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DEMONSTRATING FERTILITY PRACTICES TO MANAGE CHICKPEA MATURITY AND EARLY DISEASE RESISTANCE

ADOPT Final Report

1. Project Identification

Project Number: ADOPT #20200497
Location(s): Swift Current, RM 137.
Project start and end dates: (April 2021- February 2022)
Project contact person & details: Bryan Nybo, wcanybo@sasktel.net

2. Objectives and Rationale

Using fertility management tools, we intend to demonstrate to producers how to speed up chickpea maturity without sacrificing yield, and at the same time show producers how to get the crop off to a strong start so the plant is better equipped to resist early disease infestation.

Project Rationale:

Research done at AAFC in Swift Current has demonstrated that under proper conditions, vegetative growth and maturity can be induced early in the growing season by applying increased nitrogen fertilizer rates to inoculated chickpeas (Gan, 2007). The research suggests that applying increased nitrogen rates rather than inoculant promotes an early pod set and accelerated crop maturity. Although insignificant differences were noted in dry years, nitrogen applied at 50lbs/ac without inoculant lead to earlier maturity by 13 days in normal and wet seasons. It was also noted that chickpeas utilizing nitrogen from fertilizer sources were better equipped to fight early disease pressure compared to inoculated chickpeas since the plant does not need to expel energy required to nodulate, as would be the case in a nitrogen fixation system.

Saskatchewan Agriculture recommends applying higher rates of starter nitrogen away from the seed and without inoculant allowing plants to develop a more vigorous vegetative growth, while restricting available soil nutrients and water later in the season. Conversely, excessive amounts of nitrogen available in the soil delayed the onset of maturity. It was found that later maturing cultivars responded more significantly than earlier maturing cultivars.

Since Chickpeas have a long growing season, the biggest challenge for producers has been getting the crop to mature before late season frost occurs. Chickpeas are very susceptible to these late season frosts that have the potential to drastically downgrade the harvest sample. Speeding up chickpea maturity not only benefits producers in traditional chickpea areas in years when frost comes early in the fall, but it may also benefit producers outside of traditional chickpea growing regions that are interested in an intercrop or are limited by frost free days at harvest. However, sourcing nitrogen from fertilizer sources rather than through nitrogen fixation comes at an increased cost to producers. Applying different rates of fertilizer N with or without inoculant and using a high yielding early maturing Kabuli variety compared to a later maturing variety will demonstrate to producers how to avoid production limitations by reducing the days to maturity and risk.

Gan, Y., et al. "Promoting chickpea maturity through fertility management." Soils and Crops Workshop. 2007. https://harvest.usask.ca/bitstream/handle/10388/9405/Y.%20Gan%20et%20al.%2C%202007d.pdf?sequence=1&isAllowed=y

3. Methodology and Results

This project was set up on cereal stubble at our main site near Swift Current. Seeding was completed on May 19th when soil temperatures were around 10 degrees Celsius. Two varieties were seeded, one late maturing variety, CDC Orion, and one earlier maturing variety, CDC Leader. Each treatment received a side banded application of 90 lbs/ac MAP to ensure phosphorous levels were not limiting. Urea was then added at 0N, 15N, 40N, and 65N to bring total N from the urea and MAP to 10N, 25N, 50N, and 75N. Each fertility treatment was applied with, or without 5 lbs/ac of granular chickpea inoculant. The project was replicated 4 times.

Treatment list as follows:

Trt#	Variety	Total N (lbs/ac)	5lbs/ac Inoculant
1	Orion (or other L maturing variety)	10	yes
2	Orion (or other L maturing variety)	10	no
3	Orion (or other L maturing variety)	25	yes
4	Orion (or other L maturing variety)	25	no
5	Orion (or other L maturing variety)	50	yes
6	Orion (or other L maturing variety)	50	no
7	Orion (or other L maturing variety)	75	yes
8	Orion (or other L maturing variety)	75	no
9	Leader	10	yes
10	Leader	10	no
11	Leader	25	yes
12	Leader	25	no
13	Leader	50	yes
14	Leader	50	no
15	Leader	75	yes
16	Leader	75	no

Data Collection:

