PHOSPHORUS STARTER FERTILIZER STUDIES IN THE SOUTHERN RED RIVER VALLEY

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Until recently, the standard fertilizer P program in the Red River Valley was the broadcast applications of from 100-200 lb/a of 18-46-0 (DAP) or 11-52-0 (MAP). Through a series of experiments, Sims and Smith (2001, 2002) showed that the application of 3 gal/a 10-34-0 liquid fertilizer with the seed at planting would result in similar yield and recoverable sugar per acre compared as larger broadcast P applications. The practice of seed-placed starter P was rapidly adopted by sugarbeet growers, but also resulted in questions regarding rate, source and efficacy of certain enhancement products. The objectives of our work was to determine whether other liquid P sources would act similar or superior to the 3 gal/a 10-34-0 standard, and whether enhancement products, especially Avail would increase the efficacy of 10-34-0.

Methods

Fertilizer P starter studies were conducted at two sites in 2005 and one site in each year from 2006-2008. The site properties are detailed in Table 1.

Table 1. Site properties from 2005-2008 P starter studies.

Year	Site	Soil type	Olsen P, ppm
2005	Glyndon, MN	Wheatville sil	11
2005	Glyndon, MN	Glyndon sil	7
2006	Glyndon, MN	Glyndon vfsl	2
2007	Glyndon, MN	Elmville fsl	4
2008	Prosper, ND	Perella sicl	9

Common to each year was the experimental design. Each year the treatments were arranged in a randomized complete block design. In all years, small-scale variability within the plots caused by root disease and other factors were present, so the data was analyzed using a spatial repeated procedure within PROC MIXED in SAS 9.1. The individual plots were 11-feet wide and 30-feet long, with 25-foot alleyways separating blocks.

In some years, stand emergence counts were made, counting each emerged beet in the middle two rows. Plants were collected for total P concentration and P uptake at the 6-leaf stage of growth. These plants were dried at 45^{o} C and then ground using a stainless steel coffee grinder, and sent analyzed for total P at the NDSU Soil and Water Laboratory in Fargo.

The middle two rows of sugar beets were harvested and weighed using a 2-row sugar beet harvester, and twelve to twenty beets were collected in bags and sent to the American Crystal East Grand Forks Quality Laboratory for analysis of recoverable sugar and other quality factors.

Treatments were different in each year. Treatment volumes that were less than 3 gal/a were made up to a 3 gal/a volume with water. All applications were made by directing the flow of fertilizer behind the seed tube outlet and before the covering wheels, allowing the fertilizer to flow directly into the seed furrow. The following is a summary of treatments for each year. When product is added as a per cent (%), it means volume/volume.

2005- Treatment description

Check
40 lb/a 10-34-0 (3.3 gal/a)
80 lb/a 10-34-0 (6.6 gal/a)
120 lb/a 10-34-0 (9.9 gal/a)
40 lb/a 10-34-0 + 1% Avail® (v/v)
80 lb/a 10-34-0 + 1% Avail®
120 lb/a 10-34-0 + 1% Avail®
40 lb/a 10-34-0 + 1.5% Avail®
80 lb/a 10-34-0 + 1.5 % Avail®
120 lb/a 10-34-0 + 1.5% Avail®

2006- Treatment description. All products are banded in furrow unless otherwise noted.

Check- no supplemental P, broadcast or banded.
10-34-0 at 1 gal/acre
10-34-0 at 2 gal/acre
10-34-0 at 3 gal/acre
10-34-0 at 3 gal/acre + ACA Plus® at 32 oz/acre
10-34-0 at 3 gal/acre (in-furrow) + Awaken® post-applied
10-34-0 at 3 gal/acre (in-furrow) + Radiate ®at 2oz/acre post-applied
10-34-0 at 3 gal/acre (in-furrow) + 60 lbs P_2O_5 as 0-46-0 broadcast
10-34-0 at 1 gal/acre + Avail® 1.5% v/v
10-34-0 at 2 gal/acre + Avail® 1.5% v/v
10-34-0 at 3 gal/acre + Avail® 1.5% v/v
RiseR® 7-17-3 at 2.5 gal/acre
Awaken® at 2 qt/acre post-applied
6-22.5-0 + Humate
6-22.5-0 + Humate + ACA Plus®
Nutra Flow® 6-26-6 at 3 gal/acre
Nutra Flow® 6-26-6 at 5 gal/acre
Broadcast P at 60 lbs P_2O_5 as 0-46-0

