Solid-Seeded Dry Bean Research

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Irrigated Crop Production Update – January 21 & 22, 2014

Government of Alberta
Agriculture and Rural Development

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- **Viterra**

Thank You!

Dry Bean History

- **Irrigated crop grown since the early 1970's.**
- **Alberta Acreage - 45,000 – 50,000 acres annually. Average yield 2300 lbs/ac.**
- **Contributes approximately 60 million dollars into the economy. Second highest valued irrigated crop on per acres basis.**
- **Excellent rotational crop.**
- **Traditionally grown in wide row spacing of 22" - 30".**

Dry Bean Varieties

- **Alberta acreage comprised of five main varieties:**

Pinto

Great Northern

Reds

Yellow

Blacks

Traditional Wide Rows 22” – 30”

Solid Seeded Bean Production

Advantages to Solid-Seeded Beans

- **Potential for increased yield.**
- **Potential to increase and stabilize acres.**
- **Improved soil quality.**
- **Reduce dirt and dirt tag at harvest.**
- **Reduce specialized row crop equipment and reduce field operations.**

Challenges to Solid-Seeded Dry Beans

1. Equipment

2. White Mold Potential – early canopy, higher humidity……

7”

14”

28”

July 5th, 2013

Experiment 1

- **Varieties (2)**
- **Row Spacing (3)**
- **Seeding Rate (4)**

Experiment 1 Overview
Row Spacing x Seeding Rate x Variety


Winchester


AC Resolute

Varieties
- **Pinto - Winchester**
- **Great Northern – AC Resolute**

Row Spacing
- **18, 36 (narrow) and 70 (conventional) cm**
- **7, 14 and 28 inches**

Seeding Rate
- **for each variety at each row spacing seeded at 10, 25, 40 and 55 seeds/m^2**

Replication
- **Four**

Fertilizer application
- **Blanket rates of pre-banded N at 100 kg/ha and P_2O_5 at 20 kg/ha.**

Seedbed Utilization

- **The percentage of the seedbed that is occupied by seed.**
- **The narrower the row spacing the greater the seedbed utilization.**
- **By increasing seedbed utilization in dry bean production there may be many <u>potential benefits.</u>**
  - **- reduced in-the-row plant competition.**
  - **- increased N use efficiency.**
  - **- increased water use efficiency.**
  - **- reduced irrigation run-off.**

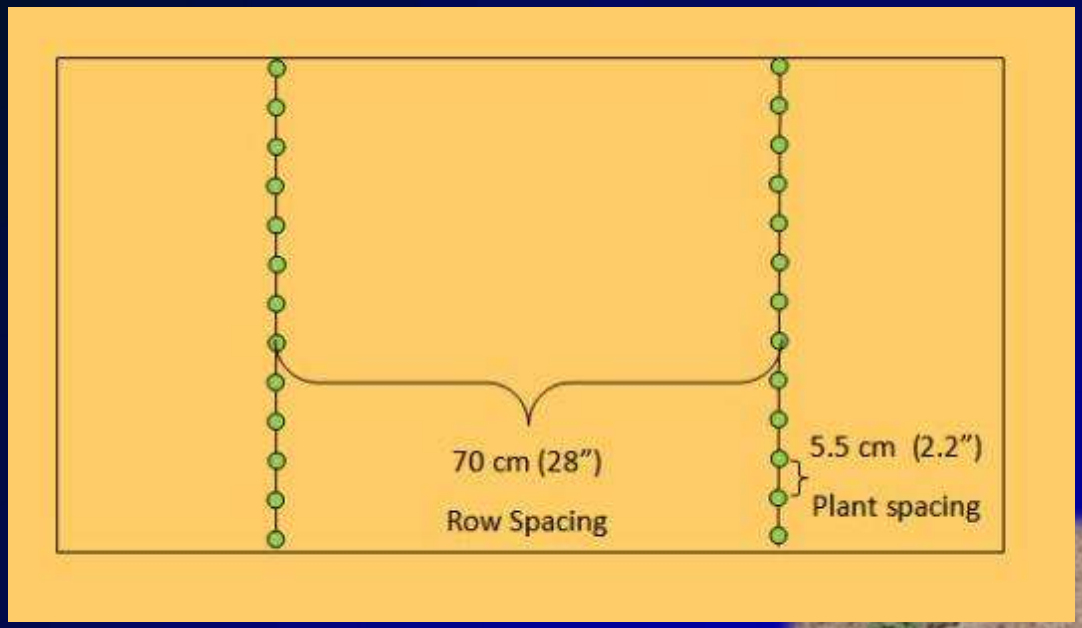
Seedbed Utilization and Agronomics

- **Increasing seedbed utilization leads us to question many agronomic factors.**

