2020 Eastern Crop and Pest Management School

Soybean Production Issues

www.ag.ndsu.edu/CarringtonREC/agronomy/extension-outreach

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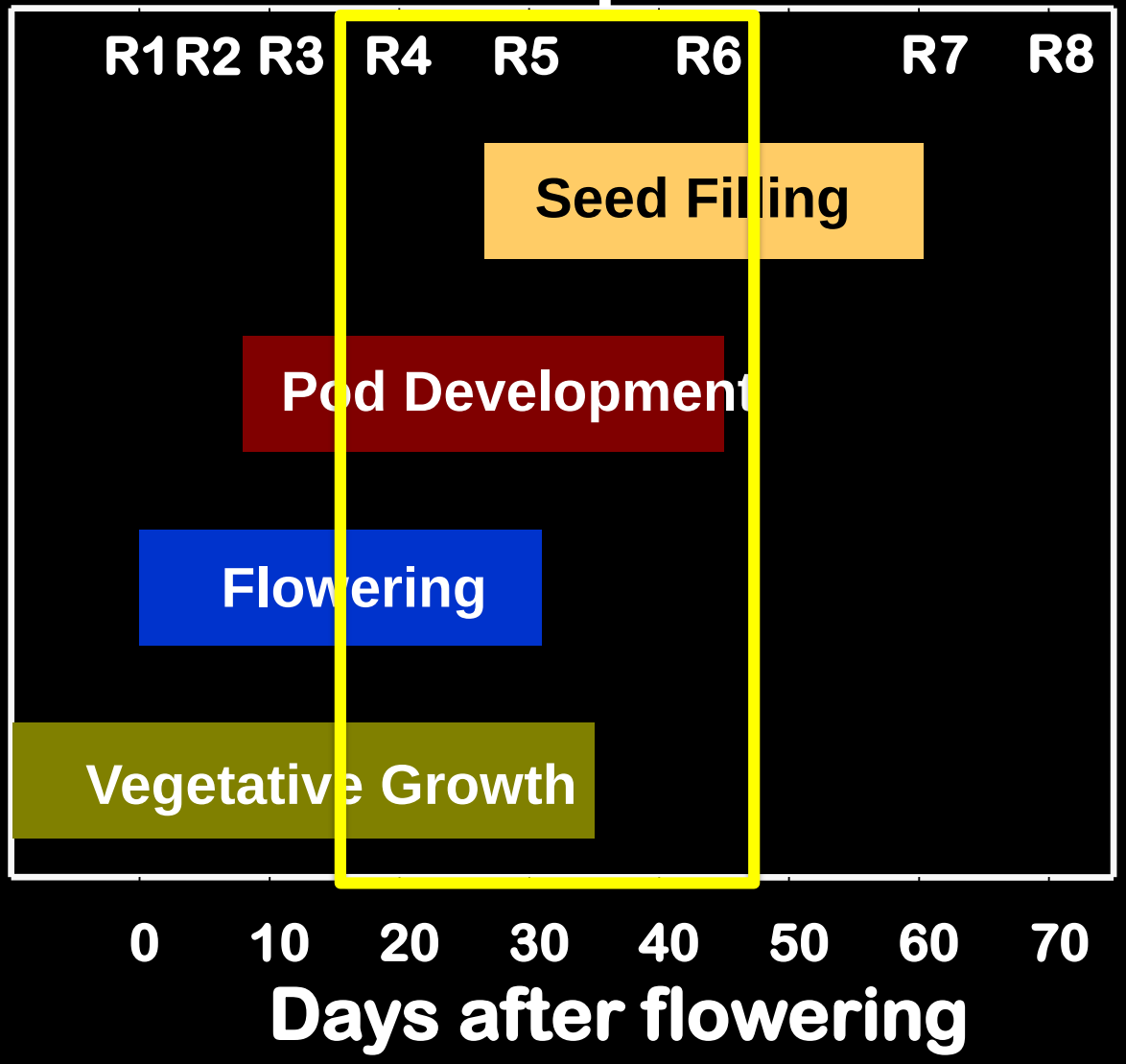
- Start with high yield potential
  - **Variety selection**
  - **Plant establishment and nutrition**
- Protect yield potential
  - Manage weeds, disease and insects

Soybean Reproductive Development



Main Factors in Variety Selection

- **Yield**
- Maturity
- Disease
  - Root rot and SCN
- **Herbicide tolerance or conventional**
- Iron Chlorosis
- Specialty markets

A843-19

North Dakota Soybean

Variety Trial Results for 2019 and Selection Guide

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Variety trial data from all NDSU Research Extension Centers for all crops can be found at *www.ag.ndsu.edu/varietytrials.*

Several herbicide traits are represented in the tables: RR = Roundup Ready, RRXT = RR2Xtend, XT = Xtend, GT = Glyphosate Tolerant, LL = Liberty Link and LLGT27 = Liberty Link GT27.

