	55A
Dillon Co	AG48X7	30	50A
Pasquotank Co	P38T42	15	59A
Pasquotank Co	P38T42	30	54A
Pasquotank Co	AG48X7	15	91A
Pasquotank Co	AG48X7	30	92A
Robeson Co	P38T42	15	44A
Robeson Co	P38T42	30	34A
Robeson Co	AG48X7	15	59A
Robeson Co	AG48X7	30	55A
Rowan Co	P38T42	15	95A
Rowan Co	P38T42	30	80B
Rowan Co	AG48X7	15	59A
Rowan Co	AG48X7	30	56A
Union Co	AG48X7	15	30A
Union Co	AG48X7	30	30A

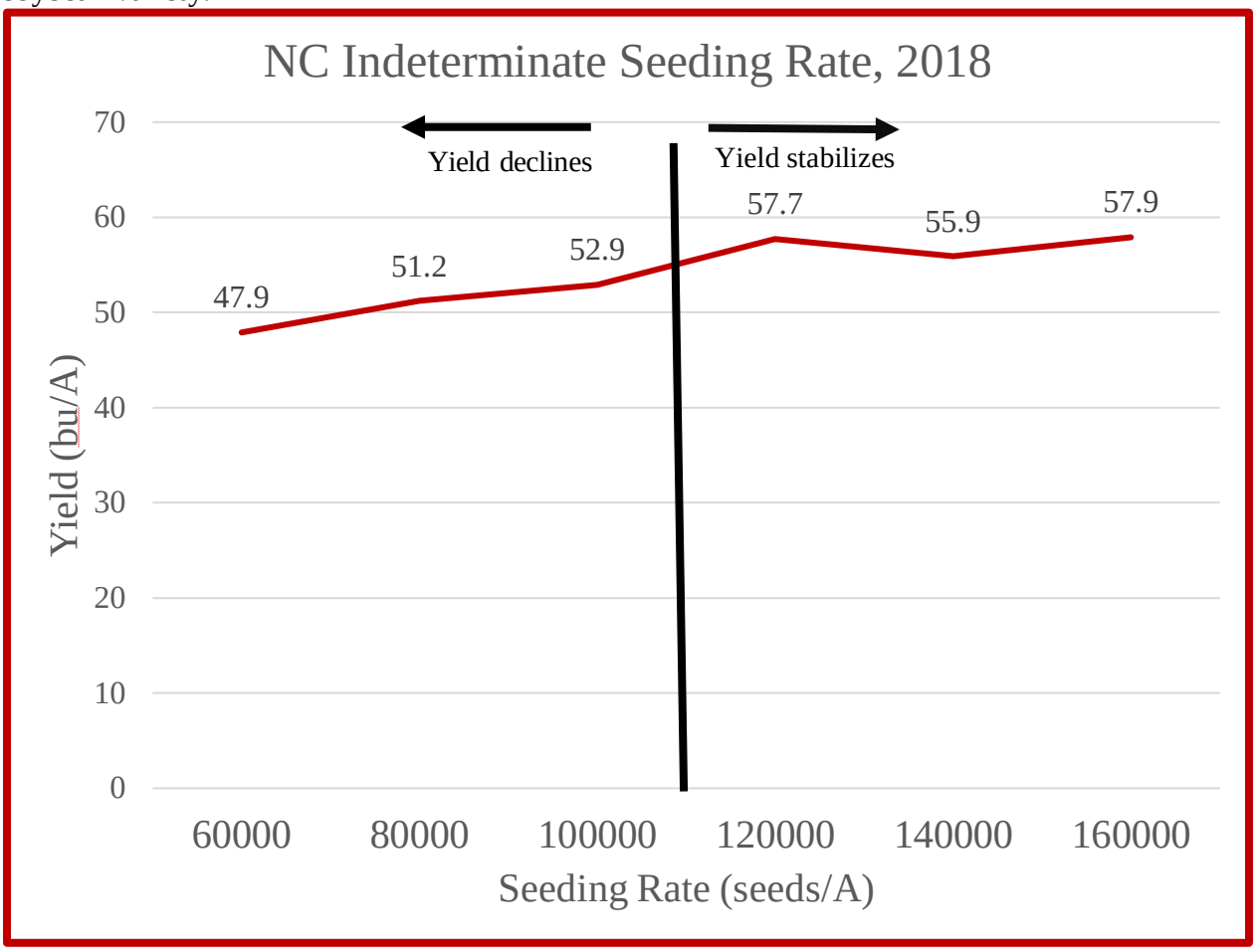
Mean were separated using Fisher's Protected LSD at $P \leq 0.05$ Mean yields followed by the same letter are not different.
*Results for the combined analysis are averaged over location and variety.

