SASKATCHEWAN INOCULANTS FOR CHICKPEA AND BEAN

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ABSTRACT

A collaborative research project between the University of Saskatchewan, the Saskatchewan Wheat Pool, MicroBio RhizoGen Corp. and Westco. Fertilizers Ltd. was initiated in 1994 to identify and develop effective rhizobial inoculants for chickpea and bean, grown in Saskatchewan. A number of chickpea and bean *Rhizobium strains* were identified as having excellent potential as legume inoculants. In particular, chickpea *Rhizobium* strain BCF32 and bean *Rhizobium* strain MBW31 are well suited to Saskatchewan conditions. Bean was particularly responsive to inoculants formulated as granular soil implants.

INTRODUCTION

Chickpea and common bean have been identified as promising specialty crops for Saskatchewan. Although currently limited, the acreage of each crop is expected to increase in the coming years, particularly with the development and introduction of new disease resistant varieties. As acreage increases, the need to identify and develop appropriate *Rhizobium* inoculants becomes greater. A collaborative research project between the University of Saskatchewan, the Saskatchewan Wheat Pool, MicroBio RhizoGen Corp. and Westco. Fertilizers Ltd. was initiated in 1994. The objective of our study was to develop effective inoculants for chickpea and bean grown in Saskatchewan. Results of initial growth chamber screening trials and field experiments were reported elsewhere (Walley et al. 1996).

MATERIALS AND METHODS

Bacterial strains, growth chamber screening and field experiments conducted in 1995 are described elsewhere (Walley et al. 1996).

Chickpea Field Experiments 1996

Following the first year of field studies (1995), three *Rhizobium* strains (BCF6, BCF31 and BCF32) were identified as potentially superior inoculants for chickpea and were prepared for field testing at three sites in 1996. At each location, two separate experiments were conducted to evaluate *Rhizobium strain* efficacy using desi-type chickpea (UC27) and kabuli-type chickpea (Sanford) as the host crops. The experiments were conducted using a completely randomized block design replicated four times. The experiments consisted of 10 treatments, including the three *Rhizobium* strains (BCF6, BCF31 and BCF32) prepared as a sterile peat formulation, strain BCF32 prepared as a granular soil implant, two commercially available peat inoculants, two commercially available granular inoculants, a control inoculated with sterile peat, and a non-legume control (flax, var. McGregor). With the exception of the commercial inoculants, MicroBio RhizoGen Corp. produced all test inoculants. Most probable number plate counts and bioassays revealed that all organisms were successfully established in the sterile peat (> 10^9 organisms per gram peat) and granular formulations. The commercially available products were applied in accordance with manufacturer's instructions.

Prior to seeding, chickpea seed was treated with a mixture (4: 1) of Crown (carbathiin and thiobendazole) and Apron-FL (metalaxyl:N-(2,6_dimethylphenyl)-N-(methoxyacetyl) alanin methyl ester) at an application rate of 6.2 mL kg^{-1} seed. Gustafson kindly supplied the seed treatment, for experimental purposes.

The field experiments were established at Outlook (NE 12 29 10 W3), Moose Jaw (NW9 18 26 W2), and Watrous (SE 19 31 24 W2). The soil at the Outlook site was an Elstow Orthic Dark Brown Chemozem and contained 23.5 kg ha^{-1} N to 30 cm (spring soil test levels). The Moose Jaw soil was a Regina Orthic Dark Brown Chemozem and contained 29.2 kg ha^{-1} N to 30 cm. The Watrous soil was an Elstow Orthic Dark Brown Chemozem and contained 5.6 kg ha^{-1} N to 30 cm.

Seeding in 1996 occurred on the following dates: Watrous - May 23; Outlook - May 25; Moose Jaw - June 7. Kabuli-type chickpea was seeded at a rate of 195 kg ha^{-1} whereas desi-type chickpea was seeded at a rate of 115 kg ha^{-1}. The experiments were harvested at midseason (i.e., early flowering) and at maturity. Dry matter and seed yield were measured.

Bean Field Experiment 1996

A single irrigated bean experiment was conducted in 1996, at the Saskatchewan Irrigation Centre (Elstow Orthic Dark Brown Chemozem). Spring soil tests indicated 8.3 kg ha^{-1} N to 30 cm. The experiment consisted of four bean *Rhizobium* strains (MWB6, MWB 17, MWB31 and MWB39) applied either as a sterile peat formulation or as a granular formulation, a commercially available peat inoculant, a commercially available granular inoculant, a control inoculated with sterile peat, and a non-legume control (flax). The granular formulation of the inoculants was included in this experiment because there had been indications that granular inoculants may be particularly well-suited for crops such as field bean. Pinto beans (var. Othello) were seeded at a rate of 80 kg ha" on June 10. Beans were harvested at midseason and maturity.

