NORTHEAST AGRICULTURE RESEARCH FOUNDATION

2012 Inoculant Product and Formulation Effect on Field Pea

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ABSTRACT
Inoculation of pulse crops is important for optimising plant nutrition and enhancing yield. In order to enhance nitrogen fixation field peas require inoculation with *rhizobium leguminosarum*, especially when grown for the first time in rotation. Commercial inoculants are formulated as granular, peat-based and liquid. There are also a variety of inoculant products available to Saskatchewan producers. Inoculant products and formulations can vary in cost per acre and in the effectiveness of their Rhizobium/legume associations. The objective of this project is to demonstrate the efficacy of different inoculant products and formulations on field pea. Field peas were seeded at three locations in Saskatchewan. Treatments included eleven different inoculant products and formulations, an uninoculated check and an uninoculated check with 60 lb ac^{-1} N side banded at the time of seeding. Data collection included nodulation, field pea biomass and grain yield. At the Swift Current site nodulation differed between treatments with inoculated treatments having more effective nodulation than uninoculated treatments. Treatment differences were not seen at the other sites. When all sites years were analysed together there were no significant differences between treatments for nodulation, biomass or yield.

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Objectives

To demonstrate the efficacy of different inoculant products and formulations on field pea.

Rationale

Inoculation of pulse crops is important for optimising plant nutrition and enhancing yield. In order to enhance nitrogen fixation field peas require inoculation with rhizobium leguminosarum, especially when grown for the first time in rotation. Commercial inoculants are formulated as granular, peat-based and liquid. Granular inoculants are soil applied, while liquid and peat-based inoculants are seed-applied. Previous research has shown that granular

inoculants were most effective at promoting nodulation in field peas followed by peat-based inoculants then liquid inoculants.

There are also a variety of inoculant products available to Saskatchewan producers. Inoculant products and formulations can vary in cost per acre and in the effectiveness of their Rhizobium/legume associations. This project will demonstrate the efficacy is inoculant formulations and products and will assist producers in the decision making process when purchasing inoculants.

Methodology

This project was conducted at Glaslyn, Swift Current and Melfort, Saskatchewan. The demonstration was set up as a randomized complete block design with four replicates. Field peas (var. CDC Centennial) were seeded at a rate of 85 seeds m^{-2} at all locations. Phosphorus, potassium and sulphur were applied at the time of seeding to soil test recommended levels. Herbicides, fungicides and desiccants were applied as required at each site.

Eleven different inoculant products and formulations were included in this demonstration, as well as an uninoculated check and an uninoculated check with 60 lb ac^{-1} N side banded at the time of seeding. See Table 1 for a complete list of treatments. Peat and liquid inoculants were applied to the seed at the recommended rates as close to seeding as possible. Granular inoculants were metered into the seed row at the recommended rates.

Table 1: Description of treatments included in the demonstration.

Trt	Inoculant	Formulation
1	No inoculant	-
2	Nodulator XL	granular
3	Nodulator XL	liquid
4	Nodulator XL	peat
5	Cell-Tech	granular
6	Cell-Tech	liquid
7	Cell-Tech	peat
8	TagTeam	granular
9	TagTeam	liquid
10	TagTeam	peat
11	Optimize	granular
12	PulseSignal II	liquid
13	No-inoculat + 60 lb/ac N	-

Data collection included nodulation, field pea biomass and grain yield. Nodulation was assessed during early flowering by digging up five plants per plot. Each plant was assigned a score based on plant growth and vigour, nodule colour/number and nodule position. The rating scale used is described in Table 2. Above ground field pea biomass was measured at physiological maturity. Two $0.5m^2$ samples were taken per plot, the field peas were dried and weight of dried samples

was recorded to determine kg ha^{-1} of biomass. Grain yields were determined by straight-combining each plot and are reported as kg ha^{-1} clean seed.

Table 2: Guide for assessment of nodulation.

