USING A POLYASPARTATE PLANT NUTRIENT ABSORPTION ENHANCER (AMISORB) WITH WHEAT, BARLEY, AND CANOLA IN ALBERTA

D.G. Pauly[1], L.K. Haderlein[1], R.H. McKenzie*, R.E. Dowbenko[1]

Abstract

In 1996, AmiSorb® was introduced in the United States as a plant nutrient absorption enhancer claiming yield increases of 20-30% Independently Alberta Agriculture and Agrium tested AmiSorb on barley, wheat and canola. Yield of all crops was increased with fertilizer but AmiSorb did not increase yield.

Introduction

In 1996, AmiSorb was introduced in the United States as a plant nutrient absorption enhancer. AmiSorb is derived from one of the amino acids used in Nutrasweet® (Anonymous, Ag Retailer, Jan. 1996) and is a salt of polyaspartic acid (copoly-[(3-carboxyproponamide)(2-carboxymethylacetatamide)] (product's MSDS). The product has been patented as a means of enhancing nutrient uptake but the mode of action is unknown (F.E. Below, 1996, personal communication).

Reports in trade publications (Anonymous, Ag Retailer, Jan., March, 1996; Aylsworth, Farm Chemicals, Feb., 1996) indicated that AmiSorb increased the efficiency of applied fertilizer resulting in earlier emergence, faster growth and higher yield. AmiSorb was repotted to attract ions of nitrogen, phosphorus, potassium and sulphur (NPKS) and micronutrients and keep them available for uptake by roots. The polyaspartate polymers were also thought to help roots store moisture. Bernardo Rico with the Donlar Corporation (the parent company to AmiLar International which markets AmiSorb) said that growers could expect to see a 25-30% increase in yield or about a 3 to 1 return on their investment in AmiSorb (Aylsworth, 1996). Although "extensive" research supported the product's efficacy on wheat, AmiSorb had also been tested on corn, soybeans, vegetables, and cotton.

Reported benefits of AmiSorb led Agrium to initiate field research trials in 1996 to determine if AmiSorb increased the yield of spring wheat and canola. In related but independent work, the Agronomy Unit (Lethbridge) of Alberta Agriculture, Food and Rural Development (AAFRD) initiated field trials in 1996 to determine if AmiSorb affected the yield of wheat or barley. For both groups the manufacturer supplied the AmiSorb and provided information on application procedures and rates. The estimated cost (~$16 ac^{-1}) of the recommended AmiSorb application rate (2 quarts acre-') was thought to be high for western Canadian farming situations. Consequently Agrium's 1996 field work included an AmiSorb rate component to determine if AmiSorb application rates and input costs could be reduced.

Materials and Methods

Agrium

Before experiments were initiated in 1996, available information indicated that AmiSorb was not crop or nutrient specific. The Torrington and Red Deer sites were selected because both had relatively low

---

[1] Agronomists with Agrium, currently in Edmonton

[2] Agronomy Unit, Alberta Agriculture, Food and Rural Development, Lethbridge

AmiSorb' is a registered trademark of AmiLar International, a Division of the Donlar Corporation

available nitrogen based on spring 1996 soil tests (Table 1) yet both were in areas with high potential yield (black soil zone of central Alberta).

Table 1. Selected soil properties of 1996 AmiSorb sites at Torrington, Red Deer, and Carmangay

	Available Nutrients (lbs/acre)							
	NO_3	N	PO_4	K_2O	SO,	pH	OM (%)	Texture
Torrington	46		37	384	45	6.8	6.5	loam
Red Deer	**36**		**31**	**344**	**66**	**6.7**	**7.3**	loam
Carmangay	**28**		**16**	**1888**	**425**	**7.7**	**3.8**	**clay loam**

The experiment was conducted with three fertilizer rates (none, half, and full) and five AmiSorb **rates in a 2** factor randomized complete block design (RCBD) with **8** replicates and 2 locations. The experiment was seeded to wheat (Teal) at Red Deer and canola (Quantum) at Tonington. The full fertilizer rate used at both sites (60 kg N, 20 kg P_2O_5, 15 kg K_2O and 10 kg S ha^{-1}) was slightly below soil test recommendations and was assumed to represent a balance between providing adequate nutrition for good growth yet still allowing for added yield from increased fertilizer efficiency. In the half fertilizer rate, the NPK and S of the full rate were all cut in half. AmiSorb equivalent to 0, 0.5, 1.0, 1.5, and 2.0 quarts (US) ac^{-1} was applied to blended NPKS prior to weighing product for individual plots. In some cases diatomaceous earth had to be added to the blended product to absorb excess moisture. In the no fertilizer treatments AmiSorb was applied to a clay based absorbent similar to kitty litter. At maturity whole plots were harvested and total grain yield was determined.

