MANITOBA Pulse Soybean GROWERS

on-farm network

Dry Bean Nitrogen Nutrition

Fertilization and Inoculation Research

March, 2022

Dry Bean Nitrogen Fertility

- Dry beans are poor nitrogen-fixers
  - Produce less than 45% of their N requirements
- Application of N fertilizer at a rate of 70 lbs N/ac is common practice, though recommendations vary by region
  - ON: no additional N
  - ND: fertilize to a total N (soil residual + fertilizer N) rate of 70 lbs/ac for **non-inoculated** beans or 40 lbs N/ac for **inoculated** beans

Dry Bean Nitrogen Fertility

Small Plot Trials at the Soybean and Pulse Agronomy Lab

Fertilizer Study

- Five rates of fertilizer (0, 35, 70, 105, 140 lbs N/ac) in Windbreaker and T9905 beans at Carman and Portage (2017 – 2019)

	Portage			Carman		
	2017	2018	2019	2017	2018	2019
Residual Nitrate-N (0-24", lbs/ac)	26	23	25	40	56	33

Inoculant Study

- Two inoculants containing *Rhizobium leguminosarium* biovar *phaseoli* (*BOS* peat and *Primo GX2* granular) evaluated in Windbreaker, T9905 and Eclipse beans at Carman and Melita (2019 - present)

	Carman		Melita
	2019	2020	2020
Residual Nitrate-N (0-24", lbs/ac)	33	12	76

Source: MacMillan 2020

Dry Bean Nitrogen Fertility

On-Farm Trials through the On-Farm Network

Fertilizer Trials

- Five trials (2019 – 2021) testing a range of N fertilizer rates (0 to 140 lbs N/ac)

	2019		2020		2021
	Norfolk Treherne	Rhineland	Boissevain Morton	Norfolk Treherne	Norfolk Treherne
Residual Nitrate-N (0-24", lbs/ac)	20	58	?	34	70
Nitrogen rates (lbs N/ac) tested	0, 70, 140	0, 40, 70, 140	40, 70, 100	0, 35, 70, 105	0, 35, 70
Variety	*T9905*	*Windbreaker*	*CDC Blackstrap*	*Vibrant*	*Vibrant*

Inoculant Trial

- One trial in 2019 tested *BOS* peat inoculant in T9905 in south-central MB

Dry Bean Nitrogen Fertility

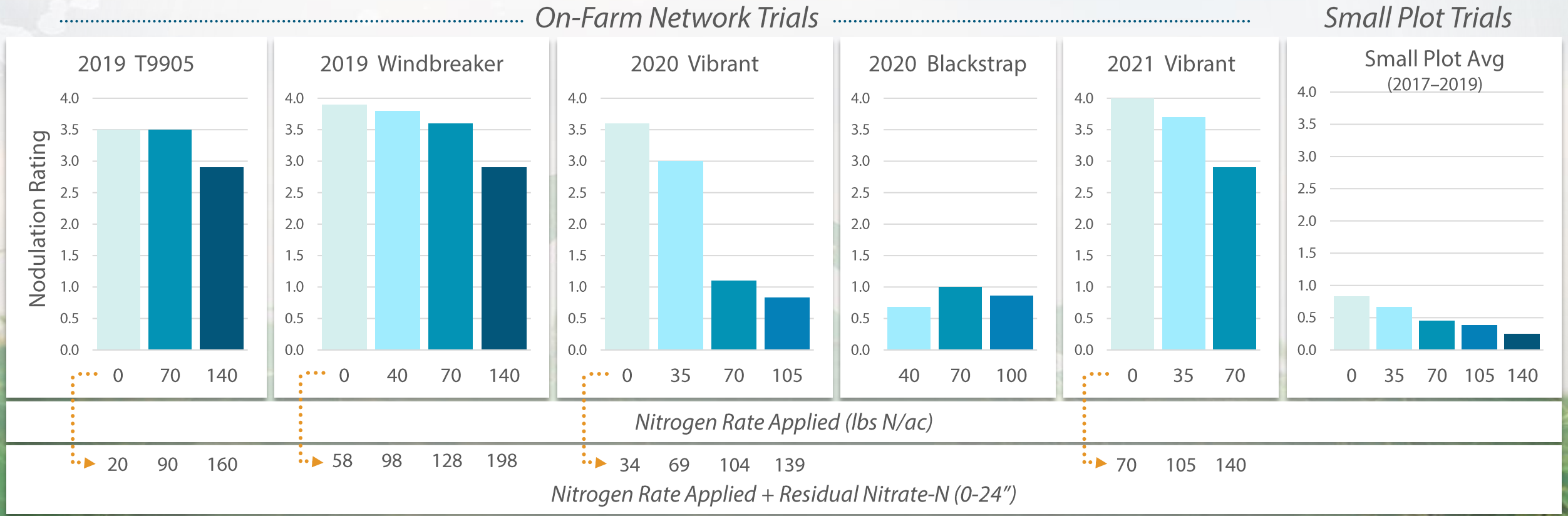
Small-Plot Trials in Western Manitoba

Fertilizer Trials – New Western Trials!