Figure 2. Yield difference between narrow row (<30 inches) and wide row (36 to 42 inches) soybeans for historical research efforts from the NC State Soybean Extension Program.



Seeding Rate: Should seeding rate be adjusted when planting indeterminate soybean varieties in North Carolina? Most of our previous research in the NC State Soybean Extension program would indicate that final plant populations as low 50,000, 75,000, and 100,000 plants/A are adequate for May, June, and July planting, respectively. However, much of this research was generated with determinate varieties. Dr. Dunphy conducted some work with indeterminate soybean varieties in the mid-2000's that indicated yield declined below 100,000 plants/A. We sought to revisit this question in 2018. In a combined analysis of research locations and varieties, soybean yield declined at the lowest seeding rates (60,000 and 80,000, $P<0.01$) (Figure 3). Soybean yield stabilized at seeding rates greater than 100,000 seeds/A. Yield declines at lower seeding rates were generally more pronounced in high yielding environments.

Figure 3. Soybean yield as impacted by soybean seeding rate averaged over research location and soybean variety.



Planting Date: More research is needed to determine the optimal planting date for early maturing soybeans in North Carolina. We have growers in the state that plant these indeterminate varieties as early as mid-March with the goal of having the soybeans flowering by the longest day of the year to capitalize on maximum sunlight (summer solstice), but what is agronomically ideal? And how late can we successfully plant these indeterminate varieties into the summer without yield declines? In 2018, we have a very limited data set on planting date for early maturing varieties (Table 2). At some locations May and June planting dates yielded comparably, whereas at some locations June planting yielded less than May planting. Yield declines were observed with July planting, likely because these varieties did not have enough time for vegetative growth to drive reproductive development prior to flowering.

Table 2. Soybean yield across 2018 research locations as impacted by planting date.

Location	Variety	Planting Date	Yield (bu/A)
Bertie Co	AG48X7	May	42A
Bertie Co	AG48X7	June	38A
Pasquotank Co	P38T42	May	79A
Pasquotank Co	P38T42	June	76A
Pasquotank Co	P38T42	July	44B
Pasquotank Co	AG48X7	May	78A
Pasquotank Co	AG48X7	June	62B
Pasquotank Co	AG48X7	July	37C
Union Co	AG48X7	May	31A
Union Co	AG48X7	June	25B

Mean were separated using Fisher's Protected LSD at $P \leq 0.05$ Mean yields followed by the same letter are not different.

R1 Fertility: There has traditionally been less emphasis in North Carolina on fertilizing soybeans compared to other crops in the rotation, despite soybeans having very high nutrient requirements to maximize yields; 245 lbs N/A, 43 lbs/P/A, and 170 lbs K/A are required to produce a 60 bu/A soybean crop (Fred Below, University of Illinois). As we begin producing more early maturing, indeterminate soybean varieties in North Carolina, are our current fertility recommendations adequate to maximize yield?

Fred Below, Crop Physiologist at the University of Illinois working primarily with indeterminate soybeans, recently visited North Carolina to discuss this topic. Prior to his trip, he provided guidance on a trials looking at soybean fertility applications in indeterminate soybeans in North Carolina. Soybean nutrient requirement drastically increases at R1 (beginning flowering) for several nutrients (Figure 3), and therefore it was of interest to look at soil-applied fertility applications at R1. In a combined analysis across research locations and varieties where this trial was conducted (Beaufort Co, Bertie Co, Pasquotank Co, and Rowan Co), R1 fertility treatment did not affect soybean yield (P=0.97, Table 3). These results would indicate that soil-applied R1 fertility applications have no impact on soybean yield. We should also acknowledge the practical limitations of soil-applied R1 fertility applications. As we strive to raise soybean yields across the state, soybean fertility should be a topic of great focus. However, this research indicates that focusing on soil-applied R1 fertility applications will not be the ticket to increasing soybean yields across the state.

Figure 4. Soybean K and P uptake curves.