1. Spring soil test to determine residual nutrients.

2. Nodulation assessment @ early flower (SPG Assessment Guide) https://saskpulse.com/files/general/150521_Nodulation_and_Nitrogen_Fixation_Field_Assessment_Guide.pdf

3. Days to Maturity (once/week when plants begin to turn colour)

4. Disease Rating

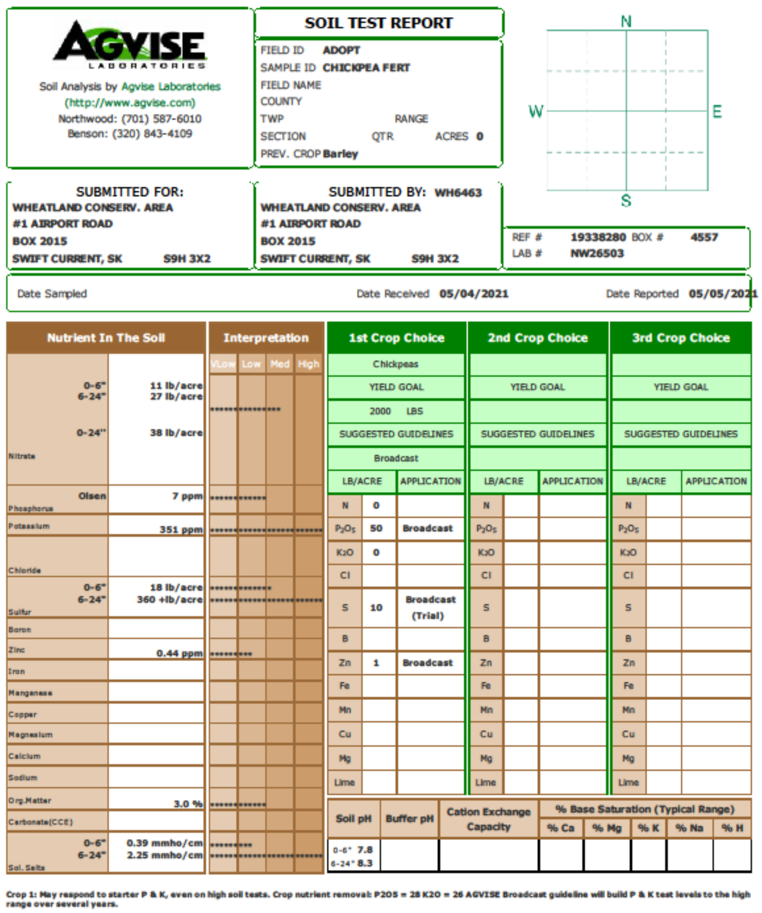
5. Yield

6. Grade

Results:

Soil samples were taken and show relatively low levels (11 lbs/ac) of residual nitrogen at 0-6-inch depths where nodulation is initiated (Fig. 1). Soil analysis also showed there was an additional 27 lbs/ac at a depth of 6-24 inches. These levels of soil N fall within acceptable levels to initiate nodulation and not interfere with the treatment responses.

Fig.1 Agvise Soil Analysis Results



AGVISE LABORATORIES
Soil Analysis by Agvise Laboratories
(http://www.agvise.com)
Northwood: (701) 587-6010
Benson: (320) 843-4109

SOIL TEST REPORT
FIELD ID ADOPT
SAMPLE ID CHICKPEA FERT
FIELD NAME
COUNTY
TWP RANGE
SECTION QTR ACRES 0
PREV. CROP Barley

SUBMITTED FOR:
WHEATLAND CONSERV. AREA
#1 AIRPORT ROAD
BOX 2015
SWIFT CURRENT, SK S9H 3X2

SUBMITTED BY: WH6463
WHEATLAND CONSERV. AREA
#1 AIRPORT ROAD
BOX 2015
SWIFT CURRENT, SK S9H 3X2

REF # 19338280 BOX # 4557
LAB # NW26503

Date Sampled Date Received 05/04/2021 Date Reported 05/05/2021

Nutrient In The Soil		
Nitrate	0-6" / 6-24"	11 lb/acre / 27 lb/acre
	0-24"	38 lb/acre
Phosphorus	Olsen	7 ppm
Potassium		351 ppm
Chloride		
Sulfur	0-6" / 6-24"	18 lb/acre / 360 +lb/acre
Boron		
Zinc		0.44 ppm
Iron		
Manganese		
Copper		
Magnesium		
Calcium		
Sodium		
Org.Matter		3.0 %
Carbonate(CCE)		
Sol. Salts	0-6" / 6-24"	0.39 mmho/cm / 2.25 mmho/cm