- Narrow-row trials started in 2021 at Carberry, Melita and Brandon:
- Testing rates of N, with and without inoculant
- Testing rates of P, seed-placed vs. side-banded

Dry Bean Nodulation

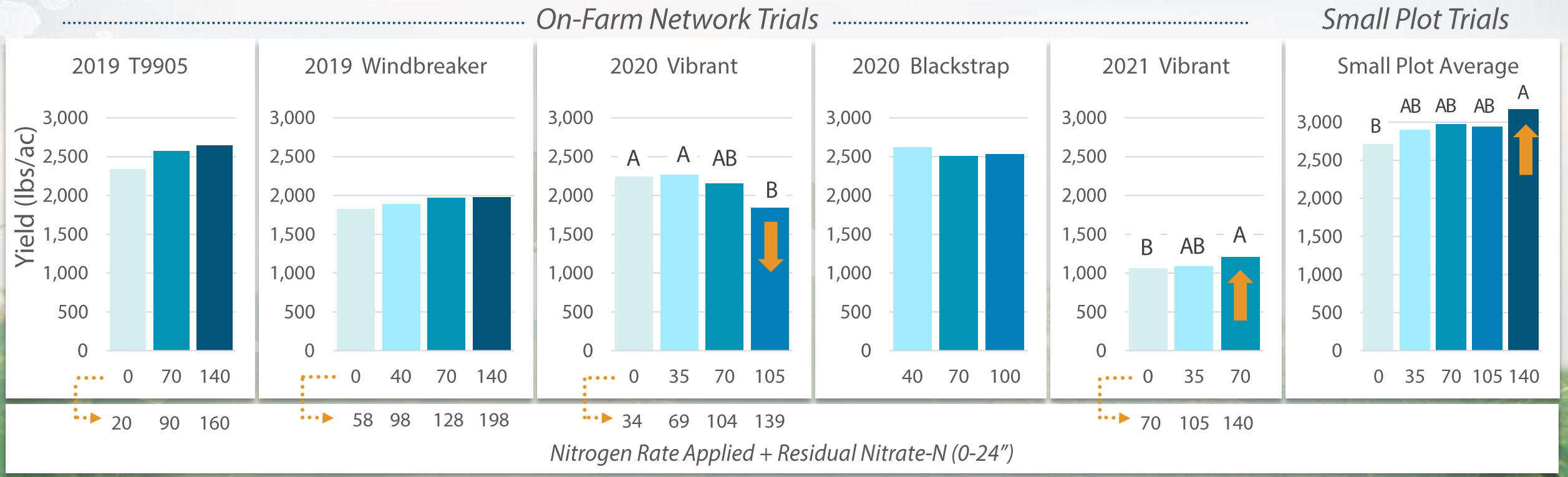
- Fertilizer trials have not been inoculated, yet often have good to excellent nodulation in on-farm trials
- As N rate increases, nodulation decreases



