



## How important is uniform emergence in soybeans?

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**Introduction:** Uniformity of soybean emergence following planting may be more important than originally thought. Dr. Ron Heiniger has widely discussed the importance of uniform corn emergence for achieving high corn yield. The question remains: how important is uniformity of emergence in soybeans? Soybeans typically emerge over a period of several days. A recently released article indicates that uneven emergence in soybeans can negatively impact soybean yield depending on variety

(<https://www.sciencedirect.com/science/article/pii/S1161030118300522>). The question may be more important for soybeans than it was for corn, since many of our NC growers use a drill to plant soybeans, and a drill does a much poorer job than a planter does of getting seedlings to all come up on the same day. Over the past several years, uniformity of soybean emergence and the subsequent impact on soybean yield has been investigated by the Soybean Extension Program and County Extension Agents in various production scenarios across the state. This publication will discuss the results from this work so far.

**Materials and Methods:** Replicated on-farm tests were established from 2016-2018 in counties across North Carolina to determine whether uniformity of soybean emergence has any effect on soybean yield (Table 1). Soybeans in a designated area were staked when they started emerging with one color stake, which indicated the first day of emergence. For the following three days, soybeans were monitored for subsequent emergence and staked with a different color stake to correspond with each day of emergence (Day 1, Day 2, Day 3, Day 4). Individual soybean plants were then harvested based on emergence date and threshed by hand or with a belt thresher. Seed yield per plant was quantified and then those values were extrapolated to bu/A based on a quantified population.

Table 1. Trial locations by County, year, participating County Extension Agent, cooperating grower, soybean variety, row spacing, quantified population\*, and soybean planting date.

County	Year	Agent	Grower	Soybean Variety	Row Spacing	Population (plants/A)	Planting Date
Cleveland	2018	Andrew Scruggs	ARS Grain	Croplan RX51365	15 inch	90,605	May 11
Cumberland	2018	Anthony Growe	Justin Smith	AG72X7	19 inch	88,037	June 6
Johnston	2018	Tim Britton	Keith Smith	SG 6985X	15 inch	83,635	June 6

Person	2018	Gary Cross	Oxford Res Sta	S55-Q3	38 inch	50,000	May 3
Wake	2018	Emily Mueller	Ryan Broadwell	AG69X6	15 inch	111,514	May 23
Greene	2017	Roy Thagard	Tommy Hardy	AG59X7	20 inch	126,000	May 12
Person	2017	Gary Cross	Alfred Gentry	DG S52RS86	15 inch	50,000	June 13
Randolph	2017	Jon Wall	Randall Spencer	95M82	Solid-Seeded	169,594	May 14
Person	2016	Gary Cross	Alfred Gentry	N/A	15 inch	102,802	July 4

\*Population was not quantified at the Greene 2017, Person 2017, and Person 2016 environments. The seeding rate for the Greene 2017 environment was 140,000 seeds/A. Assuming 90% germination, the final population is estimated at 126,000 plants/A. The seeding rate for the Person 2017 environment was ~100,000 seeds/A, but excessive rains after planting limited stand; population was estimated at 50,000 plants/A. For the Person 2016 environment, a population of 102,802 plants/A was assumed based off the seeding rate.

**Results and Discussion:** Uniformity of soybean emergence often declined with an increasing amount of time after soybean planting (Table 2), although results were variable. At several environments, the same or more soybean plants emerged on the second day of emergence compared with the first. For the most part, there was a dramatic drop-off in plants emerging by the fourth day of emergence.

The impact of soybean emergence on yield followed similar pattern, often with declining soybean yield observed as day of emergence was delayed (Table 3). In a combined analysis of 9 environments yield declined gradually from day 1 emergence to day 3 emergence, and more steeply declined by the fourth day of emergence (Figure 1). Assuming one common population of 102,777 plants/A, on average, there was a 14 bu/A yield penalty observed for soybean that emerged on the fourth day of emergence compared to those that emerged the first day. While the average trend was declining soybean yield as day of emergence was delayed, these results varied by environment (Table 3). At some environments there were negligible yield declines across soybean emergence dates and at other environments there was up to a 45 bu/A yield decline from soybean emerging on the fourth day of emergence compared to the first. This indicates that the story is complex; management and environmental factors likely have a large influence on the impact of uniform soybean emergence on soybean yield.

At 7 of the 9 environments, soybean yield declined as emergence was delayed and on average soybean yield declines were 7, 11, and 25% at day 2, 3, 4 of soybean emergence compared to day 1, respectively (Table 4). So based on these summary statistics let's say in many situations uniform soybean emergence is important for protecting soybean yield. How do we achieve uniform soybean emergence?

There are factors both in the growers control and largely out of the growers control that influence soybean emergence. Uniform planting depth, proper residue penetration, planter type (drill vs vacuum or air seeder), seed delivery, and down pressure are all factors that likely impact uniformity of soybean emergence and are management decisions in the growers control. The grower has less control over other factors that influence uniformity of soybean emergence, such