Interpretation: VLow, Low, Med, High

1st Crop Choice: Chickpeas, YIELD GOAL 2000 LBS, SUGGESTED GUIDELINES, Broadcast	LB/ACRE	APPLICATION
N	0	
P_2O_5	50	Broadcast
K_2O	0	
Cl		
S	10	Broadcast (Trial)
B		
Zn	1	Broadcast
Fe		
Mn		
Cu		
Mg		
Lime		

2nd Crop Choice: YIELD GOAL, SUGGESTED GUIDELINES
3rd Crop Choice: YIELD GOAL, SUGGESTED GUIDELINES

Soil pH	Buffer pH	Cation Exchange Capacity	% Ca	% Mg	% K	% Na	% H
0-6" 7.8 / 6-24" 8.3							

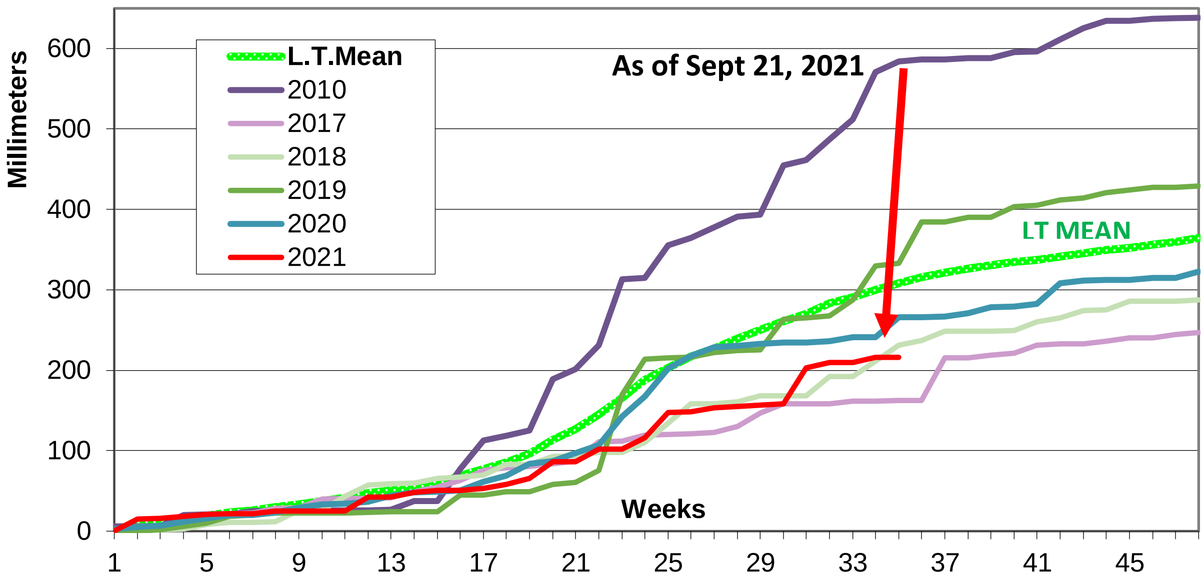
Crop 1: May respond to starter P & K, even on high soil tests. Crop nutrient removal: P2O5 = 28 K2O = 26 AGVISE Broadcast guideline will build P & K test levels to the high range over several years.

Weather had a significant effect on this trial in 2021 and had an overshadowing effect on our treatment response with regards to spring nodulation and fall maturity. Mean temperatures in June and July were more than 3 degrees C higher than average and precipitation for May, June, and July was 54% of the long-term average for Swift Current (Fig. 2). Under these conditions, inoculants were not effective in the spring and crops senesced and matured early in the fall which took away from the applied treatments in this trial.