2007- Treatment description

Check
10-34-0, 1 gal/a
10-34-0, 2 gal/a
10-34-0, 3 gal/a
10-34-0, 1 gal/a + 1.5% Avail®
10-34-0, 2 gal/a + 1.5% Avail®
10-34-0, 3 gal/a + 1.5 % Avail®
RiseR® (7-17-3)* at 2.5 gal/a
UAP Black Label® (6-22-0) at 1 gal/a
UAP Black Label® (6-22-0) at 2 gal/a
150 lb/a 0-46-0 broadcast prior to final pre-seeding tillage
Nutra Flo® 6-26-6 at 3 gal/a
Nutra Flo® 6-26-6 at 5 gal/a
Nutra Flo®6-26-6 at 3 gal/a + RGS at 5 oz/a
Nutra Flo® 6-26-6 +Zn, 3 gal/a
Nutr Flo® 6-26-6 at 3 gal/a+ 1.5% Avail
Plant-Prod In-Row® + 2 foliar applications of FPF®

2008- Treatment description

Check
10-34-0, 1 gal/a
10-34-0, 2 gal/a
10-34-0, 3 gal/a
10-34-0, 1 gal/a + 1.5% Avail®
10-34-0, 2 gal/a + 1.5% Avail®
10-34-0, 3 gal/a + 1.5 % Avail®
10-34-0, 3 gal/a + 2 qt/a Accomplish®
10-34-0, 3 gal/a + 5.8 oz/a LI6259
RiseR®, 2.5 gal/a
RiseR®, 2.5 gal/a + 2 qt/a Accomplish®
Black Label® 2 gal/a
Black Label® 2 gal/a + 2 qt/a Accomplish®
Accomplish® alone, 2 qt/a
10-34-0, 3 gal/a + 2 qt/a Accomplish®

Avail® is a phosphate fertilizer enhancement product marketed by SFP LLC, Belton, MO.
ACA Plus® is a 7-0-0 fertilizer with ACA® plant food uptake stimulant marketed by UAP, Greeley, CO.
Awaken® is a foliar applied 16-0-2 with micronutrients fertilizer marketed by Loveland Industries, Greeley, CO.
Radiate™ is a plant growth hormone marketed by Loveland Industries, Greeley, CO.
RiseR® is a 7-17-3 liquid fertilizer with micronutrients marketed by Loveland Industries, Greeley, CO.
Humate was a humic acid experimental provided by UAP, Greeley, CO.
Nutra-Flo products are liquid fertilizers marketed by Nutra-Flo Company, Sioux City, IA.
Black Label™ is a Nortrace® 6-22-0 fertilizer and humic acid liquid marketed by UAP, Greeley, CO.
Accomplish® is a 3-0-0 fertilizer with 8 listed soil bacteria for plant nutrition enhancement, marketed by Loveland Industries, Greeley, CO.
LI 6259 is an experimental product provided by Loveland Industries, Greeley, CO.

In 2005, Site 1 was seeded May 4 and Site 2 was seeded May 3 using a John Deere MaxEmerge 2 planter on 22-inch rows. Seed was placed 1.25 inches deep with 5-inch in-row spacing. The variety was Beta 1305, with Tachegaren® seed treatment of 45 g/unit. Counter 15G® was applied at 11.9 lb/acre. Seeding rate was 2.5 seeds/ft. There was good moisture present at each site, and soil was in good condition for seeding. Three applications of micro-rates (a combination of low rates of desmediphan, phenmediphan, trifusulfuron, cloyralid and MSO adjuvant) and hand-weeding as required was conducted for weed control. Site 1 was harvested September 29 and Site 2 on September 30.

