
Chickpeas Respond Well To Inoculation With TagTeam®

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Abstract

Rhizobia strains were tested in TagTeam peat and granule formulations for their effectiveness at increasing yields in chickpeas. Of the five strains tested in 1999, the top three were chosen on the basis of yields produced and were formulated in both peat and granular for testing in 2000. Desi (cv. Myles) and kabuli (cv. Chico) chickpeas were used to evaluate the strains in 2000. Results were consistent in both types of chickpeas with both varieties responding well to inoculation. In a peat formulation there was no difference between the strains but in the granular formulation there was a difference. One of the three strains survived poorly on the granules and was not used in the trials. Of the two remaining strains one showed a slight advantage over the other and this was consistent in both desi and kabuli chickpeas. The average response to inoculation over 4 locations ranged from 30% to 47% increase in yields in kabuli and 48% to 60% increase in yields in desi. The response in desi and kabuli chickpeas is site specific as Birsay gave the highest yields in desi chickpeas, while Milden was the most responsive with kabuli type chickpeas.

Introduction

The chickpea acreage in Saskatchewan has grown dramatically as acreages increased from 350,000 acres in 1999 to 680,000 acres in 2000. Projected acres for 2001 are up further to 800,000 acres. As an inoculant company, Philom Bios saw this market as a new opportunity to expand the TagTeam line of products to include chickpea. TagTeam is the first dual inoculant available for use on pulse crops. It contains a phosphate solubilizing fungus and a nitrogen fixing rhizobia. The phosphate solubilizing fungus was discovered by Dr. R.M.N. Kucey from Agriculture and Agri-Food Canada in Lethbridge in 1980's (Kucey, 1983). Although the *P. bilitaii* component of TagTeam is very important in terms of phosphate fertility, it is the nitrogen fixing component that can have the greatest impact on yield.

There are different species of rhizobia for different crops. For chickpea, the rhizobia species associated with nitrogen fixation is *Rhizobium ciceri*. Within each species of rhizobia there are numerous strains. Each strain may have different abilities to nodulate chickpeas or a certain level of attainable nitrogen fixation. Factors that affect rhizobial survival in the soil or movement towards the roots can have drastic effects on nodulation. These factors are such things as motility, competitiveness, resistance to low pH, and growth rate. Once nodulation occurs, rhizobia strains can then fix nitrogen at different efficiencies and therefore can be either a benefit to the plant if they are efficient or can be an energy sink if the nitrogen fixation is inefficient.

By increasing the levels of nitrogen fixation there is a direct affect on grain yield of the plant. The more efficient the process of nitrogen fixation, the greater the potential yield of the crop. A combination of increased crop yield potential through plant breeding in conjunction with

selection of superior rhizobia strains will allow highest yields with lowest input costs. The purpose of this study was to identify superior rhizobia strain(s) that perform well in TagTeam peat and granule formulations on both desi and kabuli type chickpeas.

Materials and Methods

Small plot field trials were set up at 6 locations in both 1999 and 2000 to look at the efficacy of rhizobia strains on chickpea yields. Sites were chosen based on low nitrogen and phosphate levels (<35 lbs/acre), no chickpeas grown in past 4 years, and no residual herbicide concerns. The field research site locations in 1999 include Milden, Cloan, Borden, Aberdeen, Elrose and Perdue. In 2000, the field research sites include Milden, Landis, Stewart Valley, Birsay, and two locations at Cupar.

In 1999, five rhizobia strains were evaluated in TagTeam peat formulation on desi (cv. Myles) chickpeas. The top 3 strains from 1999 were reevaluated in 2000 as TagTeam peat and TagTeam granule formulations on both desi (cv. Myles) and kabuli (cv. Chico) chickpeas. There were no seed treatments used in 1999. In 2000, kabuli seeds were treated with Vitaflo 280 and Apron FL.

The studies were arranged in a randomized complete block design with six replications in 1999 and four replications in 2000. Trials were direct seeded with a customized small plot air seeder. Monoammonium phosphate (11-51-0) was applied at rates according to soil test recommendations. Data collected included above ground dry matter and total grain yield in 1999 and only grain yield in 2000. The data was analyzed in SAS by GLM using contrasts to compare treatments. Data sets from sites that had coefficient of variance above 20% were not used in the calculations or statistical analysis of combined sites.

1999 Results

Inoculant response at time of dry matter sampling was significant ($p < 0.01$). Over 6 trials all strains yielded higher than the uninoculated control (Figure 1). When all 5 strains were compared there was only a significant difference between strain 113 and strain 131 ($p < 0.05$).