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Fargo, North Dakota
December 2019

RR and Xtend soybean variety trial results, southern RRV locations, 2019

Fairmount, Milnor and Colfax	
Varieties	53
Companies	18
Seed yield (bu/A)	
average	43.3
range	**33.7-52.6**

+18%

How do you select between 12 different soybean herbicide trait packages with resistance to various herbicides?

Soybean Herbicide Trait	Glyphosate	Glufosinate	2,4-D Choline	Dicamba	HPPD Inhibitors
Conventional					
Glyphosate Tolerant (GT)	✓				
Roundup Ready	✓				
Roundup Ready 2 Yield	✓				
Roundup Ready 2 Yield Xtend	✓			✓	
Roundup Ready 2 Yield Xtendflex	✓	✓		✓	
LibertyLink (LL)		✓			✓
LLGT27	✓	✓			
Enlist	✓		✓		
Enlist E3	✓	✓	✓		✓
GT27	✓				✓
MGI		✓			

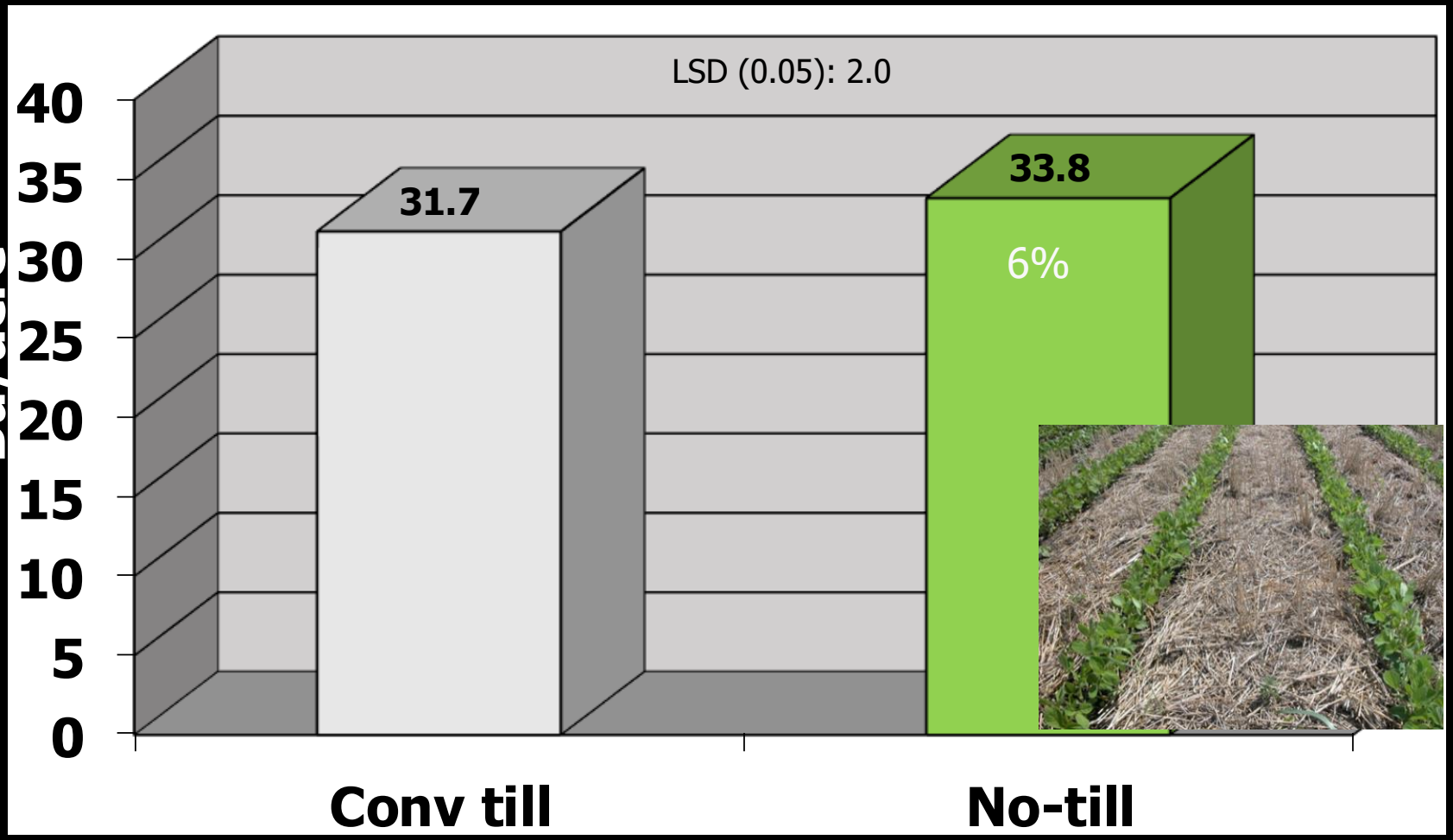
Plant establishment and nutrition

NDSU Research Summary of Soybean Plant Establishment Factors

Factor	Option A	A Yield > B (%)	Option B	NDSU trials (conducted during 1999-2018)
Tillage system	reduced till	**4**	conventional till	37
Previous crop	wheat	**5**	soybean	6
Planting date	≤ early May	**8**	mid May	9