- **What is the optimal:**
  - **- seeding rate?**
  - **- row spacing?**

How does seedbed utilization impact:
- **- fertilizer management?**
- **- disease mitigation?**

Row Spacing X Seed Rate

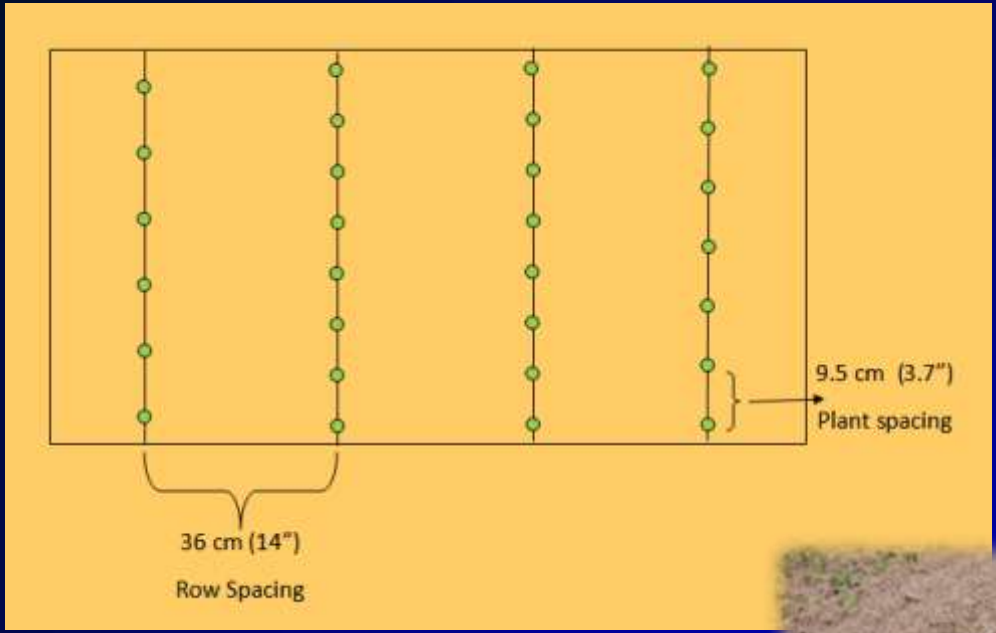


- **70 cm (28") row spacing at 25 plants / m^2**

- **"Tight" plant spacing in the row – 5.5 cm (2.2")**
- **"Low" seedbed utilization**