Fig. 2. Monthly Mean Temperatures and Precipitation, Swift Current.

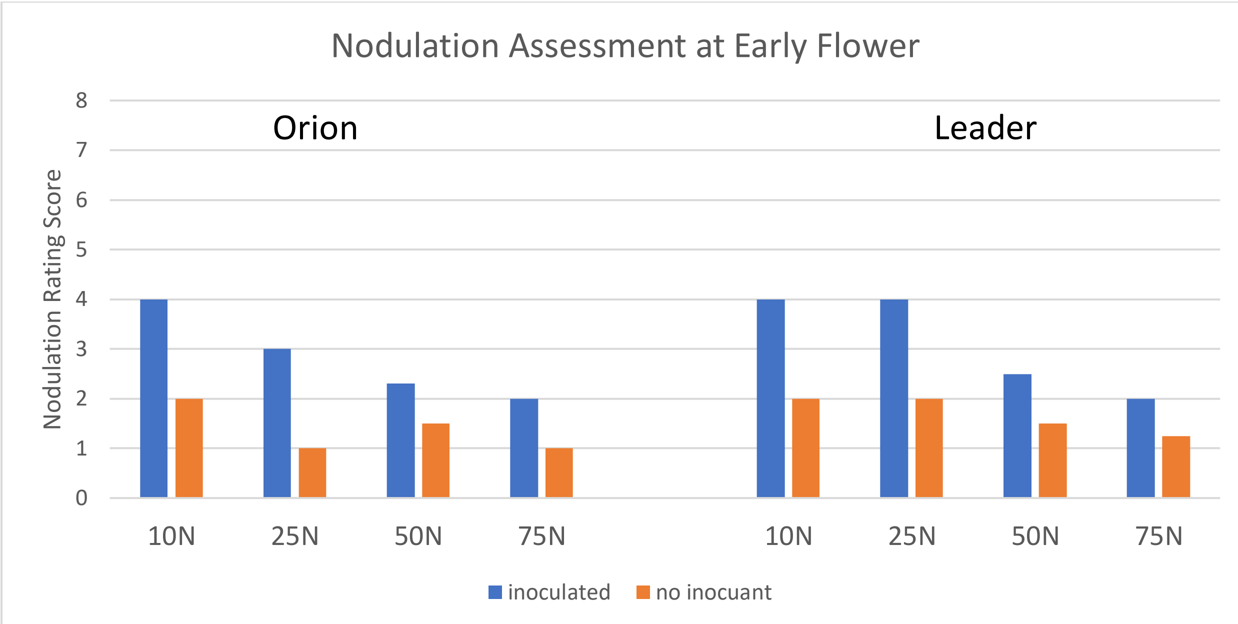
Location	Year	May	June	July	August	Avg. / Total
		-------------*Mean Temperature (°C)* -------------------				
Swift Current	2021	9.5	18.4	21.7	18	16.9
	Long-term	**10.9**	**15.3**	**18.2**	**17.6**	**15.5**
		---------------- *Precipitation (mm)* ---------------------				
Swift Current	2021	35	29.6	38.9	55.8	159
	Long-term	**51.2**	**77.1**	**60.1**	**47.4**	**236**