Planting rate (pls/A)	150-175,000	**6**	100-130,000	44
Row spacing (inches)	14-21	**4**	28-30	24
Seed fungicide	yes	**6**	no	29
Seed inoculation with soybean history	yes	**2**	no	16
P app at planting time	broadcast	**0.5**	band (away from seed)	7
Timing of initial weed control	at planting	**5**	early POST (2- to 4-inch weeds)	8

Compiled by Greg Endres, Extension agronomist

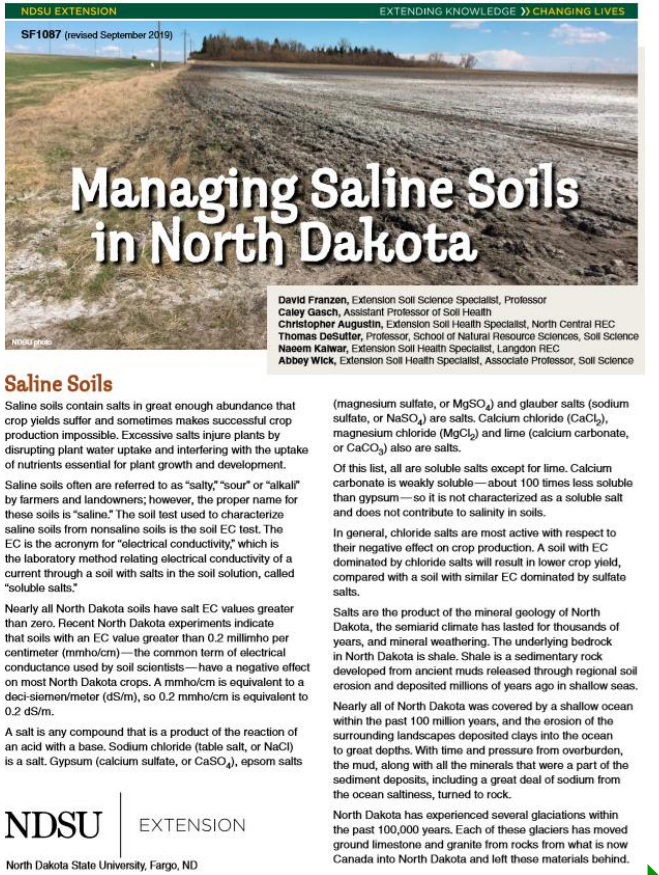
Conventional vs. no-till soybean yield, Carrington, 2003-14 (12-year average)*



*CREC cropping systems study

Expense (2020 South Valley soybean budget = $154/A direct costs) with no return

Soybean tolerance to salt-affected soils



NDSU EXTENSION — EXTENDING KNOWLEDGE ❯❯ CHANGING LIVES

SF1087 (revised September 2019)

Managing Saline Soils in North Dakota

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Saline Soils

Saline soils contain salts in great enough abundance that crop yields suffer and sometimes makes successful crop production impossible. Excessive salts injure plants by disrupting plant water uptake and interfering with the uptake of nutrients essential for plant growth and development.