Dry Bean Yield Response to N

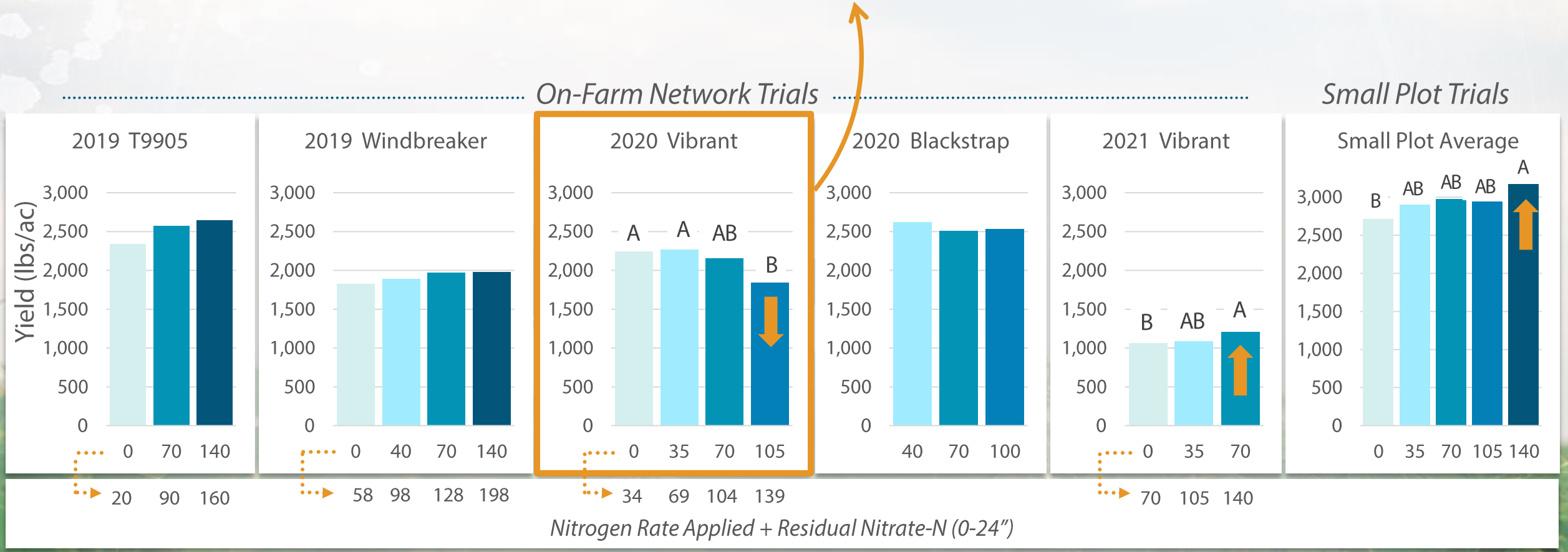
On-Farm Trials

- Three trials where yield did not respond to N rate
- Two, opposite yield responses



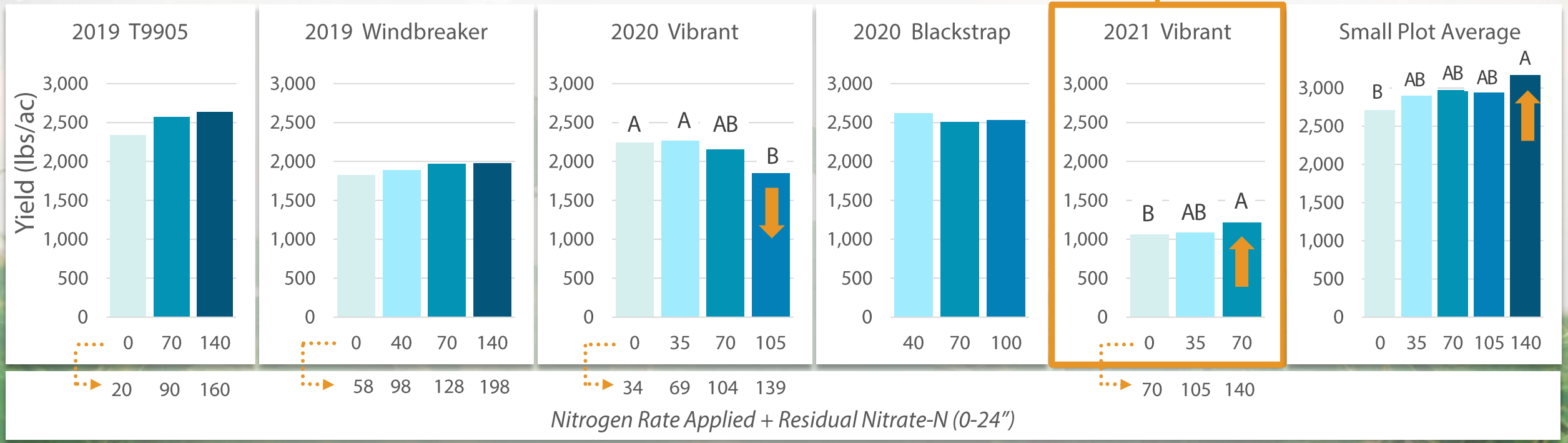
Dry Bean Yield Response to N

- Yield decreased at the highest N rate of 105 lbs N applied/ac
- Prolonged vegetative growth and delayed maturity