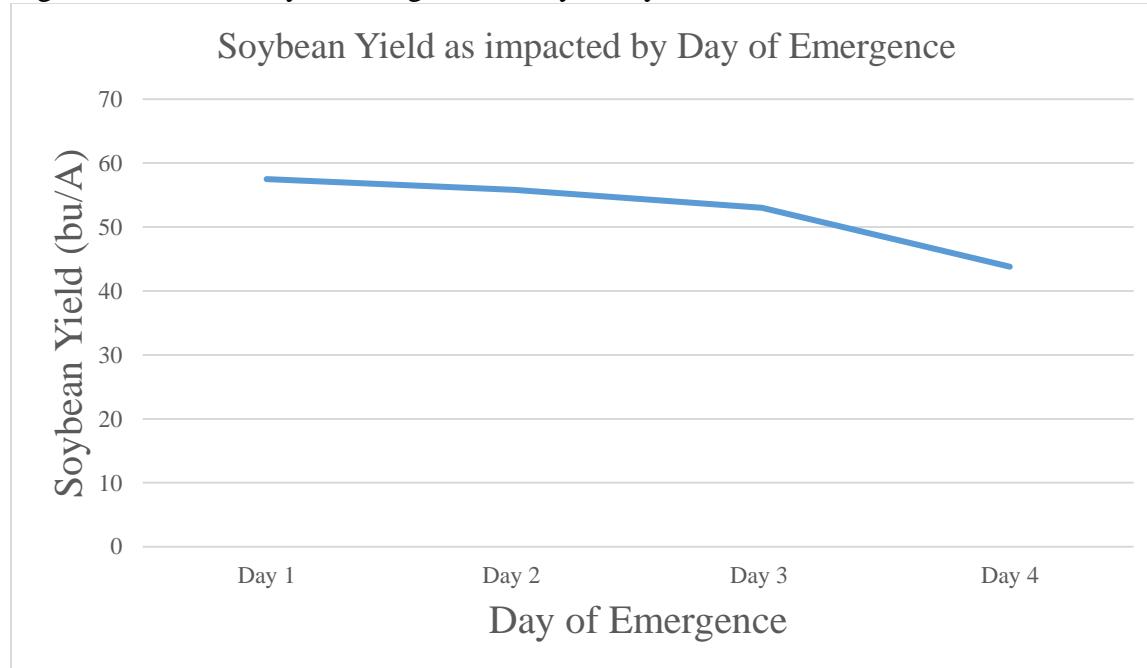
as cool soil temperatures, excess moisture, and inadequate soil moisture, although planting date can often be used as a mechanism to avoid these situations. Insect feeding and early season disease can also impact uniformity of emergence.

In a preliminary study at Central Crops Research Station in Clayton, NC in 2018, we quantified the impact of seed depth on uniformity of soybean emergence. Although preliminary, results would indicate soybeans emerged more uniformly from shallower depths (Table 5). More research is necessary to confirm the impact of planting depth on soybean yield as there was abundant rainfall following planting in this environment and the soybeans were planted in early July.

Table 2. Percentage of soybeans emerged on the first, second, third, and forth days of emergence across environments

County	Year	% Emergence			
		Day 1	Day 2	Day 3	Day 4
Cleveland	2018	22	19	23	36
Cumberland	2018	78	8	4	10
Johnston	2018	35	47	12	6
Person	2018	41	35	14	10
Wake	2018	72	19	6	3
Greene	2017	N/A	N/A	N/A	N/A
Person	2017	36	45	11	8
Randolph	2017	36	33	15	16
Person	2016	29	40	23	8

Figure 1. Effect of day of emergence on soybean yield combined across nine environments



\*The average population across environments (102,777 plants/A) was used for the combined analysis of nine environments.

Table 3. Yield of soybeans emerged on the first, second, third, and forth days of emergence across environments

		Yield (bu/A) at Quantified Population			
County	Year	Yield Day 1	Yield Day 2	Yield Day 3	Yield Day 4
Cleveland	2018	83.0	82.5	74.3	74.3
Cumberland	2018	30.0	13.8	31.8	30.1
Johnston	2018	59.2	41.0	50.9	14.6
Person	2018	35.5	57.9	41.4	44.0
Wake	2018	48.7	48.8	40.7	20.0
Greene	2017	75.6	78.0	76.3	53.6
Person	2017	53.6	43.2	40.9	46.2
Randolph	2017	91.1	80.9	75.4	69.0
Person	2016	27.8	23.0	21.2	16.6

Table 4. Yield differences of soybean emerged on the second, third, and forth days of emergence compared to yield from the first day of soybean emergence across our environments

		% Yield Difference from Plants Emerged on First Day		
County	Year	Day 2	Day 3	Day 4
Cleveland	2018	-1	-10	-10
Cumberland	2018	-54	+6	+1
Johnston	2018	-31	-15	-75
Person	2018	+63	+17	+24
Wake	2018	+1	-16	-59
Greene	2017	+3	+1	-30
Person	2017	-19	-24	-14
Randolph	2017	-12	-18	-24
Person	2016	-17	-24	-40
Combined	2016-2018	-7	-11	-25

Table 5. Soybean depth effect on soybean emergence at Central Crops Research Station 2018

Seeding Depth (in.)	% Emergence				
	Day 1	Day 2	Day 3	Day 4	>Day 4
0.5	30	54	9	3	4
1	10	41	36	10	3
1.5	14	54	22	9	1
2	VERY POOR EMERGENCE				

**Conclusions:** In many environments, soybean yield declined with delayed soybean emergence (on average a 14 bu/A yield decline was observed from first day of emergence to the fourth day of emergence). This would indicate that uniform emergence is important in soybeans in many situations. Using the knowledge that uniform soybean emergence is important in many production situations, growers can make planting decisions that target achieving more uniformly emerging soybean stands.

**Questions?** Please contact Dr. Rachel Vann, Soybean Extension Specialist in the Crop and Soil Sciences Department at NC State, at [rachel\\_vann@ncsu.edu](mailto:rachel_vann@ncsu.edu) or 919-616-6775.