Accumulative Weekly Precipitation for Years 2010...2021



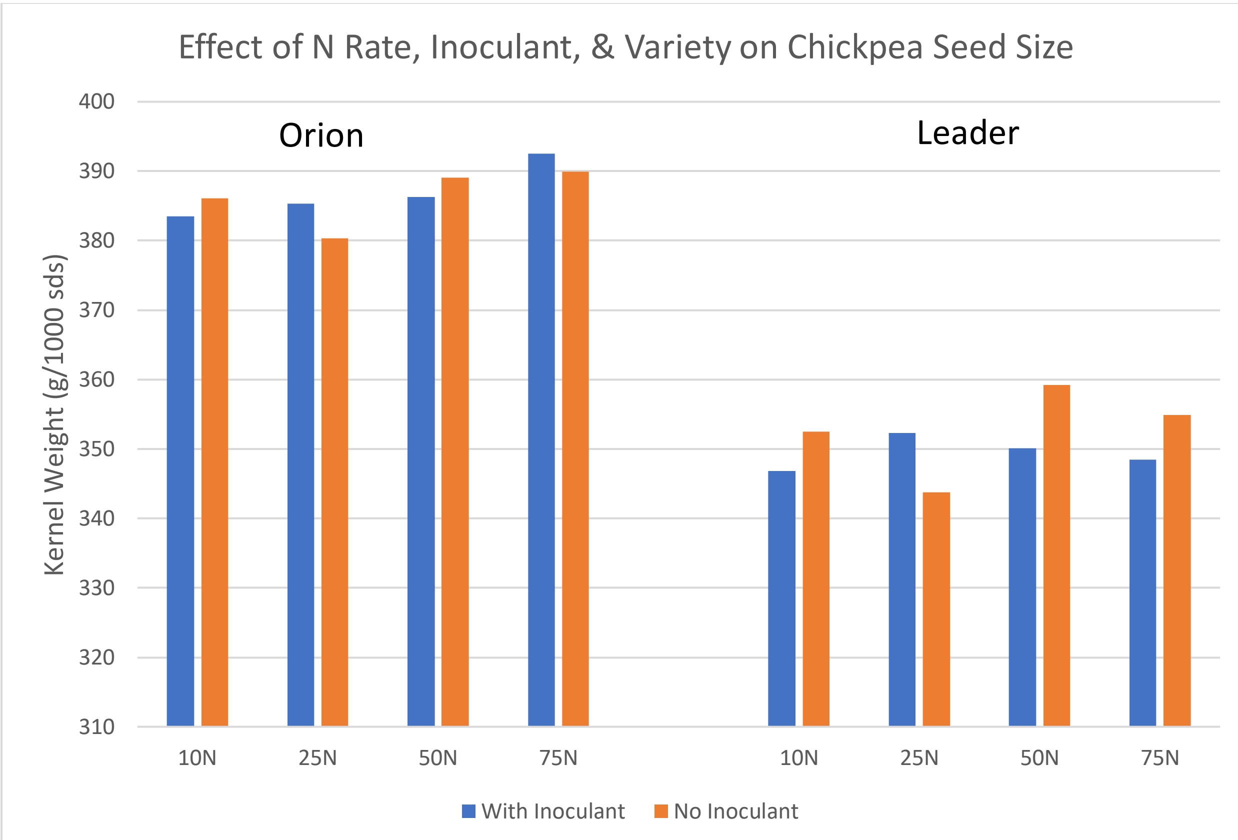
Overall nodulation in this trial was poor (Fig.3). This was indicative of the area in 2021 due to the hot, dry conditions early in the growing season. What little nodulation there was existed predominately in the plots receiving lower N rates. However, even at this level of nodulation, the plant was not able to satisfy its N requirements through fixation, rather it scavenged nitrogen through residual soil N and the applied fertilizer N put down with our treatments.