Factor Assessed	Score
1) Plant growth and vigour	
Plants green and vigorous	5
Plants green and relatively small	3
Plants slightly chlorotic	2
Plants very chlorotic	1
2) Nodule colour/number	
Greater than 5 clusters or groups of pink pigmented nodules	5
3-5 clusters/groups of predominantly pink nodules	3
Less than 3 groups of nodules OR nodules whitish or greenish in colour	1
No nodules OR nodules white or green in colour	0
3) Nodule position	
Crown and lateral nodulation	3
Generally crown nodulation	2
Generally lateral nodulation	1
Total Score	
11 - 13	**Effective nodulation -** Good nitrogen fixation potential.
7 - 10	**Nodulation less effective -** Fixation potential reduced. Were inoculation or growing conditions less than optimum?
1 - 6	**Generally unsatisfactory nodulation -** Required evaluation of inoculants used, inoculation methods and of growing conditions on site

Results

Nodulation

Assessment of nodulation found all treatments to have functioning nodules at all sites. Averaged across treatments, the Glaslyn and Swift Current sites were found to have more effective nodulation than Melfort (Table 3). There was a significant difference in nodulation across treatments at the Swift Current site only. Contrasts showed that both liquid and granular inoculants resulted in more effective nodulation than the check treatments; however, there was no significant difference between the liquid and granular treatments (Table 3). At Swift Current the treatment that received 60 lb/ac of starter N had significantly lower nodulation then the inoculated treatments, but did not differ from the no inoculant treatment without starter N. The treatment with no inoculant had statistically similar nodulation to the CellTech liquid and the TagTeam peat treatments.

When nodulation was assessed on all site years there was no significant difference in nodulation between treatments.

Biomass

Biomass production was greatest at the Glaslyn location and lowest at the Swift Current location. Biomass production was low at Swift Current due to hail on June 25, which was

followed by a record three consecutive month drought. Significant differences in biomass production between treatments were seen at Glaslyn and Swift Current but not Melfort or in the combined analysis (Table 4). While biomass production varied between treatments at Glaslyn and Swift Current there were no obvious trends. Contrasting biomass production between the no inoculant treatment, all liquid treatments and all granular treatments found no significant difference between these groups.

Yield

Yields varied across sites with Glaslyn having the highest yield and Swift Current the lowest (Table 5). Significant treatment differences for grain yield were only seen at Swift Current. Contrasts showed no significant yield differences between the no inoculant treatment and liquid or granular inoculant treatment, or between the liquid and granular treatments. Although no trends were evident at Swift Current, the highest yielding treatments were Nodulator peat, CellTech peat and no inoculant with 60 lb/ac starter N, while the lowest yielding treatment was Nodulator liquid. Applying starter N did not negatively affect yield at any location.

Table 3: Treatment effects on field pea nodulation at each site year and combined across sites.

Trt	Inoculant Product	Formulation (or N)	Gaslyn	Swift Current	Melfort	All Sites
			---------- Nodulation Score ----------			
1	None	none	11.2[z]	9.8de[y]	7.5[z]	9.5[z]
2	Nodulator	granular	11.3	11.1bc	8.0	10.1
3	Nodulator	liquid	11.4	11.7abc	9.5	10.9
4	Nodulator	peat	11.2	11.7abc	9.4	10.7
5	CellTech	granular	11.3	11.05bc	9.4	10.6
6	CellTech	liquid	11.9	10.8dc	9.8	10.8
7	CellTech	peat	12.0	12.5a	10.1	11.5
8	TagTeam	granular	10.7	12.2ab	10.6	11.2
9	TagTeam	liquid	10.7	11.5abc	7.3	9.8
10	TagTeam	peat	12.0	11bcd	9.2	10.7
11	Optimize	granular	11.6	11.3abc	9.9	10.9
12	PulseSignal	liquid	11.8	12.4a	6.5	10.2
13	None	60 lb/ac N	11.4	9.1e	8.3	9.6
Average nodulation rating			*11.4*	*11.2*	*8.9*	*10.5*
CV			6.19	7.92	25.49	18.71
LSD			-	1.27	-	-
Standard Error			0.36	0.44	1.18	0.57
Contrasts[1]						
Check vs. Liquid			-	***	-	-
Check vs. Granular			-	**	-	-
Liquid vs. Granular			-	n.s.	-	-

[y]Means within the same site year followed by the same letter within a column are not significantly different (P>0.05) according to Fischer's protected LSD.