\+ **"Better" emergence in crusted soil conditions?**

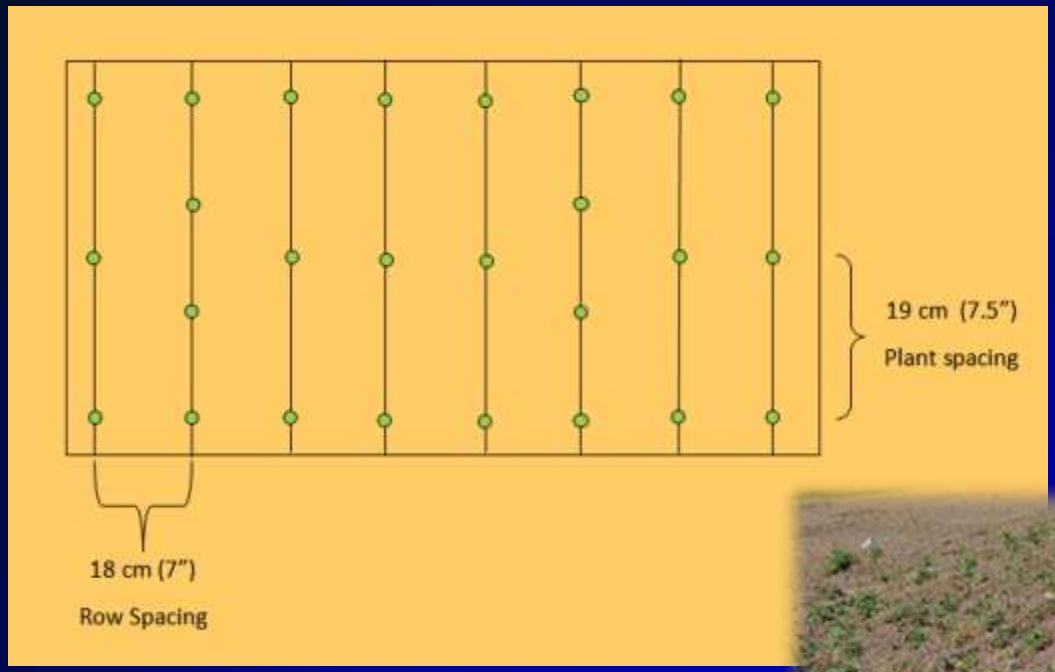
Row Spacing X Seed Rate



- **36 cm (14") row spacing at 25 plants / m^2**

- **Slightly greater plant spacing in the row – 9.5 cm (3.7")**
- **Better seedbed utilization**

Row Spacing X Seed Rate



- **18 cm (7") row spacing at 25 plants / m^2**

- **Greater plant spacing in the row – 19 cm (7.5")**
- **Greater seedbed utilization**
- **Emergence issues in crusted soil?**

