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Optimizing inoculation and fertilization for chickpea and lentil

2001 Annual Report

by

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(a) Executive Summary

The areas seeded to chickpeas in Saskatchewan have increased from less than 6,000 hectors in 1995 to more than 400,000 hectors in 2001. Little is known about the response of this new pulse crop to inoculation and fertilization. This research is being conducted in the heartland of the chickpea production of western Canada, to generate new information in the areas of inoculation and fertilization management for maximum seed yield and best marketing quality for both chickpea and lentil. The experiment was initiated in 1999 at the Swift Current Research Centre through the funding from Saskatchewan Pulse Growers (SPG) and Agriculture and Agri-Food Canada's Matching Investment Initiative (MII). Starting in 2000, a second site was established on a heavy clay soil at Stewart Valley, Saskatchewan, with the financial support provided by Saskatchewan Agricultural Development Fund (ADF) of Saskatchewan Agriculture and Food, and Potash and Phosphate Institute of Canada (PPIC). In this report, the preliminary results from both sites and in the last three years were summarized in the attached Tables. The final year of the experiment will be continued in 2002 at the Stewart Valley site only. A final report of the project will be completed in March 2003 in which six site-years data will allow us to draw sound conclusions. The final report will be submitted to all the above-mentioned funding agencies.

(b) Background

There is little information available regarding how to optimize rhizobium inoculation and fertilization for the seeding systems with 1-, 2-, and 3-tanks on a seeder. Many producers want to use granular inoculants on pulse crops, because previous studies have shown that granular inoculant performs better for pulses grown on new lands. But in a 2-tank system, the use of granular inoculant precludes application of fertilizer P, while pulses require sufficient P supply to maximize N fixation. Use of P-solublizing seed inoculant such as JumpStart in one tank and granular rhizobial inoculant in another tank is one option. Powdery rhizobia is applied to seed in one tank and P-fertilizer in another tank is another 2-tank option. In 3-tank seeding systems there are more options to accommodate the multiple requirements, but no information is available regarding the relative performance of side-banding vs seed-row placing of rhizobial inoculant.

(c) Objectives

Therefore, the objectives of this study were to:

1) determine agronomic responses of both desi- and kabuli-type chickpea to application of rhizobial inoculant and N, P fertilizers, as compared with the responses of lentils;

2) evaluate the differences between inoculant forms (powder vs granular), inoculant placement (seed-row vs side-banding), and other forms of inoculation (JumpStart, Tagteam) applied in chickpea and lentil; and

3) develop recommendations for chickpea growers in optimizing rhizobial and/or P-solublizing inoculants for direct-seeding of chickpeas and lentils with 1-, 2-, and 3-tank seeding systems.

(d) Seeding and Crop Management

In 2001, kabuli-chickpea (CDC Xena), desi-chickpea (Myles), and lentil (Glaims) were seeded in three separate tests at each of the two sites; one on a loam soil at Swift Current (established through SPG and MII funding), and the other on a clay soil at Stewart Valley (established through ADF and PPIC funding). Plots were directly seeded, using an air seeder, on wheat stubble which had a low to medium level of available soil N and P and had no pulse crops been grown in the last five years. We used both rhizobial granular soil inoculant and seed-applied powder inoculant; both containing identical Bradyrhizobium strains. So that, we can make true comparisons between the two types of rhizobium inoculants. The experiment was layout with a randomized, complete block design with 5 replicates at each site. Detailed information regarding seeding and harvesting information were summarized in Table 1. Soil residual nutrients and pesticide application information were summarized in Table 2 and Table 3.

(e) Preliminary Results

All measurements have been taken as proposed in the initial application. The preliminary results from trials conducted at Swift Current in 1999, 2000, and 2001, and trials at Stewart Valley in 2000 and 2001 were summarized in Table 4 through Table 15. Because the study has one more year to go, it would not be wise to make conclusions based on the preliminary data. However, we would like to discuss what we have learnt so far, from the previous five site-years of experiment.

1) Rhizobium inoculation vs non-inoculation

Desi chickpea reduced seed yield by an average of 20% when the crop was not inoculated with a rhizobium, as compared with the crop receiving a rhizobium inoculant (Table 5). Kabuli chickpea reduced seed yield by a merely 5% when the crop was not inoculated with a rhizobium inoculant.

2) Powder vs granular forms of inoculant

Desi chickpea reduced seed yield by an average of 20% when the crop was not inoculated with a rhizobium, as compared with the crop receiving a rhizobium inoculant (Table 5). Kabuli chickpea reduced seed yield by a merely 5% when the crop was not inoculated with a rhizobium inoculant.

3) Seed-row vs side-banding of granular inoculant

Desi chickpea reduced seed yield by an average of 20% when the crop was not inoculated with a rhizobium, as compared with the crop receiving a rhizobium inoculant (Table 5). Kabuli chickpea reduced seed yield by a merely 5% when the crop was not inoculated with a rhizobium inoculant.

4) Starter N

Desi chickpea reduced seed yield by an average of 20% when the crop was not inoculated with a rhizobium, as compared with the crop receiving a rhizobium inoculant (Table 5). Kabuli chickpea reduced seed yield by a merely 5% when the crop was not inoculated with a rhizobium inoculant.