Fig. 3. Nodulation score for Inoculated vs. no inoculant Chickpeas



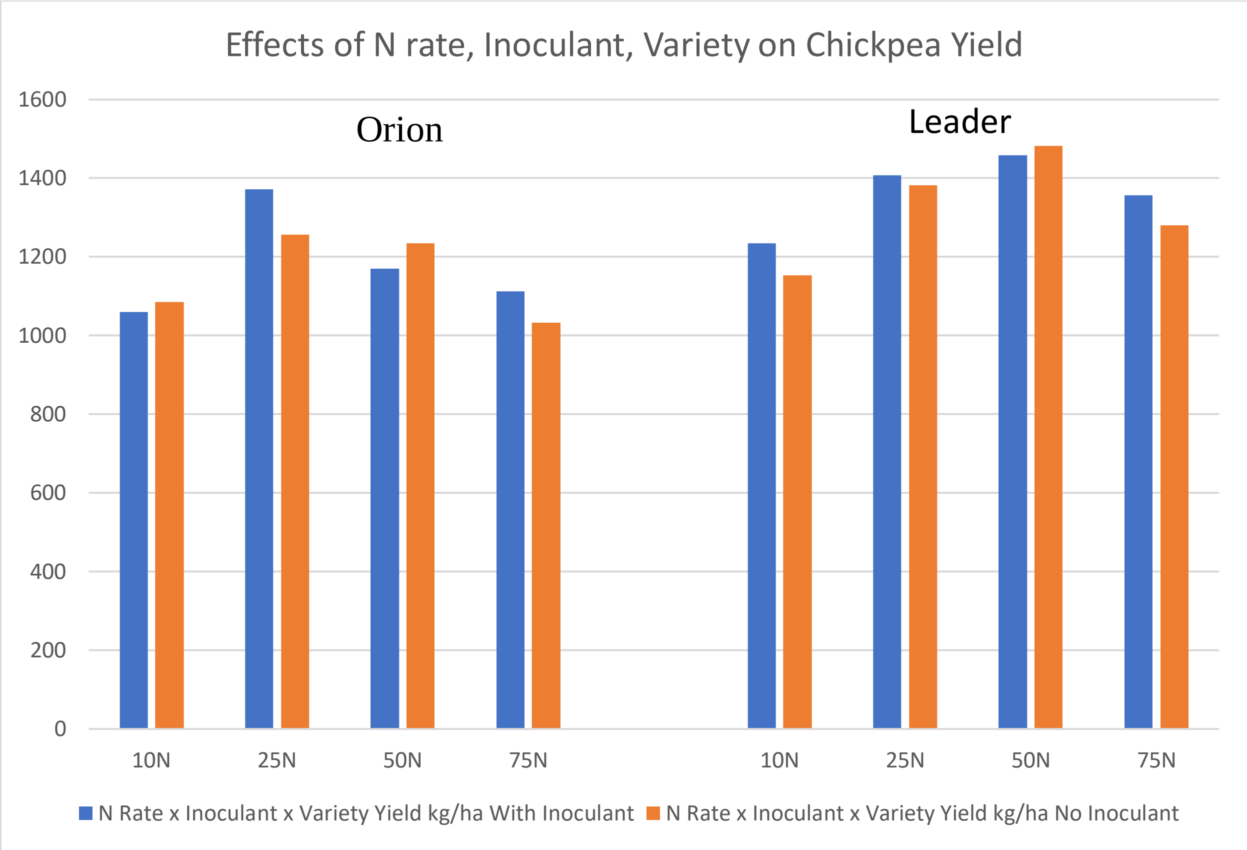
There were no statistically significant differences in seed size as a result of the fertilizer or inoculant treatments in this trial. However, the variety Orion, having an inherently larger seed was significantly larger than the smaller seeded Leader variety (Fig. 4).