RESULTS AND DISCUSSION

Response of Chickpea to Inoculation

Chickpea roots became well nodulated by the test inoculants. Nodules tended to be very large and were restricted primarily to the roots in the immediate vicinity of the original seed placement. Early visual assessments of the chickpea field trials indicated that the response of chickpea to inoculation was both favorable and dramatic. Moreover, visual assessments indicated that the test inoculants, particularly BCF32, performed as well and, in many instances, better than the commercially available products. It was particularly interesting to note that the crop canopies of chickpea plants inoculated with the granular formulations tended to have a more even appearance as compared to the plants inoculated with the peat-based counterparts. Midseason dry matter yields confirmed that the test inoculants enhanced growth as compared to uninoculated controls (Tables 1 and 2). Moreover, ranking of the data suggest that *Rhizobium* strain CP39 was a particularly effective inoculant and, in most cases, was as good or better than the commercially available product. These results are in keeping with the results observed in 1995 (Walley et al. 1996). The granular formulations of the inoculants typically were associated with the highest dry matter yields although significant differences were not detected.

Table 1. Effect of different *Rhizobium strains* and inoculant formulations on the midseason dry matter yield of desi-type chickpea (1996 field season).

		Moose Jaw		Watrous		Outlook	
Strain	Formulation	kg ha^{-1}	rank[a]	kg ha^{-1}	rank	kg ha^{-1}	rank
BCF32	Granular	2455	1	3536	5	3269	1
BCF32	Peat	2447	2	4246	1	273 1	6
BCF6	Peat	2371	3	3594	3	3085	3
BCF3 1	Peat	1964	6	3224	8	2712	7
A[b]	Granular	2199	5	3673	2	2606	8
A	Peat	2294	4	3388	6	3239	2
B	Granular	1837	7	3568	4	2866	4
B	Peat	1825	8	3062	9	2475	9
Control		1375	9	3231	7	2845	5
LSD	(0.05)	650		547		n.s.	

[a] Rank denotes the relative ranking from highest to lowest of each of the individual treatments within each column.

[b] Treatment A and B are commercially available inoculants.

Table 2. Effect of different Rhizobium strains and inoculant formulations on the midseason dry matter yield of kabuli-type chickpea (1996 field season).

		Moose Jaw		Watrous		Outlook	
Strain	Formulation	$kg\ ha^{-1}$	rank[a]	$kg\ ha^{-1}$	rank	$kg\ ha^{-1}$	rank
BCF32	Granular	2645	1	3036	2	2757	4
BCF32	Peat	2545	2	3202	1	3221	1
BCF6	Peat	2148	6	2969	4	2099	8
BCF3 1	Peat	1968	8	3015	3	2205	6
A[b]	Granular	2373	5	2634	9	2358	5
A	Peat	2545	2	2779	7	2189	7
B	Granular	2485	4	2888	6	3093	2
B	Peat	2046	7	2725	8	2798	3
Control		1757	9	2958	5	1941	9
LSD	(0.05)	428		n.s.		710	

a Rank denotes the relative ranking from highest to lowest of each of the individual treatments within each column.

b Treatment A and B are commercially available inoculants.

Response of Pinto Bean to Inoculation

It is often reported that the symbiotic N_2 fixation potential of bean is poor (Piha and Munns 1987). Weiser et al. (1985) reported that although rhizobial inoculation of bean encouraged nodulation, inoculation failed to enhance seed yield. Indeed, during the 1995 field season, we observed only limited (and often not statistically significant) responses to the test inoculants (data not shown). However, in 1996, a dramatic response to inoculants applied as a granular soil implant formulation was observed (Table 3). This observation is in contrast to suggestions that bean may not be efficient N_2 fixers and suggests that inoculant placement may play an important role in the establishment of an effective *bean-Rhizobium* association.

At both midseason and final harvest, strain MBW31 promoted the highest yields when applied as a granular inoculant. It is particularly interesting to note that when this same strain was applied as a peat formulation, yields achieved did not differ significantly from the uninoculated control.

Table 3. Effect of different *Rhizobium* strains and inoculant formulations on the midseason dry matter yield and seed yield of irrigated pinto bean (1996 field season).

Strain	Formulation	Midseason Biomass		Seed Yield	
		(kg ha^{-1})	Rank[a]	(kg ha^{-1})	Rank
MBw17	granular	1367	5	*1802*	5
MBw17	peat	995	7	*908*	11
MBw31	granular	1803	1	*2594*	1
MBw31	peat	848	10	*1166*	7
MBw39	granular	1747	3	*2481*	2
MBw39	peat	897	9	*1260*	6
MBW6	granular	1786	2	*2409*	3
MBW6	peat	829	11	1100	10
A[b]	granular	1670	4	2374	4
A	peat	1058	6	1147	8
Control		938	8	1120	9
LSD	(p=0.05)	381			

[a] Rank denotes the relative ranking from highest to lowest of each of the individual treatments within each column.

[b] Treatment A is a commercially available inoculant.

SUMMARY

This research project has resulted in the identification of a number of chickpea and bean *Rhizobium strains* that have excellent potential as legume inoculants. In particular, chickpea *Rhizobium strain* BCF32 and bean *Rhizobium* strain MBW31 appear to be well suited to Saskatchewan conditions. Bean was particularly responsive to inoculants formulated as granular soil implants. Steps towards commercial production and marketing of a new chickpea inoculant have been taken and it is anticipated that this new inoculant will be commercially available in 1997. With approximately 10,000 acres of chickpea seeded in 1996 (Dr. Bert Vandenburg, pers. comm.), and a growing interest in this crop, the introduction of a new chickpea inoculant in 1997 will be a welcome addition to the Saskatchewan market.

LITERATURE CITED

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