In 2006, variety Seedex Alpine, (rhizomania resistant variety) was planted on May 08with a John Deere MaxEmerge 2 on 22-inch rows. Sugarbeet seed was placed 1.25 inches deep with 5-inch in-row spacing. Counter 15G® was surface-band applied at 11.9 lbs/a, and incorporated with a drag chain at planting. Four postemergence micro-rate herbicide applications, two cultivations and hand labor was used as needed for weed control. Three fungicide applications, Eminent®, Supertin® and Headline® were applied for Cercospora leafspot control. Sugar beets were harvested September 27.

In 2007, variety Beta 1305 was seeded May 1 at a 1.25 inch depth, with 5-inch seed-spacing into a good seedbed moisture and 65^{o}F air temperature. Micro-rates of herbicides were applied four times during the early-mid season for weed control. Two fungicide applications were conducted using Eminent® and Headline® tank-mix for Cercospora control. Emergence stands for each plot were counted May 24. Sugar beets were harvested September 12.

In 2008, variety Beta 1305 was seeded May 1 at a 1.25 inch depth, with 5-inch seed-spacing into a moist, but drying seedbed and cool temperatures. The first five weeks of the growing season were dry and abnormally cool. The conditions resulted in erratic stands until the sugar beets approached 6-leaf stage. Subsequent weather conditions were warm and favorably moist, but the crop was two weeks behind normal growth most of the season, including at harvest. Four micro-rates of herbicides were applied during the season for weed control and (?) fungicide applications for Cercospora control were also applied. The sugar beets were harvested September 25.

Results

In 2005 there were no differences in sugar beet yield and quality at site 1 due to treatment. However, application of 10-34-0 increased P concentration of 6-leaf plants, and the addition of 1.5% Avail to the 9.9 gal/a treatment increased P uptake more than 9.9 gal/a alone (Table 2).

Table 2. P concentration of 6-leaf sugarbeet plants at Site 1, 2005 for 10-34-0 and Avail treatments for Site 1.

Treatment	P concentration, %
Check	0.330a
3.3 gal/a 10-34-0	0.350 ab
6.6 gal/a 10-34-0	0.361 bc
9.9 gal/a 10-34-0	0.355 b
3.3 gal/a 10-34-0 + 1% Avail	0.354 ab
6.6 gal/a 10-34-0 + 1% Avail	0.373 bc
9.9 gal/a 10-34-0 + 1% Avail	0.375 bc
3.3 gal/a 10-34-0 + 1.5% Avail	0.362 bc
6.6 gal/a 10-34-0 + 1.5% Avail	0.358 bc
9.9 gal/a 10-34-0 + 1.5% Avail	0.383 c

There were significant contrasts at Site 2 between the check plot and the 3.3 gal 10-34-0 treatment without Avail, and the 9.9 gal 10-34-0 treatment with 1.5% Avail (Table 3). The 3.3 gal 10-34-0 treatment without Avail was higher in yield than the same 10-34-0 treatment with both rates of Avail. The 9.9 gal/a 10-34-0 with 1 ½ % Avail was higher in yield than the 6.6 gal/a 10-34-0 with 1% Avail and the 3.3 gal/a 10-34-0 treatment with 1 ½ % Avail. There were no differences in early or harvest stand with treatment.

Table 3. Effect of 10-34-0 and Avail treatments on stand counts and harvest measurements at Site 2, 2005.

Treatment	Yield tons/a	Per cent sucrose	Early stand, plants/60 ft	Harvest stand plants/60 ft
Check	20.9	15.3	59	45
3.3 gal/a 10-34-0	26.4	15.5	52	42
6.6 gal/a 10-34-0	24.1	15.5	60	40
9.9 gal/a 10-34-0	23.9	15.6	58	47
3.3 gal/a 10-34-0 + 1% Avail	21.1	15.5	61	44
6.6 gal/a 10-34-0 + 1% Avail	22.8	15.4	61	42
9.9 gal/a 10-34-0 + 1% Avail	22.5	15.5	65	43
3.3 gal/a 10-34-0 + 1 ½ % Avail	20.7	15.4	67	46
6.6 gal/a 10-34-0 + 1 ½ % Avail	24.4	15.4	63	51
9.9 gal/a 10-34-0 + 1 ½ % Avail	25.9	15.7	64	44
Significance, F	1.83, sig 10%	0.80, NS	1.03, NS	1.40, NS

Table 4. P concentration of 6-leaf sugarbeet plants for 10-34-0 and Avail treatments at Site 2, 2005.