Row Spacing X Seed Rate

40 seeds/m2

28” spacing

June 21, Bow Island

Row Spacing X Seed Rate

40 seeds/m2

14” spacing

June 21, Bow Island

Row Spacing X Seed Rate

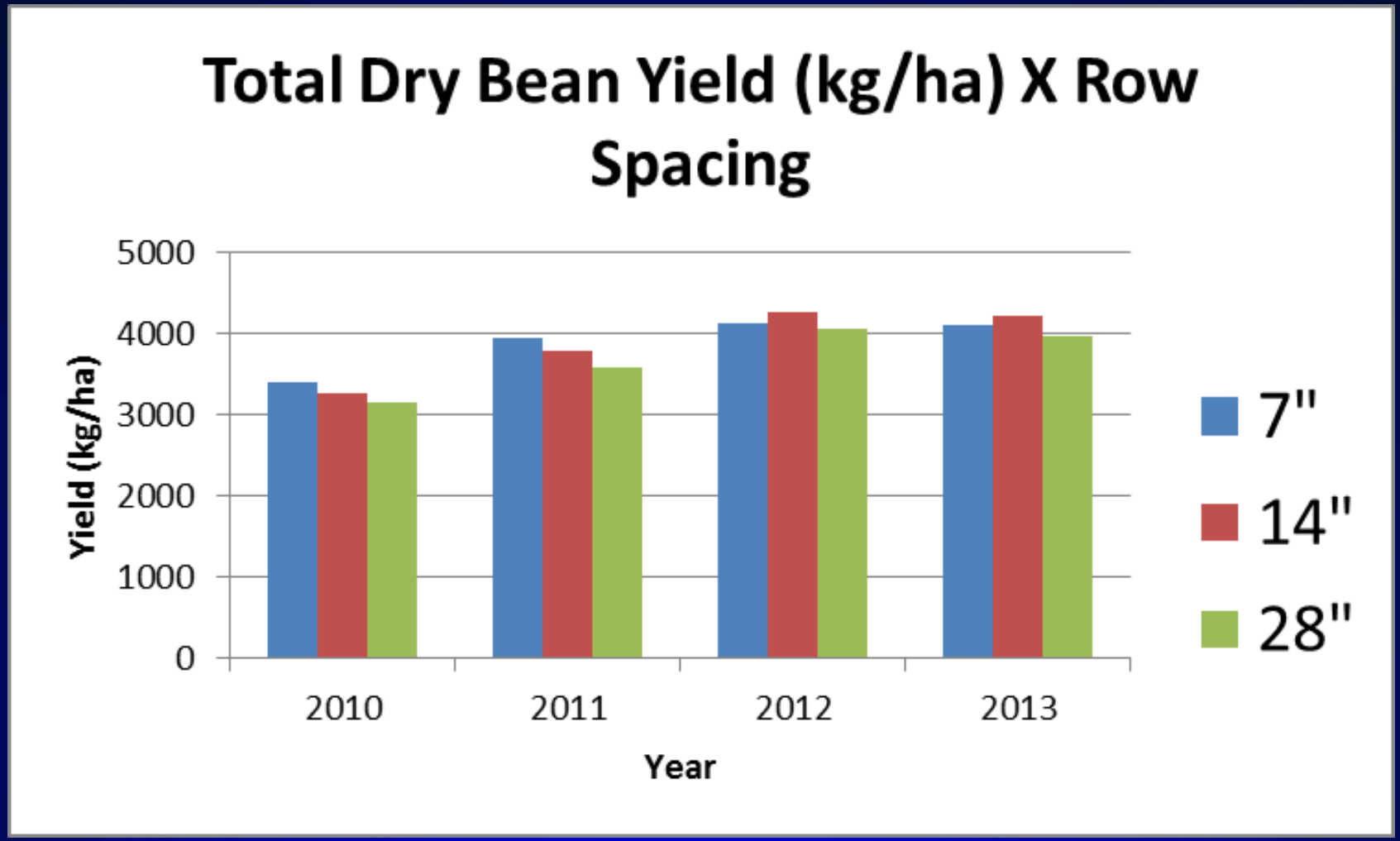
40 seeds/m2

7” spacing

June 21, Bow Island

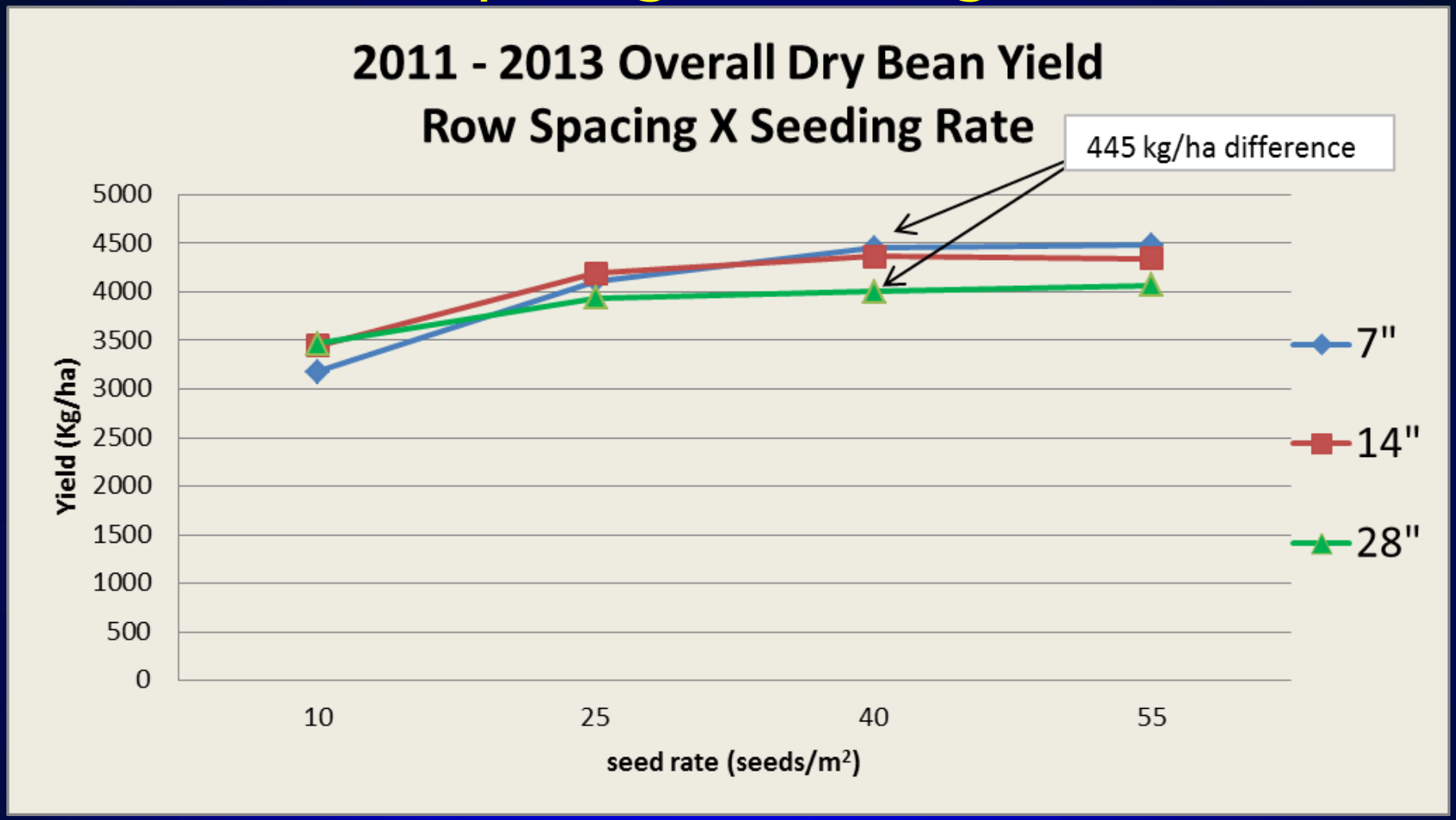
EXP. 1 RESULTS

2010-13 Overall Bean Yield X Row Spacing



Narrow row - significantly greater yield in 6 out of 12 site years.
Narrow rows - tendency of increased yield in an additional 2 out of 12 site years.

2011-2013 Average Yield
Row Spacing X Seeding Rate



- **Seeding rate yield difference in 7 out of 9 sites years.**

Experiment 2a

- **N Fertilizer Rate (4)**
- **Inoculant vs No Inoculant (2)**

Experiment 2a Overview