Dry Bean Yield Response to N

- Yield increased at the highest N rate of 70 lbs N applied/ac
- Visible differences in plant vigour and maturity
- Mineralized-N expected to have played less of a role in this drought year, and the crop was relying on fertilizer-N and BNF-N



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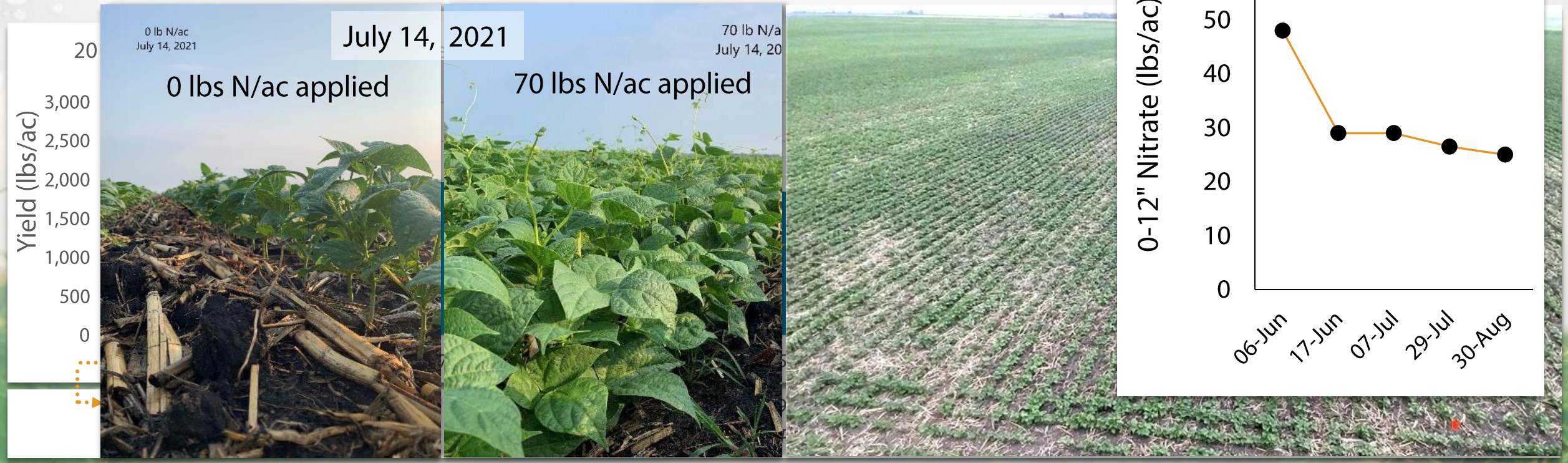
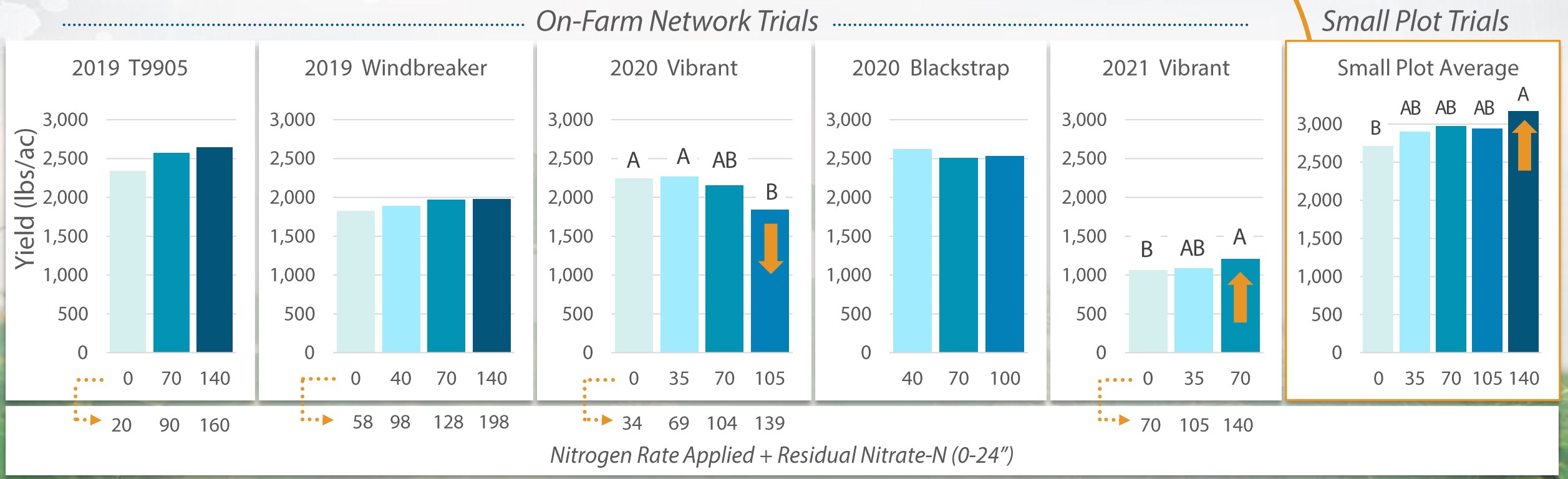


