Drs. C. Grant, G. Clayton, M. Monreal, N Lupwayi, K Turkington, D. McLaren

Search To Improve P Nutrition In Wheat

Use of mycorrhizal inoculant to encourage early-season uptake also employed in 2004 Manitoba and Alberta studies.

Summary: *Controlled release monoammonium phosphate (CRP) increased stand density and early-season biomass production as compared to uncoated monoammonium phosphate (MAP) or ammonium polyphosphate (APP). There were generally no differences between APP and MAP or with placement of MAP or APP in effects on stand or wheat yields. Analysis of mycorrhizal colonization from 2003 showed that the inoculant increased colonization, but location had the greatest impact on colonization.*

In western Canada, early-season phosphorus (P) supply may be limited due to cold temperatures and calcareous soils. On highly calcareous soils in Australia, fluid P sources can enhance early-season P supply and provide a yield benefit relative to traditional granular sources. This may be accentuated under no-till conditions. However, there has been little evaluation of fluid P sources in the Canadian prairies, as research has concentrated on the effects of urea ammonium nitrate (UAN) as an N source. The relative efficiency of monoammonium phosphate (MAP) as compared to either surface or side-banded applications of ammonium polyphosphate (APP), particularly under no-till conditions, or on cold, calcareous soils, has not been investigated. Also, there has been only limited evaluation of use of controlled release phosphate (CRP) products to improve fertilizer-use efficiency.

Use of mycorrhizal inoculant to encourage early-season uptake of P and Zn from soils in annual crop production has not been researched widely in the Canadian prairies. There is little information available comparing P fertilizer applications to use of mycorrhizal inoculants or use of mycorrhizal inoculants in combination with low levels of P fertilizer. However, based on forestry studies and recent flax trials at Brandon Research Centre, mycorrhizal inoculants could benefit agricultural systems. This study investigates applications of a mycorrhizal inoculant as compared to side-banded and seed-placed MAP and CRP and side-banded and surface dribble-banded APP. It also evaluates effects of combined application of fertilizer P and mycorrhizal on P and Zn nutrition.

2003 growing season

Chemical analysis of plant material at 6 weeks, heading, and final grain yield was completed for the two Brandon locations (data not presented). Tissue concentration of Zn for 6 weeks was generally reduced by P application but was not affected by mycorrhizal inoculations. In contrast, early P concentration was not affected by any treatment. Zinc concentration in the tissue and the grain was reduced by P application on the Manitoba Crop Diversification Centre (MCDC) site, but not the Maziers site. Concentration of P was higher with surface-dribble banded P and with mycorrhizal inoculation than with other treatments at the MCDC location but not at the Maziers location. Grain P was unaffected by treatment at either location. Leaf disease and fusarium head blight were assessed in 2003, but were not significantly affected by treatments.

Mycorrhizal colonization was also assessed at three locations. Background percent colonization varied among the three sites with the smallest percent in Lacombe (9.34%), followed by MCDC (13.87%), and Maziers with the largest percent (21.63%). Therefore, there was a difference of around 10% between Lacombe and Maziers sites. Soil textural class and lower initial P content might influence the natural potential viability of mycorrhizal fungus. At Lacombe and Maziers, treatments had an effect on mycorrhizal colonization. At MCDC treatments had smaller effect on colonization. In all sites, the addition of mycorrhizal inoculums increased colonization by approximately 3 percent. These results show that percent of colonization was largely influenced by location.

2004 growing season

Field trials were conducted at two locations in Manitoba and one location in Alberta. The growing season was cold and wet. A blizzard in mid-May interrupted seeding and continuing cold and wet conditions led to slow emergence and growth. Leaf disease development was low. Visual responses to P, Zn, and mycorrhizal inoculation were not apparent in the early growing season although there appeared to be a visual benefit to the coated P product prior to heading at some locations. The continued cold, wet conditions through summer delayed harvest. A frost on August 20 led to crop damage and a reduction in crop quality. However, wheat yields were good, considering the challenging growing season.

At Lacombe, stand density was lower with P fertilizer alone than with mycorrhizal inoculation, with or without

the use of P fertilizer. Similarly, at Maziers, application of mycorrhizal inoculant without P fertilizer increased stand density as compared to use of P fertilizer with or without mycorrhizal inoculation. In contrast, at the MCDC location, stand density was not influenced by any treatment.