Saline soils often are referred to as "salty," "sour" or "alkali" by farmers and landowners; however, the proper name for these soils is "saline." The soil test used to characterize saline soils from nonsaline soils is the soil EC test. The EC is the acronym for "electrical conductivity," which is the laboratory method relating electrical conductivity of a current through a soil with salts in the soil solution, called "soluble salts."

Nearly all North Dakota soils have salt EC values greater than zero. Recent North Dakota experiments indicate that soils with an EC value greater than 0.2 millimho per centimeter (mmho/cm)—the common term of electrical conductance used by soil scientists—have a negative effect on most North Dakota crops. A mmho/cm is equivalent to a deci-siemen/meter (dS/m), so 0.2 mmho/cm is equivalent to 0.2 dS/m.

A salt is any compound that is a product of the reaction of an acid with a base. Sodium chloride (table salt, or NaCl) is a salt. Gypsum (calcium sulfate, or $CaSO_4$), epsom salts (magnesium sulfate, or $MgSO_4$) and glauber salts (sodium sulfate, or $NaSO_4$) are salts. Calcium chloride ($CaCl_2$), magnesium chloride ($MgCl_2$) and lime (calcium carbonate, or $CaCO_3$) also are salts.

Of this list, all are soluble salts except for lime. Calcium carbonate is weakly soluble—about 100 times less soluble than gypsum—so it is not characterized as a soluble salt and does not contribute to salinity in soils.

In general, chloride salts are most active with respect to their negative effect on crop production. A soil with EC dominated by chloride salts will result in lower crop yield, compared with a soil with similar EC dominated by sulfate salts.

Salts are the product of the mineral geology of North Dakota, the semiarid climate has lasted for thousands of years, and mineral weathering. The underlying bedrock in North Dakota is shale. Shale is a sedimentary rock developed from ancient muds released through regional soil erosion and deposited millions of years ago in shallow seas.

Nearly all of North Dakota was covered by a shallow ocean within the past 100 million years, and the erosion of the surrounding landscapes deposited clays into the ocean to great depths. With time and pressure from overburden, the mud, along with all the minerals that were a part of the sediment deposits, including a great deal of sodium from the ocean saltiness, turned to rock.

North Dakota has experienced several glaciations within the past 100,000 years. Each of these glaciers has moved ground limestone and granite from rocks from what is now Canada into North Dakota and left these materials behind.

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North Dakota State University, Fargo, ND

Table 1. Approximate threshold salinity values for field crops and percent reduction in yield due to salinity.

Crop	Threshold salinity 1:1 EC, mmhos/cm	% Yield reduction due to salts			
		10	25	50	100
		mmhos/cm necessary to reduce relative yield			
Alfalfa	1	1.6	2.5	4.2	7.9
Barley	2	3	4.5	6	12
Canola	1.5	2	3	4	7.5
Chickpea	0.75	1	1.6	2.3	4
Corn	1	2	3	4	5.5
Dry bean	0.5	0.8	1.3	1.7	3
Faba bean	0.75	1	1.75	2.5	4.5
Field pea	0.3	1	1.8	3.75	7
Flax	0.5	0.6	1	1.5	3
Lentil	0.6	0.75	1.25	1.5	3
Oats	2.3	3	4	6	8
Rye	3.8	5.4	6.3	7.2	10
Safflower	3.5	4.5	6.5	8	14
Soybean	0.6	1	1.75	2.3	4
Sugarbeet	3	4	6	8	12
Sunflower	0.75	1	2.2	5	10
Wheat	1	2	3.5	5.5	11