Dry Bean Yield Response to N

Small Plot Trials

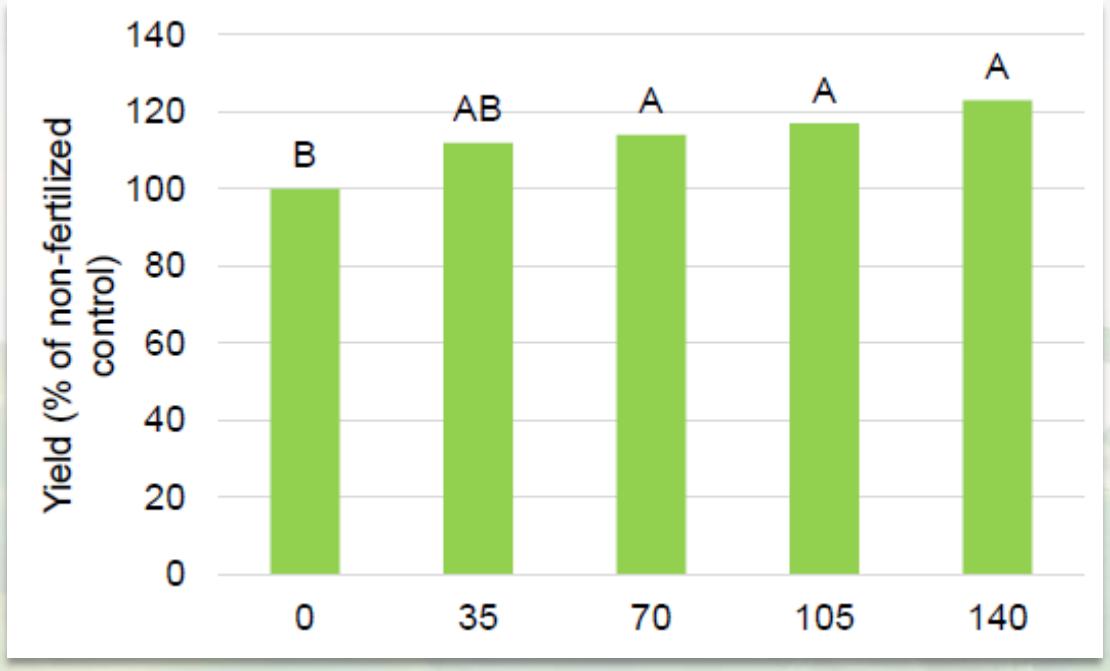
- Yield increased at the highest N rate of 140 lbs N applied/ac



Dry Bean Yield Response to N

Small Plot Trials at the Soybean and Pulse Agronomy Lab

- Yield as a percent of the non-fertilized control as a tool to reduce environmental variability in the data
- Yield was maximized at the lowest rate of N applied (35 lbs N/ac)
  - *which was 60 to 90 lbs total N/ac (N applied + soil residual N)*

