2007 TACHIGAREN SEED TREATMENT TRIALS IN RED RIVER VALLEY FIELDS

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Aphanomyces cochlioides is a soilborne pathogen causing damping-off and root rot of sugarbeet when soil is warm and wet. Infections occur most frequently from 60 to 86 °F, and seldom occur at less than 60 ^{0}F (4). In the Red River Valley (RRV) of Minnesota and North Dakota many fields are infested by the pathogen (2, 5). Most of the sugarbeet crop grown in the RRV is sown in late April to early May, but occasionally delays or re-planting of fields are necessary (when soil temperatures often are favorable for *Aphanomyces*). On any given date during planting, soil temperatures and moisture vary among fields. Additionally, fields in the RRV comprise various soil types and associated features, fertility, cropping histories, drainage, topography, inoculum levels of *A. cochlioides*, and other factors that affect plant growth and seedling disease.

Treatment of sugarbeet seed with the fungicide hymexazol (Tachigaren®) is effective in reducing Aphanomyces damping-off and early-season root rot in controlled environments favorable for disease (1, 2). Additionally, Tachigaren decomposes after planting, so effectiveness of the fungicide diminishes within a month after planting. Thus, effectiveness of Tachigaren seed treatment varies with the amount of residual fungicide available at time of disease onset. When this factor is combined with other field variables, it is not surprising that performance of Tachigaren seed treatment in RRV fields has been inconsistent. Sowing metabolically primed sugarbeet seed in fields that are "planted-to-stand" enhances rate and uniformity of emergence (2). In fields infested with *A. cochlioides*, there is interest in combining seed priming and Tachigaren for enhanced seedling stands and productivity. Since conditions vary throughout the growing season, it is important to evaluate these seed treatments across many locations to determine their effect over a wide range of environments.

OBJECTIVES

The purpose of 2007 trials was to determine efficacy of Tachigaren seed treatment, with and without seed priming, in fields sown at different locations and planting dates to cover a wide range of environmental conditions for i.) emergence and control of Aphanomyces damping-off and ii.) sugarbeet yield and quality.

MATERIALS AND METHODS

Seed treatments. Pelleted sugarbeet seed of Beta 1305R (resistant to *Aphanomyces* and rhizomania) that was non-primed (standard) and primed (Ultipro) was treated with 0, 20, or 45 g of Tachigaren (70WP per unit = 100,000 seed). The six seed treatments also were treated with standard rates of Apron (metalaxyl) and Thiram (tetramethylthiuram disulfide), which controls seed rot and damping-off caused by species of *Pythium* and *Rhizoctonia. solani*; these fungicides do not control Aphanomyces damping-off.

Field trials. Ten field trials were established by Betaseed, American Crystal, and the University of Minnesota, Northwest Research and Outreach Center (NWROC), Crookston at six, two, and two locations, respectively (Fig.1, Table 1). These fields had histories of low to high potential for Aphanomyces damping off and root rot. An additional trial was sown at Grafton, ND but was not included because of emergence problems caused by a heavy rainfall. In trials established by Betaseed (April 25–30), grower-cooperators sowed each seed treatment in six- or eight-row strips of two replicates; seeds were spaced from 4.4 to 5.125 inches at a depth of 1- to 1.5-inches in rows 22 inches apart. In American Crystal trials (April 30 and May 16), each seed treatment was sown in four-row plots (44 ft long, 22-inches apart) arranged in a randomized block design of six replicates; seeds were 4.5 inches apart and 1.25 inches deep. Trials established in the Aphanomyces Nursery at the NWROC, Crookston (May 2 and 11) included each treatment in a six-row plot (30-ft long, rows 22-inches apart) arranged in a randomized block design of four replicates. Seeds were sown at a 4.6 inch spacing and 1.25-inch depth. All research sites were maintained