Fig. 4. Effect of Nitrogen Rate, Inoculant and Variety on Chickpea Seed Size



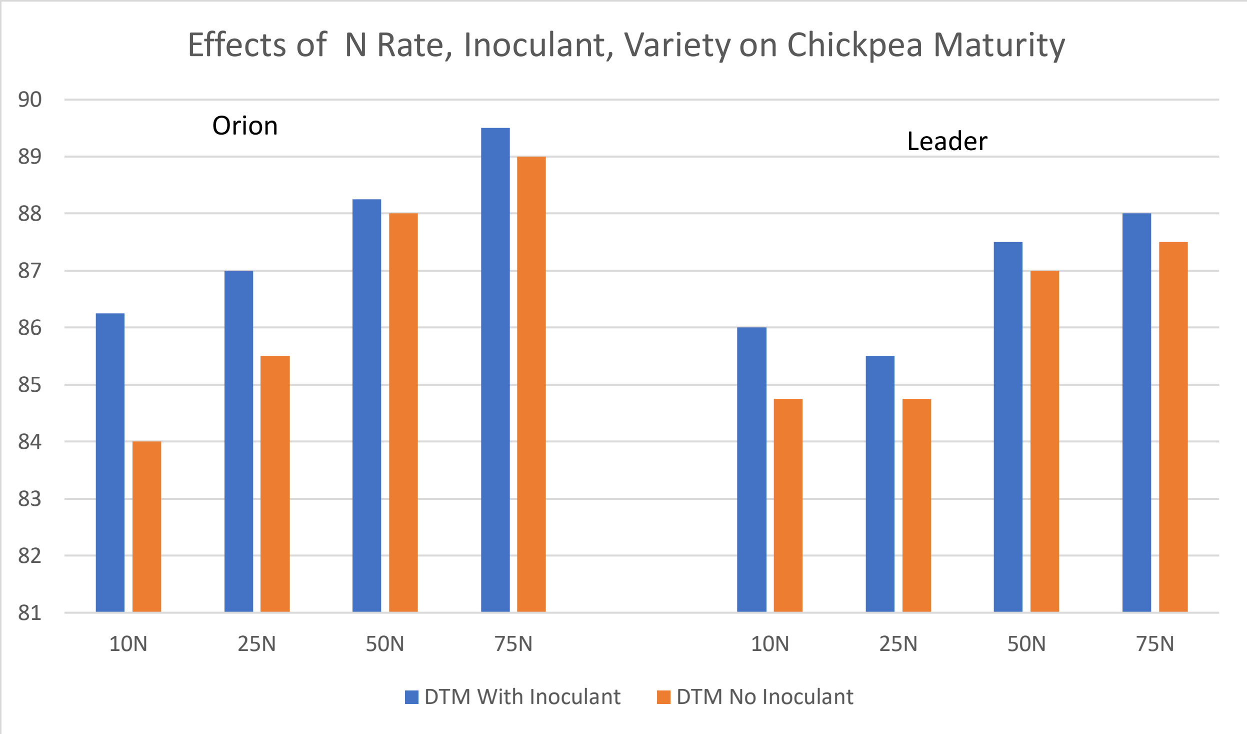
Yields were below average in this trial due to poor nodulation and lack of adequate growing season precipitation. The Leader variety, being a slightly higher yielding variety averaged about 21 bus/ac compared to the Orion variety at about 18 bus/ac (Fig. 5). There were no significant yield differences between the inoculated treatments and the uninoculated treatments indicating that nitrogen fixation had little impact on yield in 2021. The Orion chickpea reached peak yield at 25 lb/ac rate of nitrogen where the Leader chickpea reached peak yield at 50 lbs/ac rate regardless of whether or not it was inoculated, showing that nodulation had little effect on yield and nutrient uptake was limited in 2021 due to drought. There was no disease detected in 2021 at any point in the growing season that would have influenced yield. Since there was no disease in this trial we were unable to determine whether any of our applied treatments would have had an effect on early onset of Ascochyta.

Fig.5. Effect of N Rate, Inoculant, and Variety on Chickpea Yield.



The weather played a large role in maturity as well in 2021 where the hot dry conditions at the end of the growing season hastened overall maturity and had an overshadowing effect on the applied treatments (Fig. 6). For this reason, we were not able to see the full effect of each treatment in this trial since soil moisture was the limiting factor causing plants to senesce early and not the fact that soil N was depleted causing the crop to mature, as was hypothesized. Even though there were variables influencing this trial that were out of our control, we were able to pick out minor treatment responses. Comparing inoculated verses non-inoculated treatments, we saw slight differences in maturity at the higher rates of applied nitrogen, but somewhat greater differences in maturity at the lower rates of applied nitrogen. This indicates that nodulation may have contributed to nitrogen-fixation later in the year at lower N rates, which delayed maturity as hypothesized, but did not translate into increased yield.

Fig. 6. Effect of N Rate, Inoculant, and Variety on Chickpea Maturity on Days to Maturity.



4. Conclusions and Recommendations

Results from a previous AAFC study showed that chickpea maturity can be accelerated by 7-15 days depending on variety (Gan, 2007). Our study showed similar results, although not to the extent of AAFC. The hot dry conditions at the end of the growing season hastened overall maturity and had an overshadowing effect on the applied treatments. At lower rates of applied N we saw maturity up to three days sooner on the non-inoculated treatment.

Utilizing fertility practices to hasten maturity is designed to be strictly a risk management tool against frost and disease and not for increased crop yield. Advantages include the potential for much better seed quality at harvest and potential to delay disease early in the growing season. The drawbacks include the extra cost of N fertilizer, and creating larger carbon footprint.