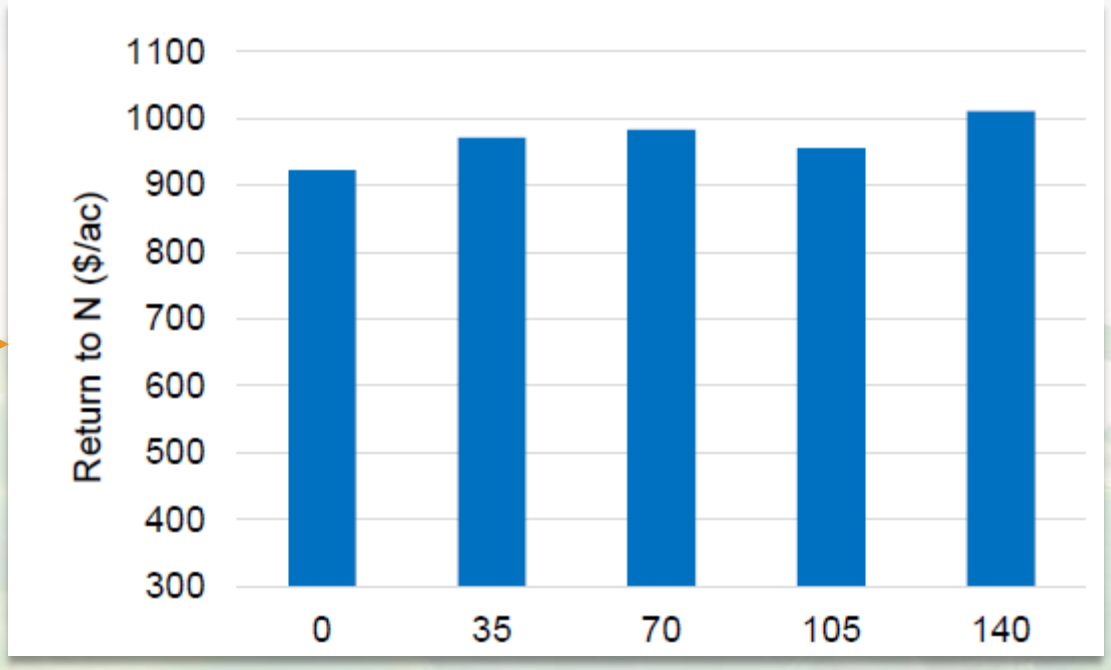


Source: MacMillan 2020

Dry Bean Yield Response to N

Small Plot Trials at the Soybean and Pulse Agronomy Lab

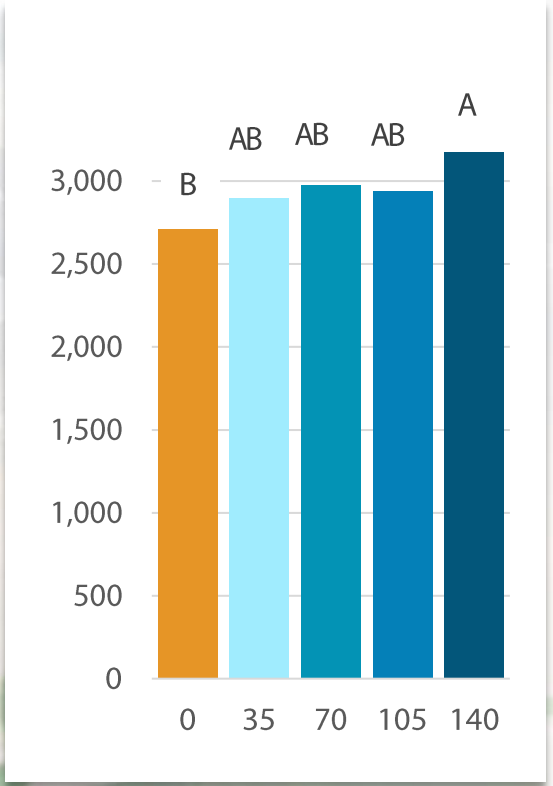
- Return on investment ($/ac)
  - *(Yield x Price) – (N rate x Cost of N)*
  - Statistically the same for all rates of N application, meaning the economic optimum rate was 0 lbs N/ac



Source: MacMillan 2020

Dry Bean Yield Response to N

Small Plot Trials at the Soybean and Pulse Agronomy Lab



- Total N uptake in the 0N treatment was estimated to be ⋯→ 64 to 169 lbs N/ac
- Total N supply from residual soil-N ⋯→ 23 to 56 lbs N/ac
- Resulting in an N deficit of ⋯→ 8 to 131 lbs N/ac
- *Post-harvest residual nitrate-N in 0N* ⋯→ *19 to 59 lbs N/ac*