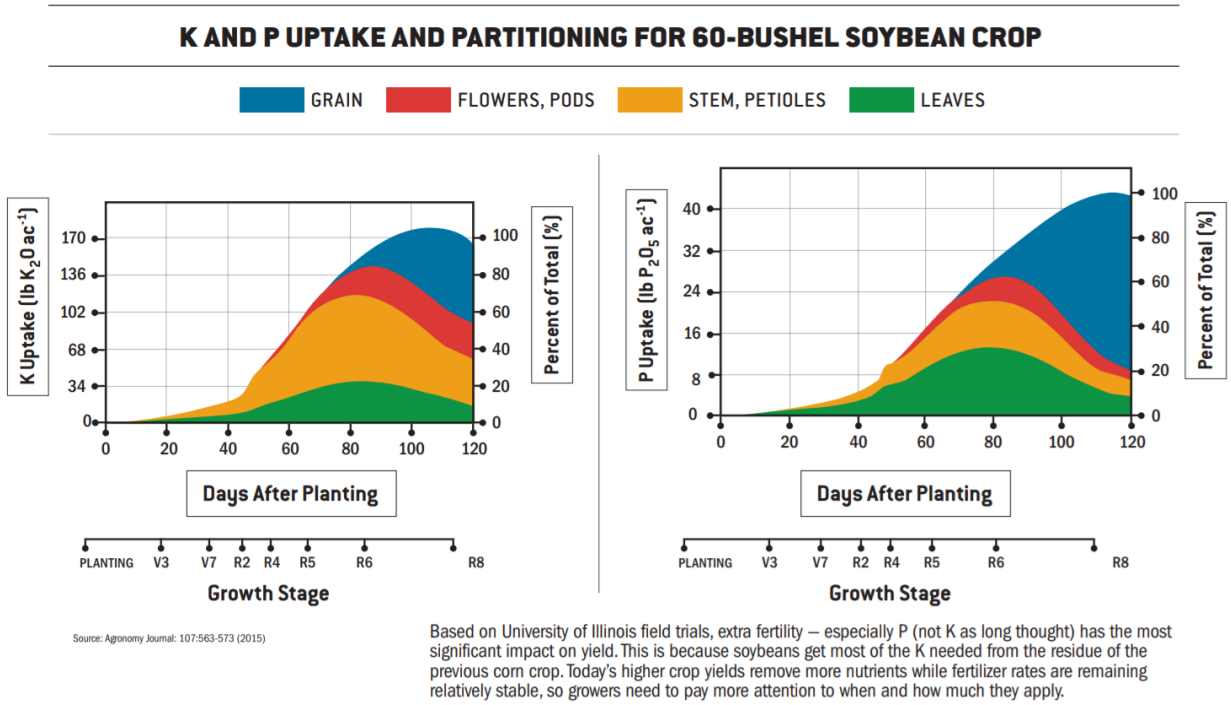


Table 3. R1 fertility impact on soybean yield combined across research locations (Beaufort Co, Bertie Co, Pasquotank Co, Rowan Co) and varieties (P38T42, P42A52X, AG48X7, AG49X6) in 2018.

R1 Fertility Treatment	Soybean Yield (bu/A)
N (50 lbs/A)	59.5A
P (75 lbs/A)	60.1A
K (75 lbs/A)	58.6A
S (15 lbs/A)	58.6A
N + P + K + S	59.4A
Nontreated Control	59.9A

Seed Quality: A challenge with producing early maturing soybeans in North Carolina is the requirement of timely harvest to prevent seed quality declines. These varieties are coming into physiological maturity when it is hot, humid, and sometimes wet; this can intensify seed quality issues. The pictures below show quality declines on early maturity soybeans we harvested in North Carolina after Hurricane Florence. Fungicides were not applied across these trials; fungicide use can help to prevent some seed quality issues. We quantified damage and purple seed stain at the plot level following North Carolina Department of Agriculture training. Damage and purple seed stain were variable across the research locations and ranged from 3.6-21.6% and 0.0-10.1%, respectively. We also analyzed samples for protein and oil content at the plot level. Average results combined over varieties and trials at each research location are available in Table 4. More information on how these various agronomic practices affected quality in these trials will be forthcoming.

Table 4. Average damage, purple seed stain (PSS), protein, and oil content averaged over trials and varieties at our various research locations.

Location	% Damage	% PSS	%Protein	% Oil
Bertie Co	15.8	5.1	-	-
Dillon Co	17.1	4.5	36.9	21.2
Pasquotank Co	3.6	2.2	34.8	20.9
Robeson Co	21.6	5.8	37.3	20.7
Rowan Co	6.4	10.1	33.3	19.5
Union Co	14.2	0.0	32.7	18.0

Conclusions:

- Row Spacing: In a combined analysis across research locations and varieties, narrow rows provided a 7 bu/A yield advantage over wider row spacing.
- Seeding Rate: In a combined analysis across research locations and varieties, soybean yield declined at seeding rates below 100,000 seeds/A.
- Planting Date: Stay tuned for more information on optimal planting date for early maturing soybeans in North Carolina.
- R1 Fertility: Our results indicate that despite high soybean nutrient demand at R1, soil-applied R1 fertility applications have no impact on soybean yield. This may be attributed to delayed nutrient availability not synchronizing with peak soybean demand.
- Seed Quality: Seed quality can be an issue with earlier maturing soybean varieties. Timely harvest is critical to prevent seed quality declines.

Questions? Please contact Dr. Rachel Vann, Soybean Extension Specialist in the Crop and Soil Sciences Department at NC State, rachel_vann@ncsu.edu or 919-616-6775, for questions on the statewide data. Please contact the County Agent for localized, county-level information.