Treatment	P concentration, %
Check	0.187a
3.3 gal/a 10-34-0	0.217 cd
6.6 gal/a 10-34-0	0.228 d
9.9 gal/a 10-34-0	0.228 d
3.3 gal/a 10-34-0 + 1% Avail	0.199 b
6.6 gal/a 10-34-0 + 1% Avail	0.219 cd
9.9 gal/a 10-34-0 + 1% Avail	0.223 d
3.3 gal/a 10-34-0 + 1.5% Avail	0.211 c
6.6 gal/a 10-34-0 + 1.5% Avail	0.215 cd
9.9 gal/a 10-34-0 + 1.5% Avail	0.233 d

There was an increase in plant P content at Site 2 in 2005 with the application of 10-34-0, but there was no additional contribution consistently observed with addition of Avail (Table 4).

Table 5. Effect of starter treatments on sugar beet emergence and harvest population. Glyndon, MN, 2006.

TREATMENT	EMERGENCE BEETS/100 FT	HARVEST BEETS /100 FT	Seedling Vigor Rating
Check	184 a	145 b	2.5 a
10-34-0, 3 gal/a	174 ab	136 ab	3.0 ab
RiserR	190 a	149 b	3.8 b
10-34-0, 3 gal/a +ACA Plus	189 a	144 b	3.7 b
Awaken post	189 a	143 b	3.6 b
6-22.5-0 + Humate	164 b	127 a	3.2 ab
6-22.5-0 + Humate + ACA Plus	166 b	135 ab	3.8 b
10-34-0 + Awaken	174 ab	133 ab	2.5 a
10-34-0 + Radiate	170 ab	123 a	2.9 ab
10-34-0, 1 gal/a	176 ab	130 ab	3.5 b
10-34-0, 2 gal/a	164 b	125 b	3.0 ab
10-34-0, 1 gal/a + Avail	174 ab	136 ab	3.5 b
10-34-0, 2 gal/a + Avail	171 ab	137 ab	3.3 ab
10-34-0, 3 gal/a + Avail	176 ab	139 b	3.8 b
Nutra Flow, 3 gal/a	172 ab	136 ab	3.4 ab
Nutra Flow, 5 gal/a	165 b	124 a	3.5 b
10-34-0, 3 gal/a + Brdcst P, 60 lb P_2O_5/a	172 ab	132 ab	3.0 ab
Brdcst P, 60 lb P_2O_5/a	186 a	150 b	3.4 ab
LSD (.05)	18	14	1.0
Mean	175	136	3.5

Table 6. Effect of starter fertilizer and additives on sugarbeet root yield, sucrose percentage, recoverable sugar production, harvest population and gross $ return. Glyndon, MN, 2006.