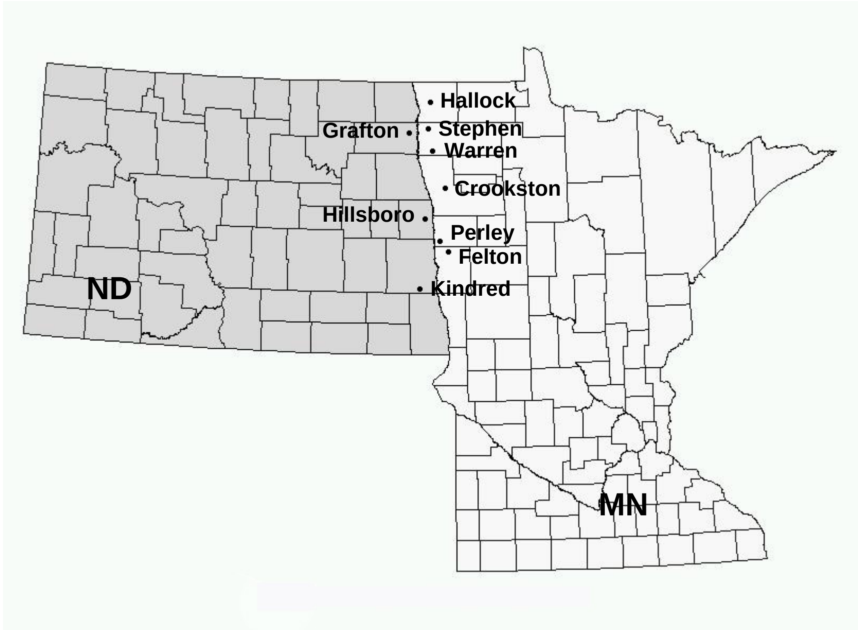

Fig. 1. Location of 2007 Tachigaren trials in Minnesota (MN) and North Dakota (ND).

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following standard production practices by grower-cooperators for the Betaseed trials and by American Crystal and NWROC personnel for their respective locations.

Data collected. Air (maximum and minimum) and soil (4-inch depth, bare soil) temperatures were obtained for each location from the nearest North Dakota Agricultural Weather Network (NDAWN) station, except at Crookston, where these data were recorded at a NWROC weather station. Visual soil moisture conditions were noted at planting. When possible, the first stand count began at 25% emergence for the best treatment, with the second stand count at 45 to 50% emergence, and the third at 4 to 6 weeks after planting (maximum emergence). In each of the Betaseed trials, two subplots per seed treatment were selected for uniformity of soil type, residue, and tillage and marked for stand counts. Seedlings in six-row strips were counted in a 16.7-foot length of each row and in eight-row strips, were counted in a 12.5-foot length per row. In the American Crystal locations, seedlings in a 12-ft length within each of two center rows per treatment plot were counted. At the NWROC sites, stand counts were made frequently because plots were on-site. The two center rows (total of 60 feet) were counted per treatment. Stand data for all trials were converted to the equivalent of 100 feet of row for comparison purposes.

The Betaseed sites were harvested by the grower-cooperators. Each treatment strip was harvested separately except at Hillsboro, where duplicate strips were combined because rows were short. The net weight of each load was used to calculate yields. For American Crystal trials, all four rows of each treatment plot were harvested. For NWROC trials, the two middle rows of each plot were harvested. Yield and quality analyses for American Crystal and NWROC trials were provided by American Crystal Co. Quality laboratories at Moorhead, MN and East Grand Forks, MN, respectively.

Soil index values. At planting, the equivalent of 1 gallon of soil was collected to a 6-inch depth across each location and assayed at the University of Minnesota, NWROC to determine Aphanomyces soil index values (they indicate disease potential when weather is ideal for infections). Each soil sample was screened through 0.25-inch hardware cloth, dispensed into four plastic pots (4.5 x 4.5 x 3.6 inches), and sown with sugarbeet ‘Crystal 817’ (25 seed/pot) to “bait” *A. cochlioides* from soil. Pots were arranged in a randomized block design in a controlled environment chamber at 70 $\pm$2 ^{0}F for 1 week for optimal emergence and then at 79 $\pm$ 2 ^{0}F (14-hour photoperiod) to favor disease. Soil was watered daily to keep moist. Stand counts were made twice weekly starting at emergence. Dying seedlings were removed at each stand count (to prevent disease from spreading to adjacent plants) and then were assayed to confirm infection by *A. cochlioides* or other root pathogens. Roots were washed free of soil, surface-treated in 0.5% NaOCl for 15 sec, rinsed twice in sterile deionized water (SDW), placed in 5 ml SDW, and examined microscopically 24 to 48 hours later. Four weeks after planting, surviving seedlings were rated for disease severity. Ratings for dead and diseased seedlings were included in a formula to calculate a Soil Index Value between 0 and 100; 0 = no potential for root rot and 100 = extremely high potential for root rot. Since *A.*

cochlioides and *R. solani* were isolated from dying seedlings at all locations, a soil index value was calculated for both pathogens.