Nitrogen Fertilizer Management

Varieties - 1

- **Pinto - Winchester**

Seeding Rate and Row Spacing - 1

- **45 seeds/m^2 at 7 in row spacing**

Experiment 2a – Inoculant Treatments – 8

- **N rate 0, 30, 60 and 90 kg N/ha.**
  0, 27, 53 and 80 lb N / ac.
- **With and without inoculant.**

Expermental Design

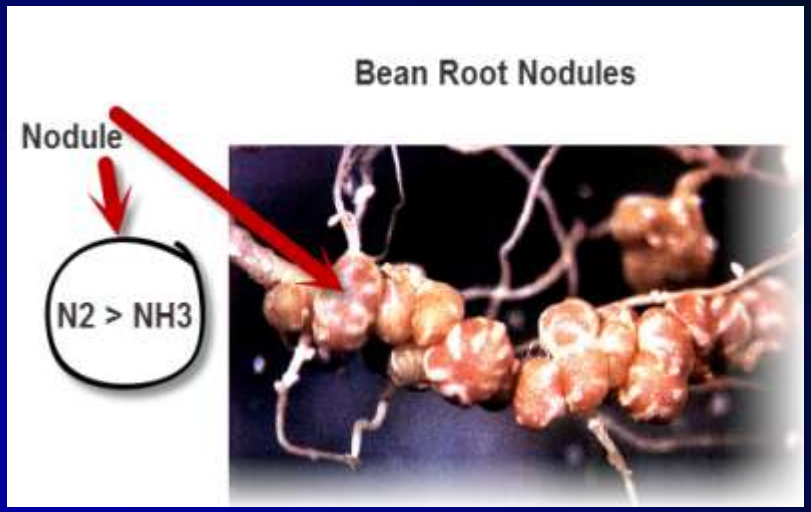
- **4 reps**

Nitrogen Fixation Process

Rhizobia bacterium (innoculant) invades the root hairs of the bean plant.

Cortex cells begin to multiply using nutrients and energy from the plant.

Forms visible nodule in 2-3 weeks after seeding.



Within the nodules the bacteria convert or fix inert atmospheric N2 into NH3 (ammonia).

The legume (bean) then has the ability to absorb the NH3 into the plant.