AAFRD

Soil fertility in the spring at the Carmangay site was moderate for both nitrogen and phosphorus (Table 1). The site was located in the Dark Brown soil zone of southern Alberta and represented climatic conditions considerably different than the Red Deer and Torrington sites.

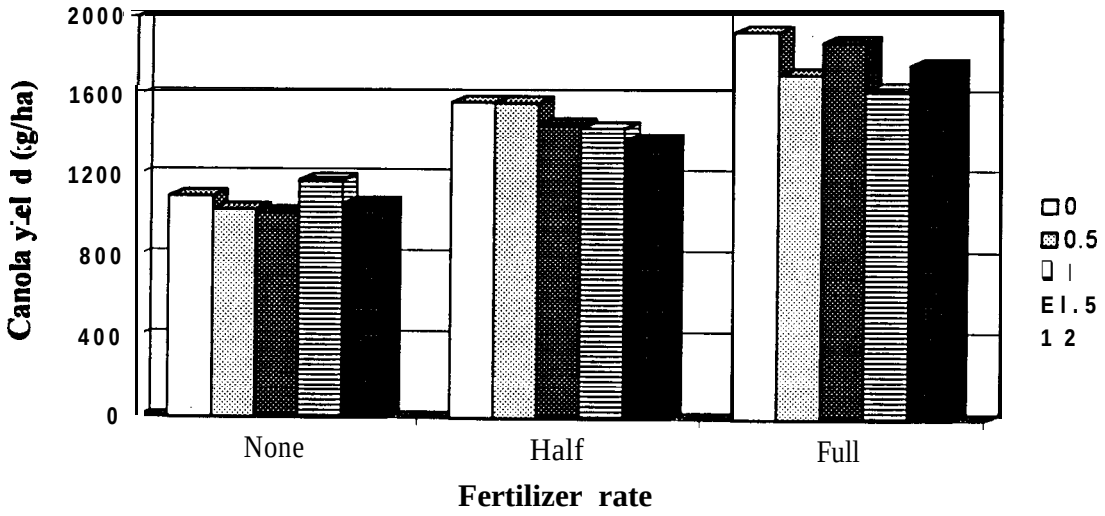
The experiment was performed as a two factor (untreated urea or AmiSorb treated urea applied at 3 nitrogen rates: 20, 40, and 60 kg N ha") RCBD with 6 replicates. AmiSorb was only applied at the recommended rate of and 2.0 quarts (US) ac^{-1} Nitrogen treatments were banded prior to seeding. Phosphate (30 kg P_2O_5 ha^{-1}) was applied in the seed-row with both Katepwa wheat and Hanington barley. At maturity whole plots were harvested and total grain yield was determined.

Results

Canola yield response to fertilizer was linear ($p = 0.000$) across the rates used in this experiment (Figure 1). Averaged across AmiSorb rates, fertilizer increased canola yield from 1078 kg ha^{-1} to 1779 kg ha^{-1}. AmiSorb did not increase canola yield at any fertilizer or AmiSorb application rate. Furthermore, at the half and full fertilizer rates, ArniSorb tended ($p = 0.05$ 1) to have a negative effect on yield.