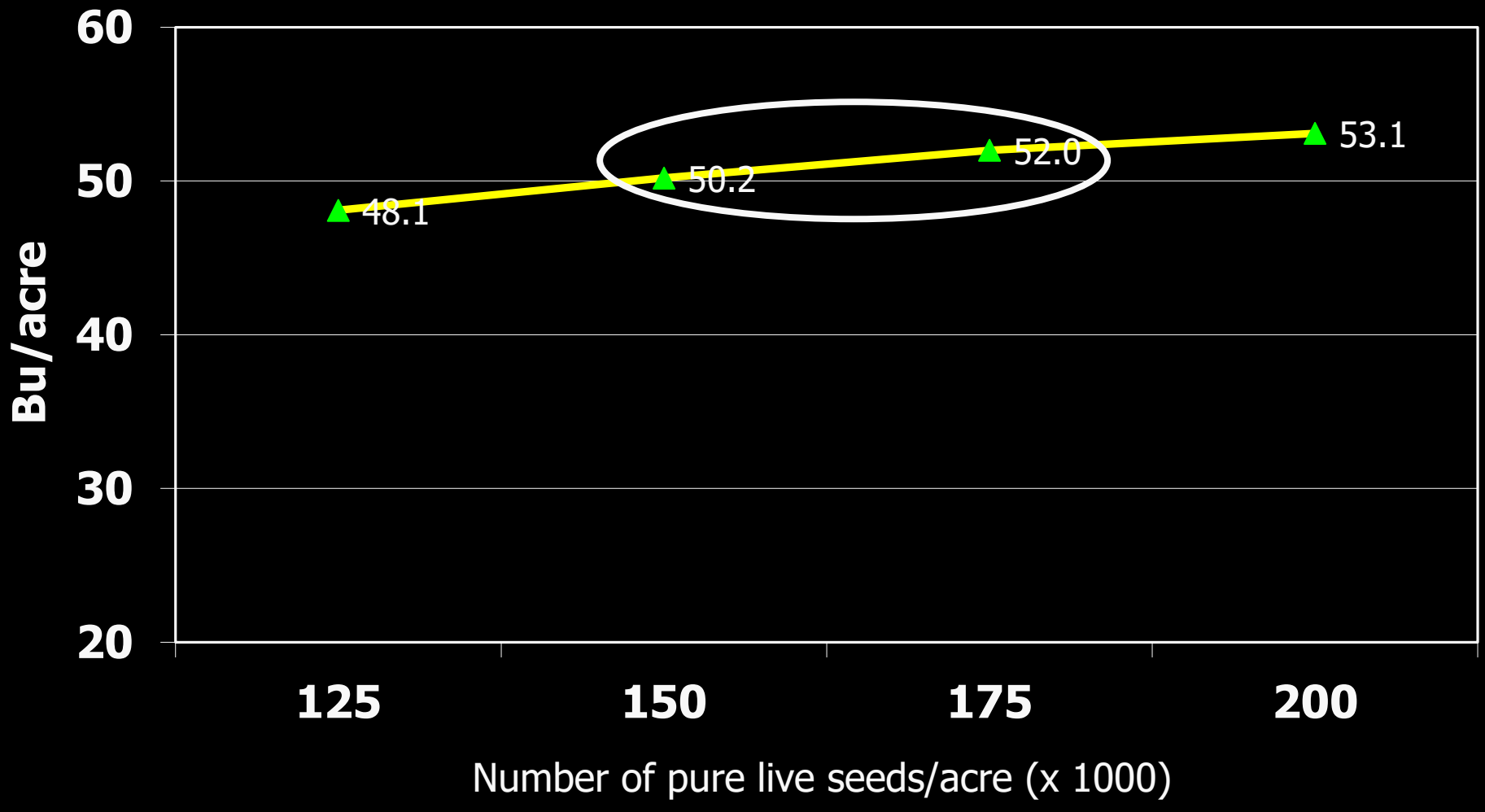
What potential yield advantage exists with **early planted** soybean?

- NDSU research in south central/east ND indicates **9%** yield increase with first week of May (or earlier) planting vs. 3rd week of May planting.
  - When soil tilth is adequate and soil temperature 1-2 days following planting is near 50 degrees.

NDSU recommends an established soybean stand of 150,000 plants/acre for any row spacing.