Treatment	Root Yield, Tons/a	Net sucrose, %	RSA*	RST**	Harvest stand beets/100 ft	Gross Return, $/a	Gross Return, $/t
Check	25.6 a	14.6 a	7475 a	292 c	145 b	962.30	37.59
10-34-0, 3 gal/a	29.1 b	14.5 a	8439 c	290 bc	136 ab	1031.89	35.46
RiserR 7-17-3 , 2.5 gal/a	31.1 bc	14.8 a	9205 e	296 d	149 b	1111.83	35.75
10-34-0, 3 g/a +ACA Plus, 32 oz/a	28.5 ab	14.8 a	8436 bc	296 d	144 b	1143.14	40.11
Awaken , 2 qt/a	29.6 b	14.6 a	8377 cd	283 a	143 b	1030.08	34.80
6-22.5-0 + Humate	31.8 bc	14.2 a	9286 e	292 c	127 a	1038.59	32.66
6-22.5-0 + Humate + ACA Plus	31.6 bc	14.6 a	9196 e	291 bc	135 ab	1059.86	33.54
10-34-0 + Awaken Post Applied	29.9 b	14.4 a	8611 cd	288 b	133 ab	1061.45	35.50
10-34-0 + Radiate Post Applied	26.5 ab	14.6 a	7738 ab	292 c	132 a	882.45	33.30
10-34-0 , 1 gal/a	29.6 b	14.5 a	8614 cd	291 b	130 ab	1041.33	35.18
10-34-0, 2 gal/a	29.9 b	14.7 a	8761 d	293 c	125 b	1039.32	34.76
10-34-0 1 gal/a + Avail	29.1 b	14.5 a	8468 c	291 b	135 ab	1045.56	35.93
10-34-0, 2 gal/a + Avail	33.5 c	14.9 a	9950 f	297 d	137 ab	1250.56	37.33
10-34-0, 3 gal/a + Avail	29.4 b	14.1 a	8291 bc	282 a	139 b	1006.07	34.22
Nutra Flow, 3 g/a	30.3 bc	14.4 a	8757cd	289 bc	136 ab	1112.62	36.72
Nutra Flow, 5 g/a	29.5 b	14.6 a	8644 cd	293 c	124 a	1081.77	36.67
10-34-0, 3 g/a + Brdcst P 60 lb/a	27.4 ab	15.0 a	8220 bc	300 e	132 ab	1063.39	38.81
Broadcast P , 60 lb/a	27.1 ab	14.8 a	7995 b	295 cd	150 b	1037.39	38.28
LSD (.05)	3.4	0.6	420	3	17	186.76	2.85

*RSA= recoverable sugar per acre ** RST = recoverable sugar per ton

In 2006, All treatments except for the 3 gal/a 10-34-0, 10-34-0 + Radiate post-applied, 10-34-0 + broadcast P and the broadcast P had greater root yield than the check. The other treatments did not differ from each other in root yield except for the 2 gal/a 10-34-0 + Avail, which yielded higher than all other treatments except for the RiserR 7-17-3 at 2.5 gal/a, the 6-22.5-0 + humate treatments and the Nutra Flow at 3gal/a treatment. The humate materials in this experiment consistently plugged nozzles and required nozzle cleanout. The supplier related that the batch that we received product from was tainted by the shipper and that the product usually flowed with no problems. The other two Avail treatments were no higher than most of the other non-check treatments. Although there were differences in net sucrose between treatments, there were no differences between any treatment and the check. All treatments improved recoverable sugar per acre. The 10-34-0@ 2 g/a + Avail was the treatment with the greatest recoverable sugar per acre. The other two Avail treatments were no different from the 10-34-0 at their respective rates without Avail.

Awaken and the 10-34-0 @3 g/a + Avail treatments were lowest in recoverable sugar per ton, while the 10-34-0 @ 3 g/a + broadcast P was highest. Gross $ return per ton and per acre differences were similar to recoverable sugar per ton and per acre, respectively, with highest gross return per ton coming from the 10-34-0 at3 g/a + broadcast P, and the highest gross per acre return from the 10-34-0 at 2g/a + Avail treatments.

2007

Emergence stand was reduced the most by the 2 gal/a rate of APP and Black Label at 2 gal/acre (Table7). Harvest stand was lowest with the Nutra Flo 3 gal/a + RGS. Higher net sugar was achieved with 3 gal APP, 1 gal APP + Avail, Nutra Flo at 3 gal/a, Nutra Flo at 3 gal/a + RGS, Nutra Flo + Zn at 3 gal/a, and Nutra Flo at 3 gal/a + Avail (Table 8). There was higher sugar loss to molasses (SLM) with Black Label at 1 gal/a and 2 gal/a, broadcast P, and Prod In-Row with 2 foliar applications of FPF.

Highest tons/a were achieved with Black Label at 1 gal/a. Highest recoverable sugar per ton was produced with APP at 3 gal/a, APP at 1 gal/a + Avail, APP at 2 gal/a + Avail, Nutra-Flo at 3 gal/a, Nutra-Flo at 3 gal/a + RGS, and Nutra-Flo at 3 gal/a + Avail.
Black Label at 1 gal/a had the highest recoverable sugar per acre. Lowest recoverable sugar per acre was the RiseR treatment.

Table 7. Emergence and harvest stands due to starter fertilizer treatments, 2007.