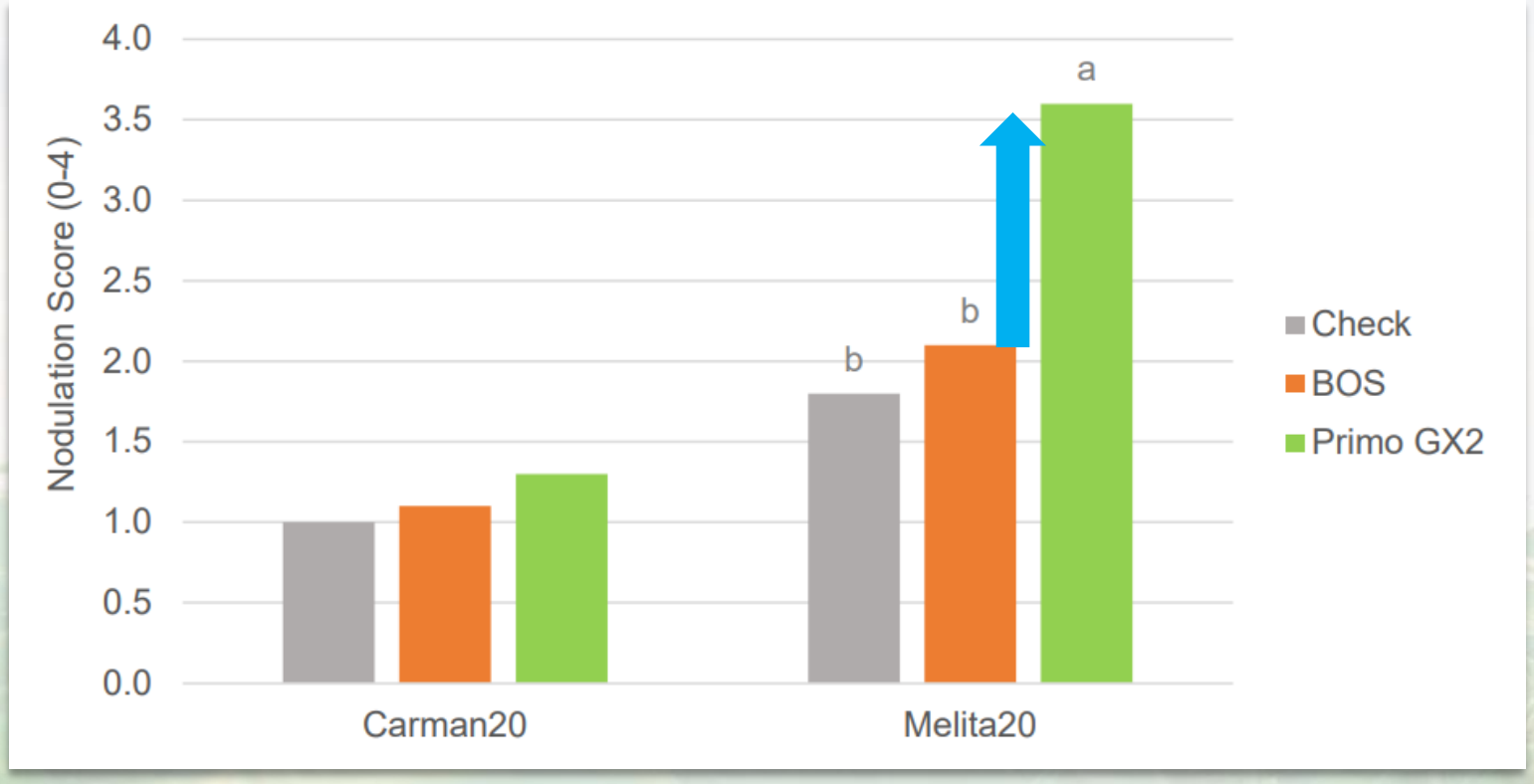
- This surplus post-harvest indicates that nitrogen was acquired through other processes like BNF, mineralization, deep nitrogen (>24”) or a combination thereof.