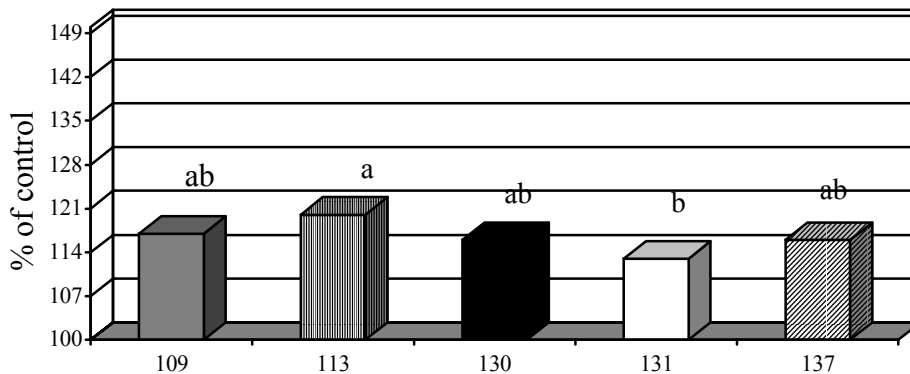


Figure 1. Average dry matter yields from 6 chickpea sites in 1999 expressed as percent of control. Control average yield was 231 kg/ha. LSD is 7% (p<0.05)

All 6 chickpea trials were taken to harvest but only Elrose, Milden and Borden were used in the statistical analysis. Perdue had coefficient of variance that was much greater than the acceptable 20% as the yields were extremely variable. Disease and early frost were involved in the variable yields at this site. Aberdeen and Cloan did have an inoculant response but it did not carry through to yield as the sites experienced an early frost that was most detrimental to the healthy green inoculated treatments and had lesser an effect on the already maturing uninoculated control. Square meter dry matter samples of Cloan were taken soon after the frost in September and the data was included in the dry matter analysis mentioned above.

Results of the three trials taken to yield demonstrate that sites respond to inoculation to different degrees (Table 1). Elrose was a very responsive site showing yield increases up to 186% of control with strain 109. Milden responded well with yields reaching up to 142% of control. Although Borden did not show a significant response to inoculation, there was a yield increase with strains 109 and 113.

Table 1. Harvest yield results from 3 trials in 1999 and the average of all three trials. Yields expressed as kg per hectare and percent of control.

Treatment	<i>Elrose</i>		Milden		Borden		Average	
	Kg/ha	% of control	Kg/ha	% of control	Kg/ha	% of control	Kg/ha	% of control
Control	1866	100	1610	100	1791	100	1756	100
109	3462	186	2178	135	1969	110	2536	144
113	3058	164	2227	138	2090	117	2458	140
130	3084	165	2287	142	1825	102	2398	137
131	3082	165	1925	120	1848	103	2285	130
137	3063	164	2104	131	1834	102	2334	133
LSD (P≤0.05)	275	15	341	21	314	18	178	10

When all sites were combined, and the mean of each individual strain was compared using contrasts, strain 131 proved inferior to all other strains. This supports the inferior performance suggested in dry matter yields. The highest grain yields were obtained with strain 109. When compared to other strains individually the strain 109 outperformed 137 and 131, and was considered similar in yield to 113 and 130.

2000 Results

To confirm findings in 1999, further testing was done in 2000. In 2000, a granular formulation of TagTeam chickpea was added to the trials. This time, only the top 3 strains were evaluated and they were chosen to be 109, 113, and 130. In choosing the strains their performance in the

field was most important but other factors were considered, such as stability on seed and growth rates. In the lab studies (results not shown) it was determined that 130 had better growth and survival on seed than 137 and this strain was added to the field tests in 2000.

Data collected in 2000 field trails involves harvest yields only. Out of 6 sites seeded, 4 were taken to harvest. The two sites lost include Stewart Valley and Landis. There was good inoculation response at both sites by visual analysis but the sites were unharvestable.

The response to inoculation with the three strains in a TagTeam peat and granule formulations is better in desi (var. Myles) than in kabuli (var. Chico) as the yields in percent of control were higher (Figure 2). In terms of actual grain yield, kabuli chickpeas yielded higher than desi chickpeas over all treatments. For example, uninoculated controls yielded 1713 and 2104 kg/ha for desi and kabuli, respectively.