Treatment	Emergence Stand, pl/100 ft.	Harvest Stand pl/100 ft.
Check	151 b	154 c
APP 1 gal/a	136 ab	129 bc
APP 2 gal/a	127 a	109 ab
APP 3 gal/a	159 b	143 c
APP 1 gal/a + Avail	130 ab	124 bc
APP 2 gal/a + Avail	150 ab	116 ab
APP 3 gal/a + Avail	156 b	141c
RiseR 2.5 gal/a	130 ab	103 ab
Black Label 1 gal/a	158 b	127 bc
Black Label 2 gal/a	127 a	113 ab
Broadcast P	154 b	142c
Nutra Flo 3 gal/a	162 b	136 bc
Nutra Flo 5 gal/a	153 b	125 bc
Nutra Flo 3 gal/a + RGS	146 ab	97 a
Nutra Flo+Zn 3 gal/a	152 b	129 bc
Nutra Flo + Avail	151 b	118 b
Prod in row + 2 foliar	140ab	106 ab
LSD 5%	24	20

Highest gross revenue per ton was achieved with the 3 gal APP, 1 gal APP + Avail, Nutra Flo at 3 gal/a, and Nutra-Flo at 3 gal/a + RGS. Highest gross revenue per acre was produced with the 3 gal APP, Black Label at 1 gal/a, and the Nutra-Flo 3 gal/a + Avail treatments. Treatments that were not significantly different from the highest revenue-grossing treatments were 1 gal/a APP + Avail, Broadcast P, and Nutra-Flo at 3 gal/a + Avail.

Similar to the 2006 trial there has been no consistently high revenue product. The 10-34-0 at 3 gal/a was higher in revenue per acre than most other treatments, however the 1 and 2 gal/a treatments were not, even when Avail was added. The Black Label starter fertilizer/humate treatment at 1 gal/a was higher in revenue than the check, but the 2 gal/a treatment was not. The Nutra Flo 6-24-6 treatment at 3 gal/a + Zn was higher than the check, but the other Nutra-Flo treatments were not. One would not expect, based on other Zn research conducted in the area, that adding Zn would be enough to single out a product as superior to others. If that were the case, one would also expect the RiseR treatment to be exceptional since it contained zinc, but it was not. Part of the problem with consistency may be due to disease pressure at the sites in both 2006 and 2007. Sand syndrome was present in both 2006 and 2007. Although the use of spatial statistics was helpful in sorting out some of the spatial differences not attributed to treatment, variability due to the sand syndrome effect within the plot area could not be removed entirely.

Table 8. Sugarbeet yield and quality with starter P treatments, 2007.

Treatment	Net Sugar%	SLM %	Tons/a	RST lb/t	RSA lb/a	Gross $ per ton	Gross $ per acre
Check	13.9 a	1.21 a	22.6 a	279 a	6305 b	33.74 a	762.54 a
10-34-0, 1 gal/a	14.2 ab	1.18 a	22.1 a	284 ab	6276 b	35.12 a	776.15 ab
10-34-0, 2 gal/a	14.0 ab	1.29 ab	22.4 a	279 a	6250 b	33.90 a	759.36 a
10-34-0, 3 gal/a	14.8 b	1.18 a	24.1 ab	295 b	7110 bc	37.74 b	909.53 ab
10-34-0, 1 gal/a + Avail	14.8 b	1.15 a	21.0 a	295 b	6195 ab	37.80 b	793.80 ab
10-34-0, 2 gal/a + Avail	14.5 b	1.18 a	21.3 a	291 b	6198 ab	36.74 ab	782.56 ab
10-34-0, 3 gal/a + Avail	14.3 ab	1.20 a	21.3 a	287 ab	6113a b	35.69 ab	760.20 a
RiseR, 2.5 gal.a	13.9 a	1.23 ab	18.8 a	278 a	5226 a	33.55 a	630.74 a
Black Label 1 gal/a	13.8 a	1.30 b	26.7 b	276 a	7369 c	32.97 a	880.30 ab
Black Label 2 gal/a	13.5 a	1.32 b	22.9 a	271 a	6206 ab	31.78 a	727.76 a
Broadcast P	14.1 ab	1.31 b	25.3 ab	283 ab	7160 bc	34.76 ab	879.43 ab
Nutra-Flo, 3 gal/a	14.7 b	1.26 ab	21.2 a	293 b	6212 ab	37.28 b	790.34ab
Nutra-Flo, 5 gal/a	14.1 ab	1.27 ab	24.1 ab	281 ab	6672 bc	34.36 a	828.08 ab
Nutra-Flo, 3gal/a +RGS	14.8 b	1.24 ab	21.8 a	297 b	6475 bc	38.21 b	832.98 ab
Nutra-Flo Zinc	14.6 b	1.28 ab	24.9 ab	291 b	7244 bc	36.76 ab	915.32 b
Nutra-Flo + Avail	14.6 b	1.16 a	23.7 ab	291 b	6897 bc	36.78 ab	871.69 ab
Plant Prod	14.2 ab	1.35 b	23.2 ab	284 ab	6589 bc	34.98 ab	811.54 ab
LSD 5%	0.6	0.09	3.1	12	1000	3.09	148.00