N Fixating Ability
Alberta's Annual Legume Crops

Most Efficient

Least Efficient

Faba Beans

Field Peas

Lentils

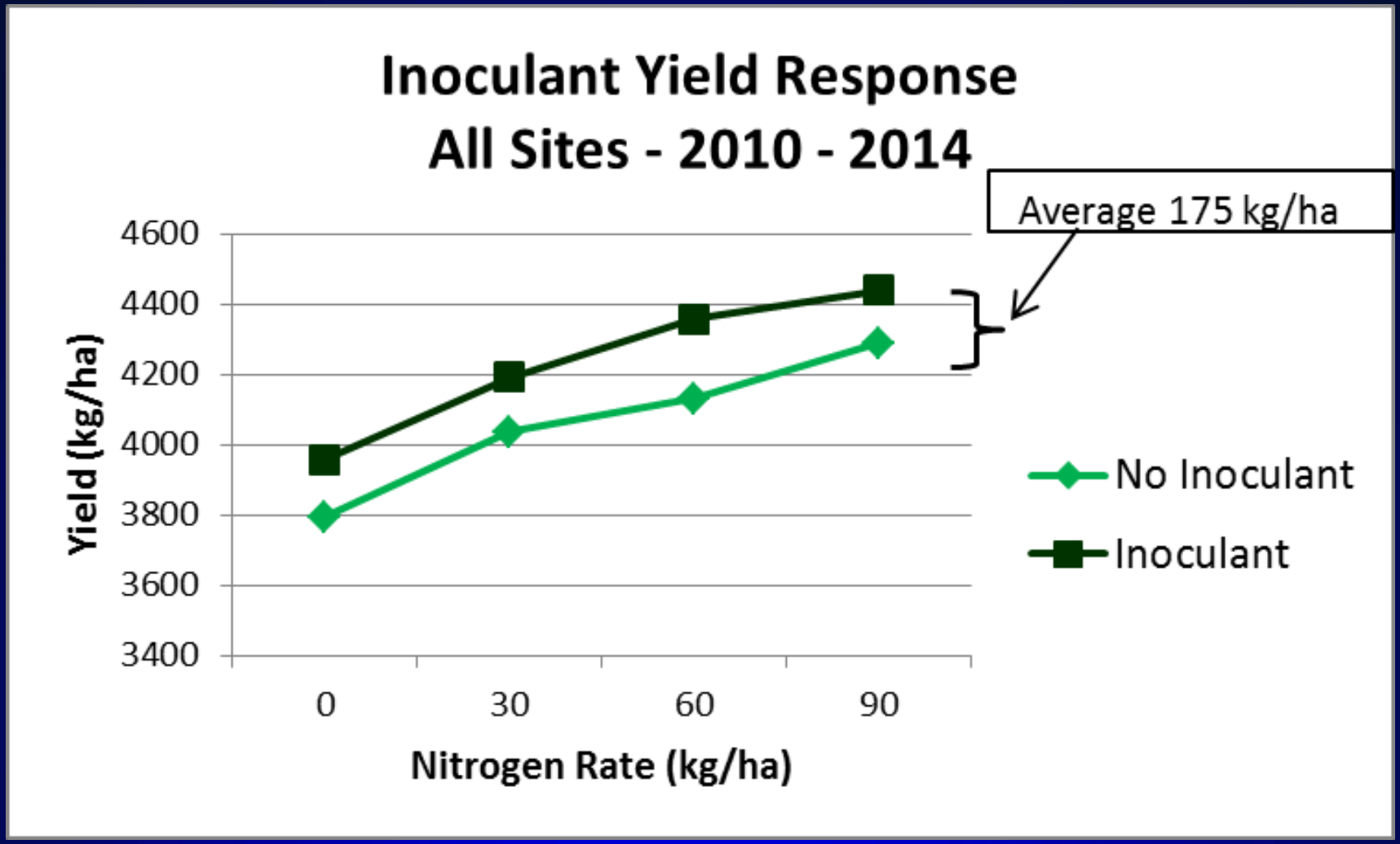
Dry Beans

Nodulation performance sensitive to:

- Genotype of host plant
- Rhizobial strain
- Environmental stresses
  - Drought
  - High temperature
  - Soil nutrient levels

EXP. 2a RESULTS

Innoculant Yield Results



- **There was a yield increase (significant or strong tendency) in 50 % of site years.**

Experiment 2b

- **N Fertilizer Form (2)**
- **N Fertilizer Rate (6)**
- **Split N application (2)**

Experiment 2b Overview
Nitrogen Fertilizer Management

Varieties (1), Seeding Rate (1) and Row Spacing(1)