[z]Means are not significantly different (P>0.05) according to Fischer's protected LSD.

[1]Contrasts: n.s. (not significant at P<0.05), *(P<0.05), **(P<0.01), ***(P<0.001)

This demonstration was shown at the Melfort Field Day, which was held on July 18 and had approximately 75 people in attendance. An official stop was not made at the Swift Current field day, but people that were interested could stop and ask questions. The Swift Current site was shown as part of the Patterson Grain field tour held on July 13 (25 people in attendance) and at the Viterra Diagnostic School held on July 17 and 23 (26 people in attendance). Results from this demonstration were presented at the AgriARM Research Update on January 11, 2013 (88 people in attendance). The results of this project will be included in the site annual reports and on the WARC website.

Table 4: Treatment effects on field pea biomass at each site year and combined across sites.

Trt	Inoculant Product	Formulation (or N)	Glaslyn	Swift Current	Melfort	All
			---------- Biomass (kg ha^{-1}) ----------			
1	None	none	6495c	4103cd	5758	5452
2	Nodulator	granular	8070ab	4718abcd	5459	6082
3	Nodulator	liquid	6965bc	3865d	5016	5282
4	Nodulator	peat	8095ab	4560abcd	6292	6316
5	CellTech	granular	6575c	4058cd	5653	5428
6	CellTech	liquid	8485a	5300a	5540	6442
7	CellTech	peat	7480abc	4370bcd	6308	6053
8	TagTeam	granular	6615c	4885abc	5582	5694
9	TagTeam	liquid	6480c	4095cd	5716	5430
10	TagTeam	peat	6545c	4663abcd	6177	5795
11	Optimize	granular	7165abc	3935d	5326	5475
12	PulseSignal	liquid	7505abc	4310bcd	4716	5510
13	None	sixty	8420a	5048ab	5535	6334
Average biomass			*7300*	*4455*	*5621*	*5792*
CV			12.71	13.42	20.27	27.77
LSD			1331	857		
Standard Error			561.93	353.27	636.78	462.09
Contrasts						
Check vs. Liquid			n.s.	n.s.	-	-
Check vs. Granular			n.s.	n.s.	-	-
Liquid vs. Granular			n.s.	n.s.	-	-

Conclusions and Recommendations

It was hypothesized that inoculation of field peas would result in more effective field pea nodulation, greater biomass production and higher grain yield than the uninoculated check treatments. With the exception of nodulation at Swift Current this was not found to be the case. When a combined analysis was performed on data from all sites there were no significant treatment differences for nodulation, biomass or yield.

There are a few possible reasons why nodulation did not differ between treatments at Melfort

and Glaslyn. It is possible that the indigenous rhizobium species were very effective at colonizing field peas or that field peas were included in the rotation on these sites more recently then was thought, which may have resulted in the appropriate rhizobium species already being present in the soil. Previous research has not always found inoculation to be beneficial, even in locations where field peas had never been grown in that location. However, it is recommended that producers inoculate field peas and other legumes with the appropriate rhizobium species as they have proven to be beneficial in many circumstances. Small doses of fertilizer N may be beneficial when initial nodulation is restricted or delayed due to environmental conditions or when soil test N levels are very low, but in general starter N is not recommended. Application of fertilizer N to field pea crops can have a negative effect on nodulation and N_2 fixation of legumes.

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