RESULTS

Environmental conditions and potential for Aphanomyces diseases. Warren, MN was the first site sown (April 25); soil temperature at the 4-inch depth was 47 ^{0}F and air was 73 ^{0}F (Table 1). Six other locations were sown from April 27 to 30, and soil temperatures ranged from 54 to 61 ^{0}F and air from 68 to 76 ^{0}F (Table 1). Locations sown on May 2, 11, and 16 fell within the same range of soil and air temperatures as those sown in April (Table 1). All sites had moist soil at planting, except at Hallock, MN which was dry (sown April 29) and at Perley, MN which was very moist (sown May 11) (Table 1).

Average soil temperatures at 4-inches gradually increased over the next 4 weeks and across locations ranged from 51 to 62 ^{0}F the first week, 54 to 63 ^{0}F the second, 55 to 68 ^{0}F the third, and 54 to 69 ^{0}F the fourth week (Table 2). Soil temperatures tended to be slightly higher as sites were located increasing south and the last planting date (May 16) compared to earlier dates. Correspondingly, minimum and maximum air temperatures gradually increased each week after planting, and tended to increase with southerly locations and later planting dates. Minimum average air temperatures across locations after planting ranged from 40 to 50 ^{0}F the first week, 45 to 49 ^{0}F the second week, 40 to 54 ^{0}F the third week, and 43 to 58 ^{0}F the fourth week. Maximum average air temperatures across locations during this period ranged from 67 to 74 ^{0}F the first week, 65 to 76 ^{0}F the second, 66 to 74 ^{0}F the third, and 62 to 81 ^{0}F the fourth week (Table 2). Daily temperatures recorded at Crookston from May 1 through June 8 illustrate the dramatic fluctuations in maximum and minimum air temperatures and the relative stability of soil temperatures at 2- and 4-inch depths (Fig. 2). Average soil temperatures at the 2- inch depth followed changes in maximum air temperatures more closely than at the 4-inch depth.

Precipitation (amounts and timing) was the greatest variable after planting among field trials (Table 2). Within 2 weeks of planting all sites had > 1.5 inches of rainfall, except for Stephen, Hallock (also dry at planting), and Crookston-2, which had 1.37, 1.12, and 0.58 inches, respectively. By 4 weeks after planting, all locations had received a total of 2.5 to about 3.5 inches of rainfall, but Hallock had 6.2 inches, Felton 4.1, Crookston-1 3.7, and Perley 5.9 inches (Table 2).

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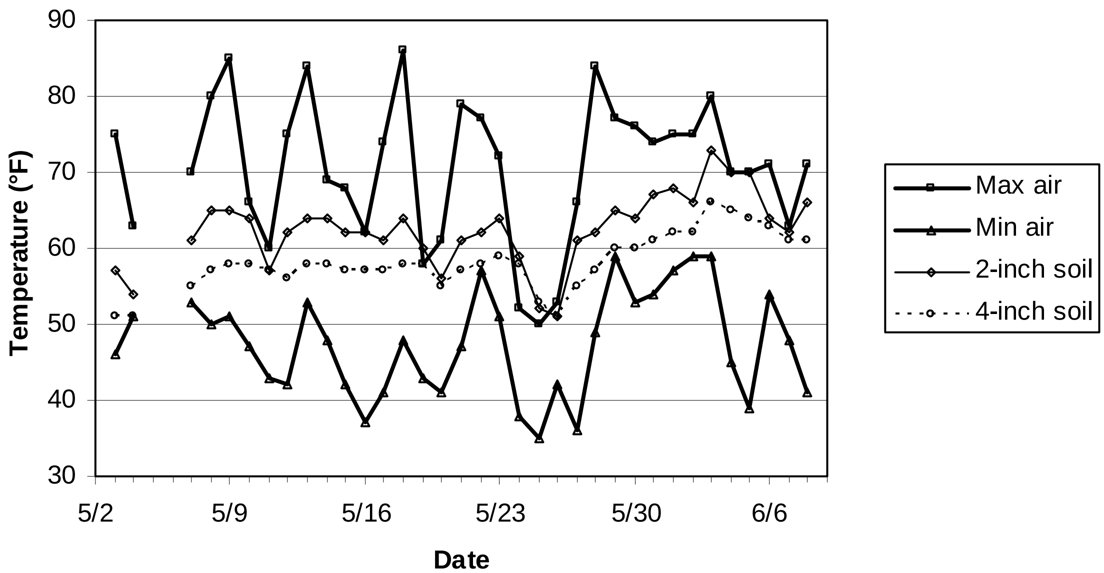