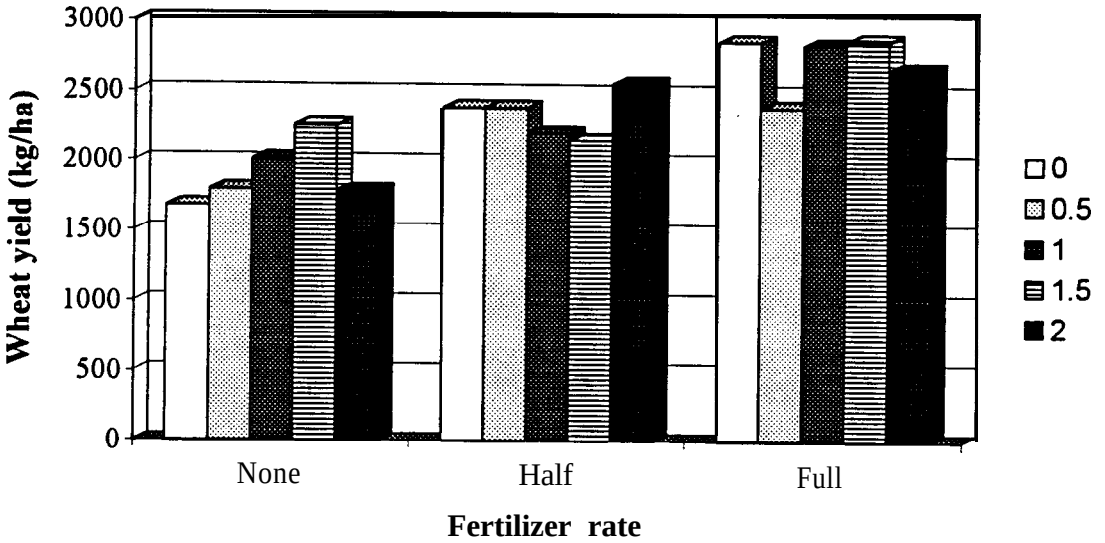
The wheat experiment at Red Deer had similar yield results as the canola experiment at Tonington. Wheat yield response to fertilizer (averaged across AmiSorb rates) was linear ($p = 0.000$) with yield increasing from 1903 kg ha" without fertilizer to 2722 kg ha" with the full rate of fertilizer (Figure 2). AmiSorb did not have any effect on wheat yield. When no fertilizer was applied, there appeared to be some benefit from AmiSorb, especially at the 1.5 qt ac^{-1} rate, but there were no significant differences between treatments.

Figure 1. Canola yield* at Torrington with 5 rates of AmiSorb (0,0.5, 1.0, 1.5, and 2.0 qt/ac) and 3 rates of fertilizer (none, half, and full***)**



'Yield: 0% moisture basis "Half: 30/10/7.5/5 kg/ha (N/P2O5/K2O/S) Full"': 60/20/15/10 kg/ha (N/P2O5/K2O/S)

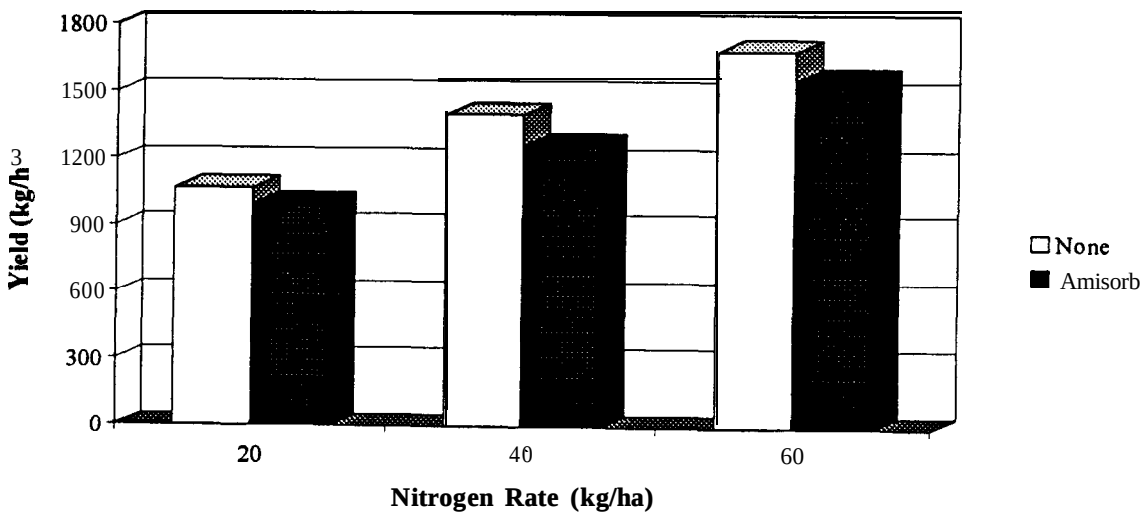
Figure 2. Wheat yield* at Red Deer with 5 rates of AmiSorb (0,0.5,1.0,1.5, and 2.0 qt/ac) and 3 rates of fertilizer (none, half, and full***)**