- **Innoculated Pinto - Winchester - 45 seeds/m^2**
- **7 in row spacing**

Experiment 2b N Treatments - 16

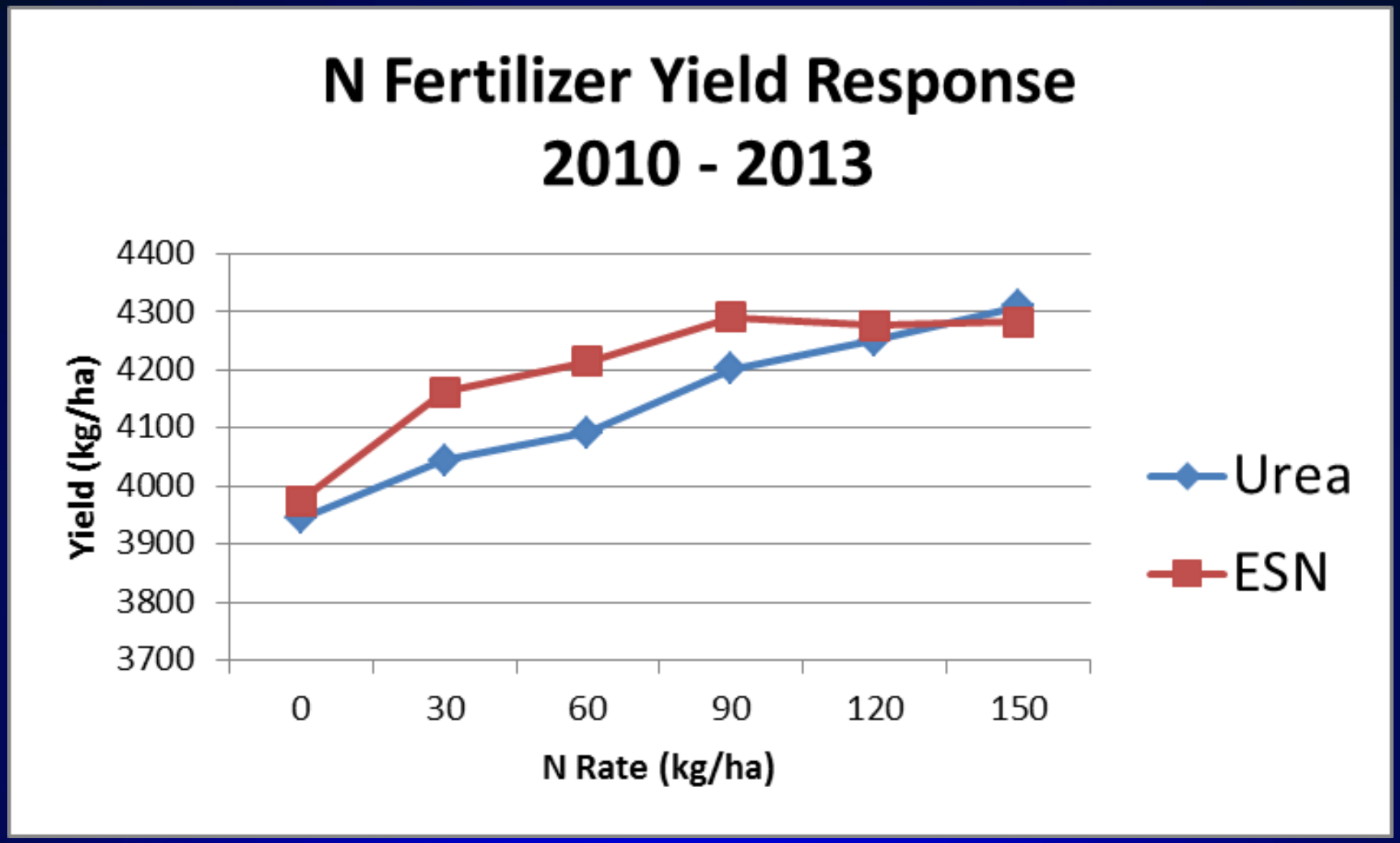
- **Urea and ESN fertilizer types side banded at:**
- **0, 30, 60, 90, 120 and 150 kg N/ac**
- **0, 27, 53, 81, 107 and 134 lbs/ac**
- **Split application - 60 and 90 kg N/ha urea applied at seeding + 30 kg N/ha in-crop urea applied before flowering**
- **Total of 14 nutrient management treatments.**
- **Rate of P_2O_5 at 30 kg/ha pre banded.**