Fig. 2. Daily maximum and minimum air temperatures and average soil temperatures at a 2- and 4-inch depth from May 1 to June 8, 2007 (spans 28 day periods after the first and second planting dates) at the University of Minnesota, Northwest Research and Outreach Center, Crookston.

Table 1. Overview of locations, soil index values for *Aphanomyces cochlioides* (*Aphano*) and *Rhizoctonia solani* (*Rhizoc*), planting information, and environmental conditions at planting the 2007 Tachigaren trials.

Location	Soil index value (0-100 scale)[D] *Aphano*	*Rhizoc*	Planting date	Seed spacing (inches)	Planting depth (inches)	No. replicates/ treatment	Temp (^{0}F) @ planting[E] Soil	Air	Soil moisture @ planting[F]
Warren, MN[A]	93	5	April 25	4.75	1.25	2	47	73	Moist
Stephen, MN[A]	63	6	April 27	5.0	1.0	2	56	68	Moist
Hallock, MN[A]	74	16	April 29	4.625	1.5	2	54	70	Dry
Hillsboro, ND[A]	92	6	April 29	4.4	1.25	2	61	70	Moist
Felton, MN[A]	6	2	April 30	5.0	1.5	2	56	73	Moist
Kindred, ND – 1[A]	66	13	April 30	4.7	1.25	2	57	76	Moist
Kindred, ND – 2[B]	67	15	April 30	4.5	1.25	6	57	76	Moist
Crookston, MN – 1[C]	60	5	May 2	4.6	1.25	4	51	69	Moist (22%)
Crookston, MN – 2[C]	73	18	May 11	4.6	1.25	4	57	63	Moist (23%)
Perley, MN[B]	86	8	May 16	4.5	1.25	6	61	63	Very moist

[A] Trials were established by Betaseed with several cooperators: Johnson Farms, T. Hvidsten, Muir Farms, L. and L. Anderson, B. Pake, and J. Kub in locations listed from top to bottom of Table 1, respectively. Cooperators sowed each seed treatment in a 6- or 8-row strip of two replicates. Before emergence, two locations in each treatment strip were selected for uniformity of soil type, residue, and tillage and marked for stand counts.

[B] Trials were established by American Crystal; cooperators at Kindred and Perley were J. Kub and M. Hoff, respectively. Each seed treatment was sown in four-row plots (44 feet long, 22 inches apart) and replicated six times in a randomized block design.

[C] Trials were established in an Aphanomyces Nursery at the University of Minnesota, Northwest Research and Outreach Center, Crookston; each seed treatment was sown in six-row plots (30 feet long, 22 inches apart) and replicated four times in a randomized block design.

[D] Soil samples (0 to 6-inch depth) were collected for each location at planting. Soil index values were determined for *Aphanomyces* (*Aphano*) and *Rhizoctonia* (*Rhizoc*) in controlled environment chambers in a 4 week bioassay in conditions favorable for disease. Soil from each location was dispensed into four plastic plots (4.5 x 4.5 x 3.6 inches) sown with seed of 'Crystal 817' (25 seed/pot). Based on the number of dead and diseased seedlings throughout the 4-week assay and microscopic examination of these seedlings, a soil index value was calculated for each pathogen on a 0 to 100 scale (0 = no seedling pathogens detected and 100 = all seedlings died during the assay).