'Yield: 0% moisture basis .'Half: 30/10/7.5/5 kgha(NIP205/K20/S) "'Full: 60/20/I 5/I 0 kglha (N/P205/K20/S)

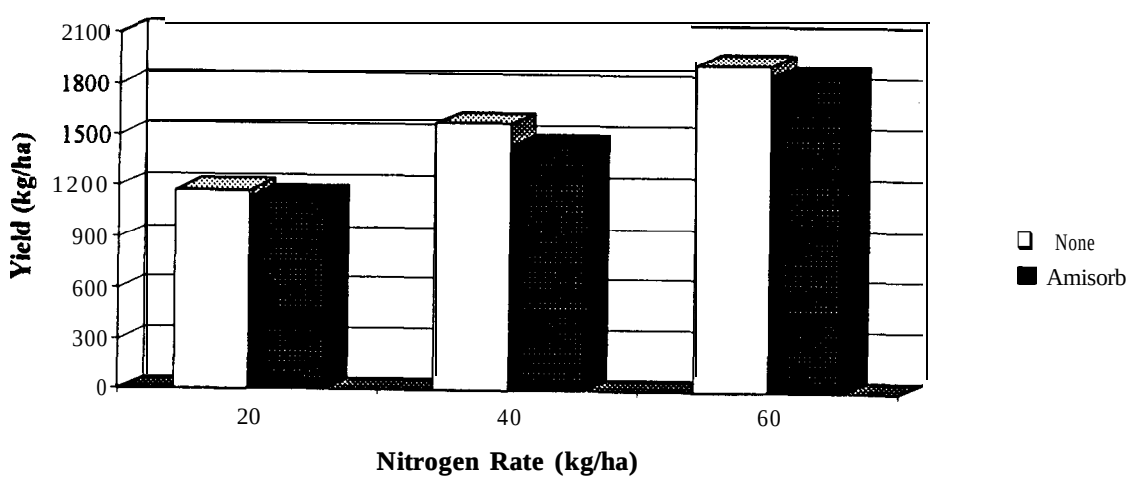
At Carmangay, nitrogen fertilization increased wheat and barley yield but AmiSorb did not increase yield of either crop (Figures 3 and 4). In fact, yield with AmiSorb was consistently lower than yield with regular urea at the same nitrogen application rate.

Figure 3. Wheat yield* at Carmangay with urea and AmiSorb treated urea at 3 nitrogen rates



*yield adjusted to 14% moisture

Figure 4. Barley yield at Carmangay with urea and AmiSorb treated urea at 3 nitrogen rates



*yield adjusted to 14% moisture

Discussion

Results from 1996 AmiSorb field work were incongruent with reported product claims; AmiSorb not only failed to increase the yield of canola, wheat, or barley but there were indications that AmiSorb might have reduced yield in some instances. The research sites and fertilizer rates used in 1996 should have created conditions where the yield-enhancing benefits of AmiSorb were evident. Crop yield at all sites was responsive to increased rates of applied fertilizer indicating that plant nutrients were a yield-limiting factor. There is no indication from the 1996 results to indicate that AmiSorb increased the efficiency of applied fertilizer.

The wheat site at Red Deer is a concern because of the high cv which probably can be attributed to a quackgrass problem. It would be diflicult to draw conclusions about the efficacy of AmiSorb based solely on the Red Deer data. However, the close parallel in results between Carmangay, Torrington and Red Deer alleviates some of these concerns. Furthermore, even with the apparent imprecision associated with the Red Deer data, the effect of fertilizer at Red Deer was still highly significant so one seriously has to question why there was not at least a hint of a beneficial trend from a product that supposedly increases the efficiency of applied fertilizer.