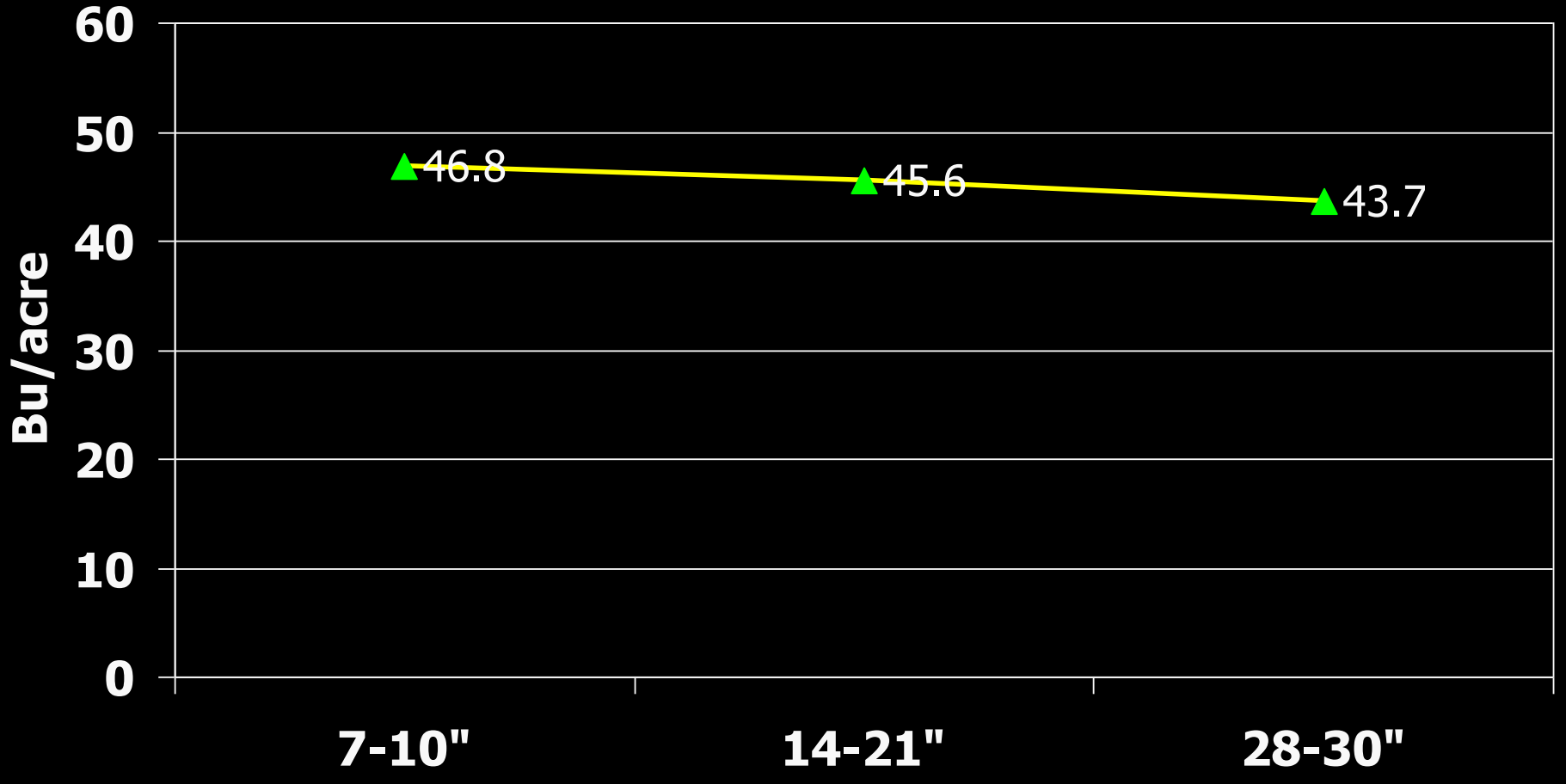
- Unlikely yield impact with variance of -10 to -12%

Planting rate influence on soybean yield, Northeast ND, 2011-16 (8 site-years)*



*Cavalier, Lakota, Langdon, Park River, Pekin, Vesleyville, and Voss. Bryan Hanson, Langdon REC

Row spacing influence on soybean yield, Carrington, Minot and Oakes, 1999-2016 (8 site-years)



SF1164 (Revised November 2019)

Soybean Soil Fertility

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Soybeans require 14 mineral nutrients: nitrogen (N), phosphorus (P), potassium (K), sulfur (S), calcium (Ca), magnesium (Mg), copper (Cu), iron (Fe), manganese (Mn), zinc (Zn), boron (B), chloride (Cl), molybdenum (Mo) and nickel (Ni) to grow successfully.

North Dakota soils provide adequate amounts for soybean production except for N, P, K, S and Fe.

Nitrogen

Nodulation

Although the atmosphere is 78% nitrogen (N) gas, plants cannot use it directly. Plants can use only ammonium-N or nitrate-N. Soybeans are a legume and normally should provide adequate N through a symbiotic relationship with N-fixing bacteria of the species *Bradyrhizobium japonicum*. In this symbiotic relationship, carbohydrates and minerals are supplied to the bacteria by the plant, and the bacteria transform nitrogen gas from the atmosphere into ammonium-N for use by the plant.