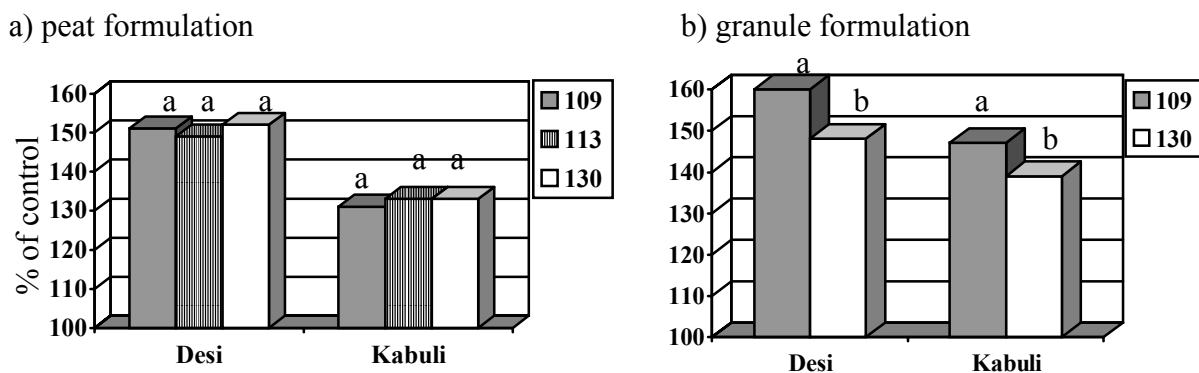


Figure 2. Response of desi and kabuli chickpeas to inoculation with three strains of rhizobia in a TagTeam peat (a) and granule (b) formulations. LSD ($p < 0.05$) for desi is 12%, and for kabuli is 7%.

In terms of strain responses, there was no significant difference between the three strains in the peat formulation. In the granule formulation there was a significant difference with strain 109 being superior to strain 130 kabuli ($P < 0.05$) and only slightly superior in desi ($p < 0.10$) (Figure 4). Strain 113 was not put into the field trials in a granule formulation because the titres were too low (data not presented).

Formulation does have an impact on yield with strain 109 as the granular formulation produced higher yields than the peat formulation in kabuli chickpeas (Figure 5). The desi chickpeas also responded to granular TagTeam but yields were not statistically significant. Strain 130, on the other hand, responded similarly in both peat and granular formulations.

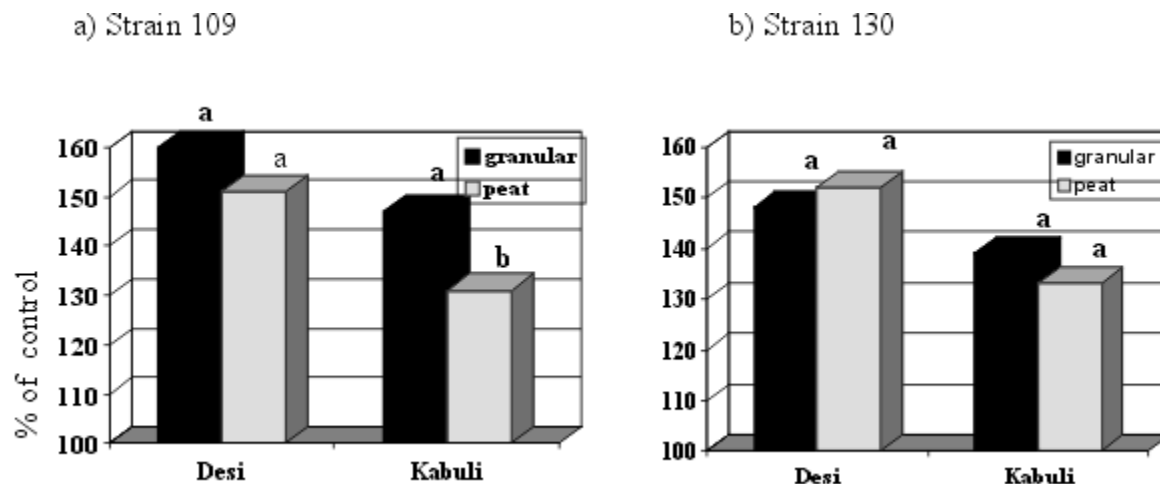


Figure 4. Response of desi and kabuli chickpea to peat and granular formulations of TagTeam strain 109 (a) and 130(b). LSD ($p < 0.05$) for desi is 12%, and for kabuli is 7%. Same letters within each type of chickpea mean no difference between the means at the 5% level of significance.

Conclusions

Desi and kabuli chickpeas respond well to inoculation with TagTeam. Within the inoculant response there were different yields obtained by each strain. Out of the five strains tested in 1999 there were 3 strains that were superior in terms of yield produced and growth rate in the lab. The three strains tested in 2000 demonstrate no difference in yields obtained from the peat formulations, but strain 109 was superior in the granule formulation. When the two formulations were compared strains 109 and 130 responded differently. Strain 109 efficacy increased with the granular formulation whereas, strain 130 showed no difference between the peat and granule formulations. The improved efficacy of strain 109 in granule formulation was most evident in kabuli chickpeas. From these results it can be stated that rhizobial strain and formulation do have an impact on efficacy of TagTeam inoculants for chickpea and desi and kabuli chickpeas do respond similarly.

Literature Cited

Kucey, R.M.N. 1983. Phosphate-solubilizing bacteria and fungi in various cultivated and virgin Alberta soils. *Can. J. Soil Sci.* **63**:671-678.