5) Phosphate effects

Desi chickpea reduced seed yield by an average of 20% when the crop was not inoculated with a rhizobium, as compared with the crop receiving a rhizobium inoculant (Table 5). Kabuli chickpea reduced seed yield by a merely 5% when the crop was not inoculated with a rhizobium inoculant.

6) JumpStart and Tagteam

Desi chickpea reduced seed yield by an average of 20% when the crop was not inoculated with a rhizobium, as compared with the crop receiving a rhizobium inoculant (Table 5). Kabuli chickpea reduced seed yield by a merely 5% when the crop was not inoculated with a rhizobium inoculant.

(f) Project Activities

This experiment was a showcase in our Dryland Cropping System Annual Field Day hold on July 4, 2001; attracting great attentions from producers, industrial representatives, and extension agrologists in western Canada and Northern States. During the summer, the plots had been visited by international scientists, regional delegates, and local producers groups. Visitors to the research site include researchers and producers from Australia, Argentina, Israel, and USA, and others from Saskatchewan Wheat Pool, Manitoba pea breeders, The experiments were also served as "field class" for Certified Crops Advisors Diagnostic School conducted by Westco Fertilizers Ltd.

(g) Acknowledgment

Project supports from SPG, ADF, and MII have been verbally mentioned to numerous producer groups interested in this area of research in addition to acknowledgments of the SPG and ADF supports at several producers' meetings, pulse workshops, field days, and conferences. The research site at Swift Current was toured by more than 400 visitors at the Dryland Cropping Systems field day with printed and verbal acknowledgments of the research funding. Some of the preliminary results were presented at Pulse Day 2001, Swift Current Marketing Club, and Swift Current Palliser's Crop Club.

Table 1. Seed and seeding information for desi-chickpea, kabuli-chickpea, and lentil grown at Swift Current and Stewart Valley, Saskatchewan, in 1999 and 2000.

Year	Cultivar	Seeding Date		Kernel weight (mg seed^{-1})	Seed germination (%)	Seeding rate (kg ha^{-1})	Aschochyta (%)	Harvest Date	
		Swift Current	Stewart Valley					Swift Current	Stewart Valley
	Laird	May 25, 17 C	N/A	68.8	99	99	0	Sept 10	Sept 10
	Myles	May 26, 17 C	N/A	181	98	103	0	Set 14	Sept 14
1999	Sanford	May 26, 17 C	N/A	499	99	224	0	Sept 17	Sept 17
	Glamis	May 3, 16 C	May 4, 12 C	60	98	84	0	37113	37119
	Myles	May 3, 16 C	May 4, 12 C	178	94	100	0	37130	Sept 8
2000	Xena	May 4, 16 C	May 5, 13 C	554	89	244	2.8	Sept 1	Sept 1

Table 2. Soil residual nutrients prior to seeding for desi-chickpea, kabuli-chickpea, and lentil grown at Swift Current and Stewart Valley, Saskatchewan, in 1999 and 2000.

		Soil Residual Nutrients (kg ha^{-1})			
Year	Crop	N	P	K	S
		Swift Current			
	Lentils	16	20	N/A	N/A
	Desi	21	25	N/A	N/A
1999	Kabuli	16	16	N/A	N/A
	Lentils	9	28	N/A	N/A
	Desi	10	26	N/A	N/A
2000	Kabuli	11	21	N/A	N/A
		Stewart Valley			
	Lentils	18	10	N/A	N/A
	Desi	17	10	N/A	N/A
2000	Kabuli	17	10	N/A	N/A

Table 3. Pesticide application information for desi-chickpea, kabuli-chickpea, and lentil grown at Swift Current and Stewart Valley, Saskatchewan, in 1999 and 2000.

Year, site	Herbicide Application			Fungicide Application
	Previous fall	Pre-seeding	In-crop	In-crop
1999 Swift Current	None	May 6 glyphosate, 1.11 kg ha^{-1} May 18 trifluralin, 1.1 kg ha^{-1}	September 1(lentils only) diquat, .40 kg ha^{-1} September 9(all crops) diquat, .40 kg ha^{-1}	July 21(chickpeas only) chlorothalonil, 1.48 kg ha^{-1} August 11(chickpeas only) chlorothalonil, 1.98 kg ha^{-1}
2000 Swift Current	None	April 25 glyphosate, .44 kg ha^{-1} trifluralin, 1.1 kg ha^{-1}	May 25, metribuzin, 0.16 kg ha^{-1} May 26, sethoxydim, 0.21 kg ha^{-1} Aug 9, diquat, 0.40 kg ha^{-1}	June 29, July 12, July 21 chlorothalonil, 1.73 kg ha^{-1}
2000 Stewart Valley	October 7/99 2,4-D 700 ester, 0.69 kg ha^{-1}	April 20 trifluralin , 1.1 kg ha^{-1} April 24, May 2 glyphosate, 0.44 kg ha^{-1}	May 25, metribuzin, 0.16 kg ha^{-1} May 29, sethoxydim, 0.21 kg ha^{-1} Aug 11(lentils only), diquat, 0.40 kg ha^{-1} Aug 31(desi only), diquat,0.40 kg ha^{-1}	June 30, July 13 chlorothalonil, 1.73 kg ha^{-1}