The process of soybean infection by N-fixing bacteria and symbiotic N fixation is a complex process between the bacteria and the plant. The correct species of N-fixing bacteria must be present in the soil, either through inoculation of the seed or the seed zone at planting.

Nitrogen-fixing bacteria are attracted to soybean roots by chemical signals from the soybean root in the form of flavenoid compounds (1). Once in contact with the root hairs, a root compound binds the bacteria to the root hair cell wall. The bacteria releases a chemical that causes curling and cracking of the root hair, allowing the bacteria to invade the interior of the cell and begin to change the plant cell structure to form nodules (2, 3, 4) (Figure 1, Page 2).

The bacteria live in compartments, up to 10,000 in each nodule, called bacteroids (Figure 2, Page 3). Each bacteroid is

www.ag.ndsu.edu/publications/crops/soybean-soil-fertility

Table 8. Phosphorus and potassium recommendation for soybeans based on soil test.

Olsen Soil Test Phosphorus, ppm					Soil Test Potassium, ppm					
VL	L	M	H	VH	VL/VL	L/L	M/M	H/M	VH-H	VH/VH
0-3	4-7	8-11	12-15	16+	0-40	41-80	81-120	121-150	151-200	201+
lbs/acre P_2O_5					CLAY content lbs/acre K_2O					
52	26	0	0	0	90/90*	60/90	60/60	30/60	0/60	0/0

white/dark

* Rate of K_2O in soils with smectite:illite ratio less than 3.5; rate of K_2O in soils with smectite:illite ratio greater than 3.5.

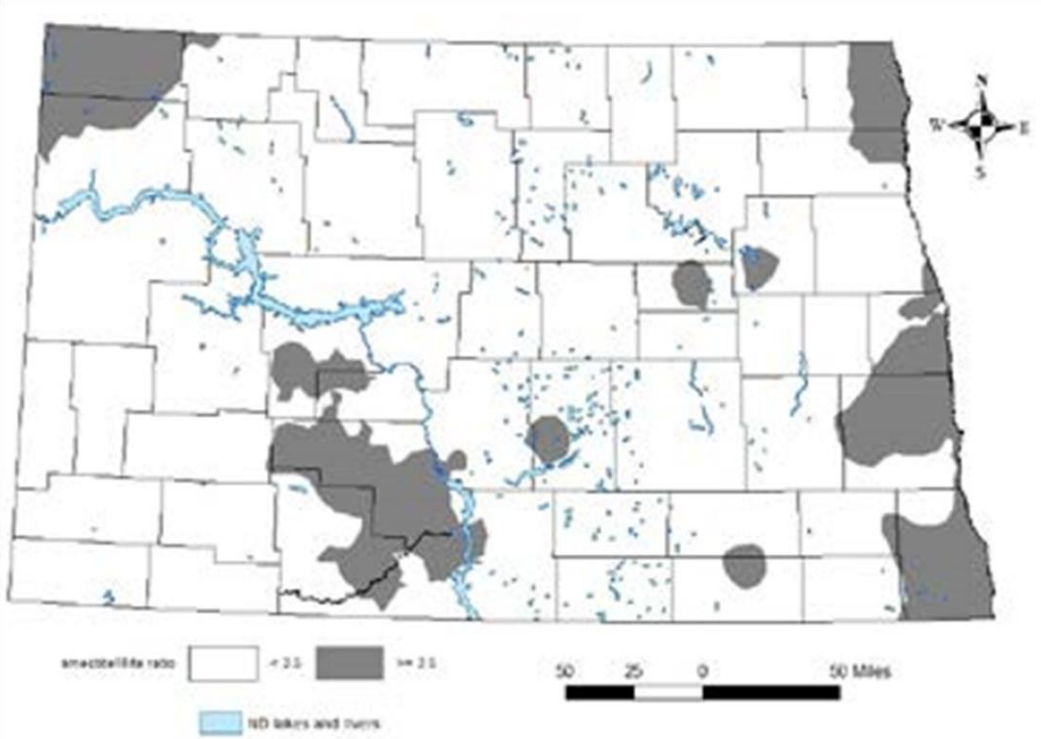

Figure 3. Smectite-to-illite ratio of surface soils in North Dakota from a soil sampling conducted in spring 2017. Dark gray regions are greater than 3.5. White areas are less than 3.5.

Soybean summary

- Do your homework on variety selection
- Use reduced tillage system and manage salt-affected soil areas
- Plant early and narrow at adequate rate
- Keep plant nutrition simple