Source: MacMillan 2020

Dry Bean Inoculant

Small Plot Trials at the Soybean and Pulse Agronomy Lab

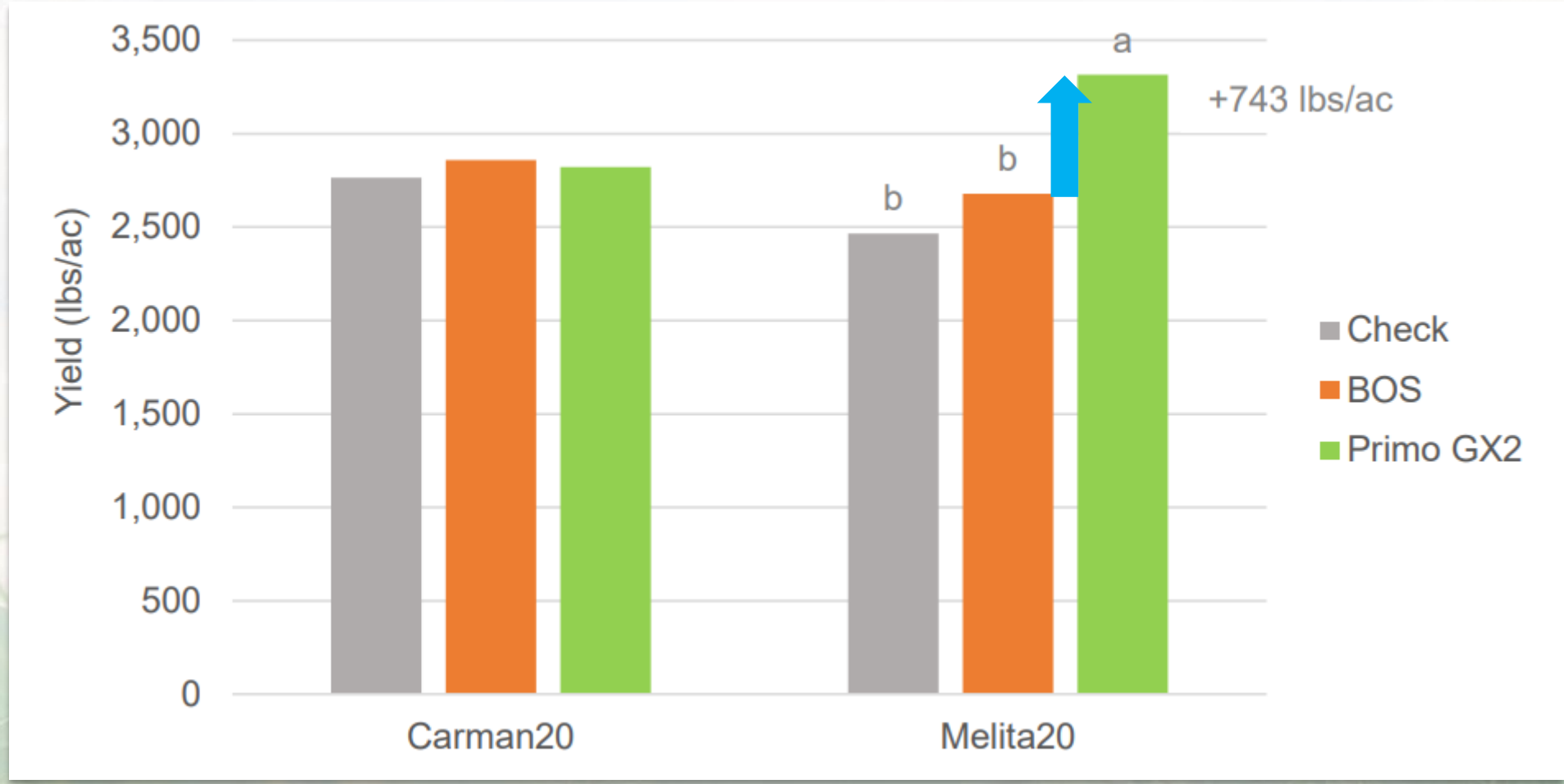
- Two inoculants containing *Rhizobium leguminosarium* biovar *phaseoli* (*BOS* peat and *Primo GX2* granular) evaluated in Windbreaker, T9905 and Eclipse beans at Carman and Melita



Source: MacMillan 2020

Dry Bean Inoculant

Small Plot Trials at the Soybean and Pulse Agronomy Lab



Source: MacMillan 2020

Dry Bean Inoculant

On-Farm Network Trial

- BOS peat inoculant vs. untreated in T9905 navy beans in 2019
- 14 years since last dry bean crop

	BOS Peat Inoculant	Untreated
Nodulation Rating at R1	3.4	3.6
Yield (lbs/ac)	1514	1516

Dry Bean Nitrogen Fertility

Emerging Guidelines

1. No supplemental N, no inoculation
   - Expect 86-93% of maximum yield
   - Economic optimum in the small-plot research and at 4 of 5 on-farm trials
2. Supplemental N at 35 lbs N/ac or to reach 70 lbs total N (including soil residual N)
   - If skipping N fertilizer is too risky
   - Reach maximum yield without reducing nodulation
3. Inoculation
   - As product availability and testing increases
4. Inoculation and supplemental N?
   - *Needs research first*

Source: MacMillan 2020

Where to find more information?

on-farm network

research reports

results database

manitobapulse.ca/on-farm-network

@MBPulseGrowers