Expermental Design

- **4 reps**

EXP. 2b RESULTS

Nitrogen Rate / Form Results

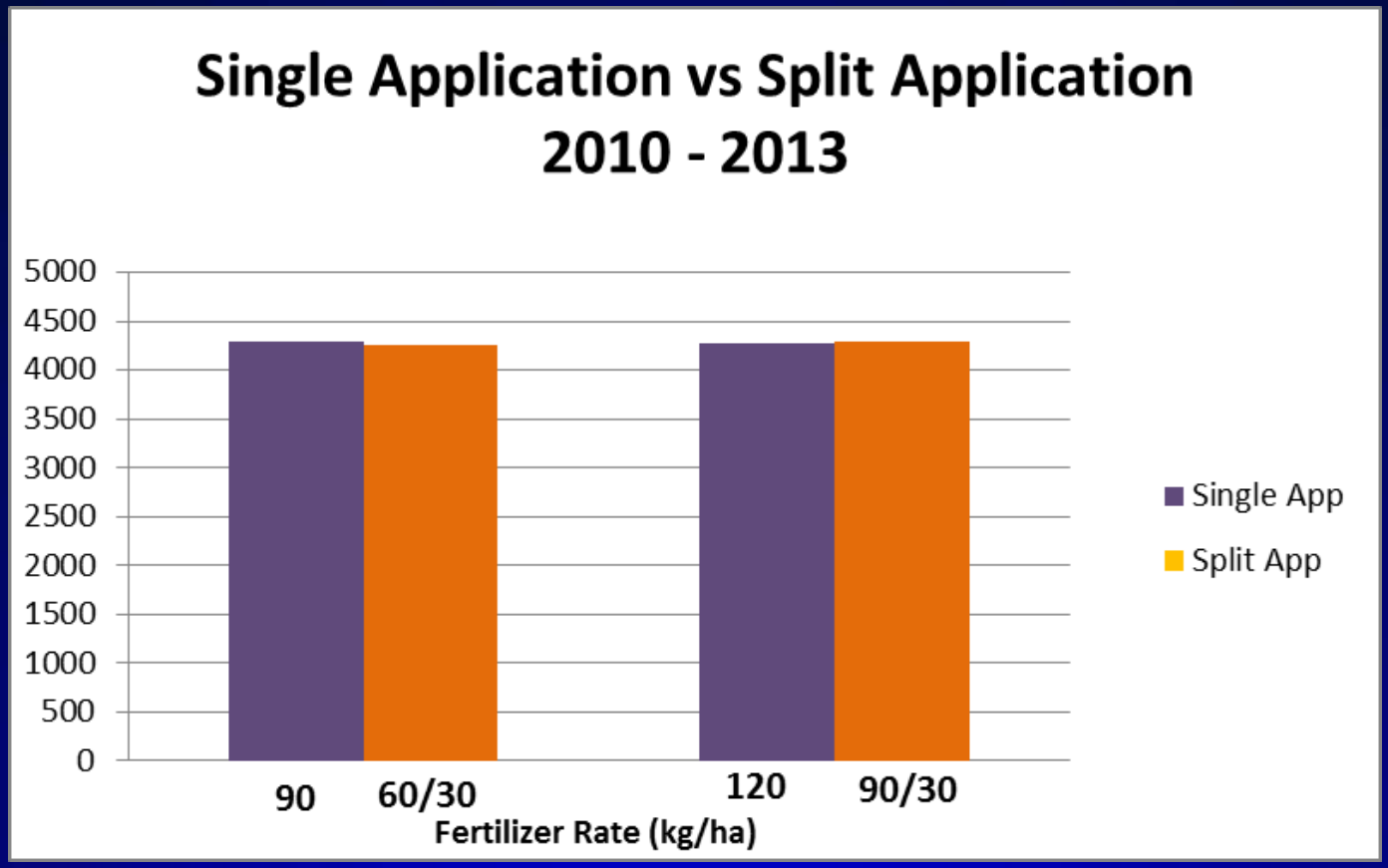


N fertilizer (Yield)

Rate - Difference (5) or tendency (3) in 8 out of 12 site years.

Form – Difference (1) or tendency (5) in 6 out of 12 sites.

In Crop N Yield Results



- **No difference or tendency in any of the site years as compared to the single-application counterpart.**
- **In crop N application timing is critical.**

Solid-Seeded Dry Bean Seeding Rate and Fertilizer Recommendations

- **Narrow row treatments yielded greater than wide rows in 50% of the site years (average of 200kg/ha greater).**
- **Applying rhizobium (innoculant) has resulted in a significant yield increase (average 175 kg/ha).**
- **Increased seedbed utilization (solid-seeded production) requires increased crop inputs!**
- **Our 4 years research indicates that narrow row bean production requires approximately:**
  - **50 - 60 % more seed than wide row bean production.**
  - **20% more fertilizer than wide row bean production.**

Project Team

- **Ross McKenzie, Doon Pauly, Pat Pfiffner, Allan Middleton,** Agronomy, Research Div. ARD, Lethbridge
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- **Parthiba Balasubramanian**, Agriculture and Agri-Food Canada
- **Eric Bremer**, Symbio Ag Consulting
- **Blair Roth & staff,** Viterra

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Thank You!

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