[E] Data from the nearest North Dakota Agricultural Weather Network Station; data for Hallock from the Humboldt station, for Felton from Perley. and for Kindred from the Leonard station. Data for Crookston was recorded at the University of Minnesota, Northwest Research and Outreach Center weather stations. Soil temperature was at a 4-inch depth.

[F] Based on observations at planting; soil moisture content also was measured at Crookston.

Table 2. Average soil (at 4-inch depth) and air temperatures (minimum and maximum) and total precipitation each week for 4 weeks after planting at 10 sites where Tachigaren sugarbeet seed treatments trials were established in 2007.

Location (planting date)	Average soil temp @ 4-in depth / week (wk) after planting (°F)				Average air temp/week (wk) after planting (°F)								Precipitation (inches)/week (wk)					Seedling stand counts (No. days after planting)
					Minimum				Maximum									
	Wk 1	Wk 2	Wk 3	Wk 4	Wk 1	Wk 2	Wk 3	Wk 4	Wk 1	Wk 2	Wk 3	Wk 4	Wk 1	Wk 2	Wk 3	Wk 4	Total	
Warren, MN[A] (April 25)	51	54	56	56	40	49	43	45	72	72	69	73	0.13	2.11	0.01	0.56	2.81	12, 20, 29
Stephen, MN[A] (April 27)	56	58	59	57	42	47	43	43	69	71	71	64	0.82	0.55	0.09	1.21	2.67	13, 19, 27
Hallock, MN[A] (April 29)	51	58	55	54	44	46	40	43	67	75	66	62	1.12	0	0.46	4.63	6.21	17, 25, 32
Hillsboro, ND[A] (April 29)	58	62	63	59	46	48	43	44	67	75	69	65	2.29	0	0.10	1.01	3.40	11, 15, 19, 26
Felton, MN[A] (April 30)	57	62	61	59	48	48	44	45	67	75	69	68	2.69	0.01	0.64	0.75	4.11	13, 21
Kindred, ND 1[A] (April 30)	56	63	60	59	48	49	44	46	68	76	72	69	1.71	0.09	0.17	0.66	2.63	10, 14, 18
Kindred, ND 2[B] (April 30)	56	63	60	59	48	49	44	46	68	76	72	69	1.71	0.09	0.17	0.66	2.63	15, 19, 37
Crookston, MN 1[C] (May 2)	54	57	57	56	50	43	48	46	71	70	73	66	2.06	0	0.44	1.22	3.72	8, 9, 12, 14, 19, 23, 27, 30
Crookston, MN 2[C] (May 11)	57	57	58	63	45	45	51	51	74	65	72	73	0	0.58	1.08	1.47	3.13	7, 10, 12, 14, 18, 25, 31
Perley, MN[B] (May 16)	62	59	68	69	49	46	54	58	72	69	74	81	0.90	0.61	0.44	3.98	5.93	13, 19, 26

[A] Trials were established by Betaseed with several cooperators: Johnson Farms, T. Hvidsten, Muir Farms, L and L. Anderson, B. Pake, and J. Kub in locations listed from top to bottom of Table 2, respectively.

[B] Trials were established by American Crystal; cooperators at Kindred and Perley were J. Kub and M. Hoff, respectively.

[C] Trials were established in an Aphanomyces Nursery at the University of Minnesota, Northwest Research and Outreach Center, Crookston.

[D] Data from nearest North Dakota Agriculture Weather Network station; data for Hallock from the Humboldt station, for Felton from Perley, for Kindred from Leonard, data for Crookston from weather stations at the University of Minnesota, Northwest Research and Outreach Center.

Table 3. Sugarbeet stands at three planting dates within 1 month after planting standard seed (no priming) and Ultipro (primed) seed supplemented with 0, 20, or 45 g of Tachigaren (70WP product/unit of seed). Trials were established at ten sites throughout the Red River Valley.