Stand density at Lacombe was higher with the use of CRP than with the use of APP side-banded or MAP seed-placed or side-banded. Stand density did not differ between seedplaced and side-banded CRP.

Biomass yield was measured at 6 weeks after seeding to determine influence of treatments on early growth and nutrient uptake. There was a tendency at Lacombe for early-season biomass production to be higher with mycorrhizal inoculant plus P than for P alone. At MCDC, early-season biomass production was higher with P fertilization than in the control treatment and higher with P fertilizer with or without inoculant than with mycorrhizal inoculant alone. There was also a tendency at Maziers for yield with P fertilizer to be higher than with the mycorrhizal inoculant alone.

Early-season biomass production at Lacombe was higher with CRP as compared to side-banded APP or seed-placed or side-banded MAP, respectively. Similarly, at Maziers, biomass yield was higher with seedplaced CRP than MAP. Biomass yield at Maziers was also higher when the CRP was seed-placed than sidebanded, although at the Lacombe site there was a tendency in the opposite direction. Also at Maziers, biomass yield was increased at the higher P rate, mainly due to benefits with the higher rate of MAP.

At MCDC, biomass yield at heading was higher with P fertilizer or P fertilizer plus mycorrhizal inoculation than with mycorrhizal inoculation alone. At the Lacombe site, biomass yield at heading was higher with side-banded CRP than

Table 1. Effect of fertilizer and mycorrhizal treatments on grain yield at three locations, 2004.

				Lacombe		MCDC		Maziers	
P Rate	Source	Placement	Zinc	No Myc	Myc	No Myc	Myc	No Myc	Myc
				bu/A					
0	0	0	None	88.5	90.8	72.6	75.5	52.6	53.1
15	MAP	SB	None	84.0	92.2	76.6	76.9	53.1	56.3
30	MAP	SB	None	89.4	90.2	76.0	71.5	57.7	55.8
15	MAP	Seed	None	88.9	0.0	78.1	0.0	54.4	0.0
30	MAP	Seed	None	89.2	0.0	81.2	0.0	57.2	0.0
15	CRP	SB	None	95.9	91.9	77.3	76.4	54.0	55.3
30	CRP	SB	None	88.8	92.9	74.3	78.9	54.4	57.8
15	CRP	Seed	None	92.0	0.0	74.3	0.0	57.8	0.0
30	CRP	Seed	None	95.6	0.0	75.8	0.0	57.8	0.0
15	APP	SB	None	89.7	91.6	77.0	80.4	59.0	54.0
30	APP	SB	None	89.9		78.1		56.2	
15	APP	Dribble	None	91.0	87.4	78.2	75.5	58.1	55.2
30	APP	Dribble	None	91.7		77.2		57.7	
15	APP	SB	Zn	84.9		78.9		55.8	
30	APP	SB	Zn	89.4		78.4		57.2	

SB = sideband

APP and with seed-placed rather than side-banded CRP. At Maziers, biomass yield at heading was also higher with seed-placed CRP than seed-placed MAP. Biomass yield at heading was greater with the high than the low P rate at all three locations. At the MCDC site, biomass yield was higher with the high than the low rate of CRP with the same tendency showing with APP. Similarly, at both the Lacombe and Maziers sites, biomass yield at heading was higher with a high than with a low rate of MAP. At Maziers, biomass yield at heading was higher with surface dribble-banded APP than with side-banded APP, especially at the higher application rate.

A frost on August 20 led to significant crop damage across much of western Canada. Final grain yield was still relatively high on the Lacombe and MCDC sites (Table 1), but was restricted at Maziers. Grain quality was also influenced by frost.

While grain yield was numerically higher with P fertilization than without at all sites, differences were not significant. However, at the Lacombe site, grain yield was higher with the CRP than with MAP, particularly when side-banded.

Drs. Grant, Monreal, and McLaren are research scientists at the AAFC Research Centre in Brandon, Manitoba, while Drs. Clayton and Turkington are research scientists at the AAFC Research Centre in Lacombe, Alberta, and Dr. Lupwayi is research scientist at Agriculture and Agri-Food Canada at Beaverlodge, Alberta.