2008

There were no differences between treatments in net sugar, sugar loss to molasses, recoverable sugar per ton, gross dollar return per acre, gross dollar return per ton, or plant P concentration, so these data are not presented in Table 9. There was an increase in early stand due to the Black Label + Accomplish treatment, and this probably contributed to this treatment producing the most tons of any treatments. However, the increased tons did not result in increased recoverable sugar per acre over the check. No treatment was significantly higher than the check in recoverable sugar per acre, however several treatments were lower. It is possible that because the beets lingered in the soil for several weeks, most of the starter treatments may have been a detriment to productivity rather than a benefit.

Table 9. 2008 Prosper stand and significant harvest results.

Treatment	Early Stand Plants/100 ft	Harvest Stand Plants/100 ft	Root yield, Tons/a	Recoverable Sugar/a
Check	44.3	125	22.3	5980
10-34-0, 1 gal/a	43.0	137	22.8	6200
10-34-0, 2 gal/a	40.4	133	22.7	6080
10-34-0, 3 gal/a	33.9	135	22.9	6080
10-34-0, 1 gal/a + Avail	44.3	123	19.4	5243
10-34-0, 2 gal/a + Avail	35.0	126	18.1	4960
10-34-0, 3 gal/a + Avail	39.4	121	21.1	5920
10-34-0, 3 gal/a + Accomplish	49.0	109	19.9	5390
10-34-0, 3 gal/a + LI6259	39.3	133	21.8	6040
RiseR	33.5	130	19.1	5100
RiseR + Accomplish	49.9	143	22.1	5920
Black Label, 2 gal/a	44.5	132	19.7	5300
Black Label, 2 gal/a + Accomplish	68.4	127	24.0	6370
Accomplish	31.0	133	21.6	5817
10-34-0, 3 gal/a + Prod	44.3	144	20.6	5460
LSD 5%	18.0	24 (P>0.10)	3.0	700

Summary

Of all the treatments, the 10-34-0 alone treatments were most consistent between years and sites. The 10-34-0 treatments provided increased yields in three of five site years. RiseR increased yield in one of three studies. Awaken, a foliar product, increased yield and sugar in the one year that it was tested. Avail was the most tested product and was tested each year. It increased tons two of eighteen treatments over years, and in those years the product also increased recoverable sugar/a. It increased P concentration of 6-leaf plants in one treatment out of six in 2005. Radiate was only tested one year and was not different than the check in yields. Broadcast P and Nutra-Flo products tended to increase yields and sugar similar to 10-34-0 treatments. The humate and Black Label products also similarly increased yields compared to 10-34-0 treatments. There was no product that stood out in 2006, 2007

and 2008 as being superior to the 3 gal/a 10-34-0 standard. Growers should decide on their product based on price, availability and ease of handling.

Acknowledgements-
Funding for this project was provided partially by the Sugarbeet Research and Education Board of Minnesota and North Dakota. Additional funding was provided by J.R. Simplot Co, UAP, and product was provided by a Nutra-Flo representative.

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Use of specific products in this study does not constitute an endorsement of their use over other products by the authors or NDSU.