When looking at basic economics using last fall urea price ($1320/tonne) applying 50 lbs/ac N (109 lbs/ac Urea) = $65/ac. vs. Inoculant at 5 lbs/ac cost about $15/ac. Using this scenario, the cost of risk management is $50/ac. If harvest conditions are poor and the chickpea crop does not mature before a hard frost one could lose $96/ac assuming an 8 cent/lb spread between 1CW and sample grade chickpea averaging 20 bu/ac.

Utilizing fertility practices to hasten maturity may not be economical in traditional chickpea growing areas where overall risk is lower, opposed to areas outside or on the fringe of traditional chickpea growing areas where there may be some economic scenarios.

5. **Acknowledgments/Extension**

We thank the Ministry of Agriculture for all ADOPT projects including plot signage and verbal acknowledgement at field days. We also thank Shannon Chant with the Saskatchewan Ministry of Agriculture. Ongoing yearly results are shared with producers through crop tours planned throughout the summer and are presented at winter meetings and workshops including the Crop Production Show. As well, information is shared weekly throughout the summer on a CKSW radio program "Walk the Plots." This project was also presented by Bryan Nybo as a part of the Virutal Research Update on November 29, 2021. A summary will also be posted on our website at www.wheatlandconservation.ca

6. **Appendices**

Field Notes and Dates

14-May	Pre-seed spray application of Authority @ 118 ml/ac	
	Seed information:	
	Leader Chickpea: 44 plants/m2	Orion Chickpea: 44 plants/m2
	germination: 90%	germination: 84%
	TKW= 351.5 grams	TKW= 404.9 grams
	Both varieties treated with Vibrance Maxx RFC	
	All plots received 90 lb/ac MAP	
	N rates were balanced taking in account of the N included in the MAP formulation	
19-May	Seeded chickpea at a depth of 2 1/4"	
	All fertility was sidebanded 3/4" to 1" lateral spread away from seed	
01-Jun	Roundup Transorb (540g/l) applied before crop emergence	
14-Jun	Plant counts (2 rows x 1 m) x 2	
15-Jun	Centurion @ 100ml/ac + Amigo @ 1 litre/100L spray solution	
07-Jul	Nodulation assessment 3-5 plants/plot at early flower.	
27-Jul	Disease ratings done.	Found no disease in trial
06-Aug	Photos taken	
13-Aug	Maturity Ratings taken.	
31-Aug	Harvested plots (7 rows x 8.25" row spacing)	
	All seed harvested seed from plots graded No. 1 CW	

7. **Abstract**

The objective of this trial is to demonstrate to producers how to speed up chickpea maturity without sacrificing yield, and at the same time show producers how to get the crop off to a strong start so the plant is better equipped to resist early disease infestation. Since Chickpeas have a long growing season, the biggest challenge for producers has been getting the crop to mature before late season frost occurs. Chickpeas are very susceptible to these late season frosts that have the potential to drastically downgrade the harvest sample. Speeding up chickpea maturity not only benefits producers in traditional chickpea areas in years when frost comes early in the fall, but it may also benefit producers outside of traditional chickpea growing regions that are limited by frost free days at harvest. However, sourcing nitrogen from fertilizer sources rather than through nitrogen fixation comes at an increased cost to producers. Applying different rates of fertilizer N with, or without inoculant and using a high yielding early maturing Kabuli variety compared to a later maturing variety demonstrates to producers how to avoid production limitations by reducing the days to maturity and risk. The hot dry weather played a large role in maturity in 2021 where these conditions at the end of the growing season hastened overall maturity and had an overshadowing effect on the applied treatments. At lower rates of applied N we saw maturity up to three days sooner on the non-inoculated treatment. Under more favorable growing conditions, AAFC studies showed chickpea maturity can be advanced significantly by supplying the plants nitrogen requirements from applied fertilizer over nitrogen supplied by N fixation by as much as 7-15 day (Gan, 2007). Utilizing fertility practices to hasten maturity may not be economical in traditional chickpea growing areas where overall risk is lower, opposed to areas outside or on the fringe of traditional chickpea growing areas where there may be some economic scenarios.