It has been suggested that the method of AmiSorb application was responsible for its ineffectiveness. However, information available in the spring of 1996 suggested that AmiSorb could be mixed with fluid fertilizers or impregnated onto dry fertilizers. It was also suggested that AmiSorb could be applied in the fall, top dressed during the growing season, or applied in some form of split application. Although AmiSorb promotional materials did not address the issue of band applications, the materials did not indicate that there were any applications that would limit the product's effectiveness.

In the Agrium experiments the diatomaceous earth used to dry the wet fertilizer might have reduced the effectiveness of AmiSorb. Relative to the amount of AmiSorb applied, the amount of applied diatomaceous earth was fairly substantial. In both full and half fertility rates, the ratio (by weight) of AmiSorb to diatomaceous earth was between 1 and 2. Possibly the drying agent bound with the AmiSorb and reduced or eliminated its effectiveness.

There are gaps in what is known about AmiSorb, how it works, and what results can be expected in a number of farming situations. In order for AmiSorb to increase the efficiency of nitrogen fertilizer it would either have to prevent losses or deliver the nitrogen to the plant in a controlled manner similar to a controlled-release urea. The primary nitrogen loss mechanism for spring applied fertilizer would have to be leaching which for the vast majority of western Canada is negligible. Even if leaching were a problem, it is estimated that the amount of nitrogen applied would have swamped the adsorptive/exchange capacity of applied AmiSorb.

Conclusions

Promotional material on AmiSorb indicated that the product could increase yield by 20-30%. In independent work, AAFRD and Agrium tested AmiSorb on barley, wheat and canola. Yield of all crops was increased with fertilizer but AmiSorb did not increase yield. Advertised yield claims may not be applicable with all crops in all farming situations.

References

Anonymous. 1996. Amisorb increases nutrient uptake. Ag Retailer. January, p. 74.

Anonymous. 1996. AmiLar product ready to take root. Ag Retailer. March, p. 114.

Aylsworth, J. D. 1996. Stretching fertilizer benefits. Farm Chemicals. February, pp. 64,65

Appendices

ANOVA of AmiSorb wheat experiment at Red Deer

Source	DF	Sum of Squares	Mean Square	F Value	Significance p>F
Replication	7	22133670	3161953	5.72	0.0000
Fertilizer (A)	2	13417652	6708826	12.15	0.0000
AmiSorb (B)	4	695573	173893	0.31	
A*B	8	3177385	397173	0.72	
Error	97	53575150	552321		

cv = 32%

ANOVA of AmiSorb canola experiment at Torrington

Source	DF	Sum of Squares	Mean Square	F Value	Significance p>F
Replication	7	6068845	866978	13.12	0.0000
Fertilizer (A)	2	9916043	4958022	75.01	0.0000
AmiSorb (B)	4	239652	59663	0.90	
A*B	8	552432	69054	1.04	0.4082
Error	98	6476807	66090		

cv= 18%

Contrast analysis for the effect of fertilizer and AmiSorb on canola and wheat yield at Torrington and Red Deer

	Torrington	Red Deer
Fertilizer (linear)	0.000	0.000
AmiSorb (linear)	ns	ns
Fert*AmiSorb (linear)	ns	ns
Fertilizer (quadratic)	ns	ns
half and full no AmiSorb vs half and full with AmiSorb	0.051	

ANOVA of AmiSorb wheat experiment at Carmangay

Source	DF	Sum of Squares	Mean Square	F Value	Significance p>F
Replication	5	1233660	246732	2.73	0.0425
AmiSorb (A)	1	115940	115940	1.28	0.2685
N rate (B)	2	2129644	1064822	11.76	0.0003
A*B	2	7834	3917	0.04	0.9577
Error	25	2263399	90536		

cv = 23%

ANOVA of AmiSorb barley experiment at Carmangay

Source	DF	Sum of Squares	Mean Square	F Value	Significance p>F
Replication	5	1565430	313086	2.16	0.0920
AmiSorb (A)	1	66684	66684	0.46	0.5036
N rate (B)	2	3290437	1645218	11.38	0.0003
A*B	2	7331	3665	0.03	0.9750
Error	24	8259459	144623		

cv = 25%