Seed Treatment[A]	Warren (Apr. 25)	Stephen (Apr. 27)	Hallock (Apr. 29)	Hillsboro (Apr. 29)	Felton (Apr. 30)	Kindred-1 (Apr. 30)	Kindred-2 (Apr. 30)	Crookston-1 (May 2)	Crookston-2 (May 11)	Perley May 16)	Average	% of Standard[D]
	Number plants/100 ft row/location (planting date)[C]											
1st Stand count	12 DAP	13 DAP	17 DAP	11 DAP	13 DAP	10 DAP	15 DAP	8 DAP	7 DAP	13 DAP		
Standard (Std)+0 Tach	83	66	106	39	96	85	52	85 a	35 a	83	73	100
Ultipro (Ulti)+0 Tach	124	94	122	95	116	150	68	131 b	66 b	105	107	147
Std + 20 g Tach	89	69	114	38	82	123	54	75 a	21 a	77	74	101
Ulti + 20 g Tach	112	101	110	73	102	162	66	130 b	67 b	108	103	141
Std + 45 g Tach	75	71	111	39	84	105	50	69 a	28 a	90	72	99
Ulti + 45 g Tach	117	76	106	59	98	136	60	120 b	61 b	94	93	127
LSD (*P*=0.05)[B]							NS	18.4	20.6	NS		
2nd Stand count	20 DAP	19 DAP	25 DAP	15 DAP	21 DAP	14 DAP	19 DAP	14 DAP	14 DAP	19 DAP		
Std + 0 Tach	153	129	143	125	122	179	117	167	221	210	157	100
Ulti + 0 Tach	161	154	143	150	132	201	106	177	216	202	154	98
Std + 20 g Tach	152	124	142	119	104	194	103	160	211	206	152	97
Ulti + 20 g Tach	151	146	135	127	118	196	94	175	208	220	157	100
Std + 45 g Tach	149	137	151	127	105	186	92	154	213	216	153	97
Ulti + 45 g Tach	156	130	145	135	116	197	87	177	223	205	157	100
LSD (*P*=0.05)[B]							NS	NS	NS	NS		
3rd Stand count	29 DAP	27 DAP	32 DAP	19 DAP	No data	18 DAP	37 DAP	23 DAP	18 DAP	26 DAP		
Std + 0 Tach	165	183	153	159	-	191	145	179	238	212	181	100
Ulti + 0 Tach	171	186	151	171	-	203	118	189	234	202	181	100
Std + 20 g Tach	164	163	153	149	-	204	119	177	229	208	174	96
Ulti + 20 g Tach	165	193	145	165	-	216	108	186	237	212	181	100
Std + 45 g Tach	163	184	166	159	-	194	115	174	236	220	179	99
Ulti + 45 g Tach	166	184	151	163	-	202	111	190	237	210	179	99
LSD (*P*=0.05)[B]							NS	NS	NS	NS		

A All seed treatments of 'Beta 1305R' were treated with standard rates of Apron + Thiram for control of seed rot and damping-off caused by species of *Pythium* and *Rhizoctonia solani* (these fungicides do not control Aphanomyces damping-off).

B Pertains to columns identified as Kindred-2, Crookston-1, Crookston-2, and Perley (other locations had strip trials, which could not be statistically analyzed); LSD = Least significant difference, *P* = 0.05, for each column, values followed by the same letter are not significantly different; NS = no significantly differences.

C DAP = days after planting; Stand counts at Warren, Stephen, Hallock, Hillsboro, Felton and Kindred-1 (Betaseed trials) were made at two predetermined areas within two replicates per seed treatment. Counts at Kindred-2 and Perley (American Crystal trials) were made in a 12-ft length within the two center of each plot (six replicates). At Crookston, the two center rows (30 feet long) were counted per plot (four replicates). Stand counts were adjusted to a 100-ft row.

D Each value is compared to the "standard + 0 Tachigaren" treatment.

Seedling stand. Based on indexing soil samples collected at planting, the potential for Aphanomyces diseases was at moderately high (e.g., 60) to severe (e.g., 86) levels at all sites, except at Felton, MN, where the index was low (= 6) (Table 1). At all sites, however, Aphanomyces damping-off and early-season root rot were infrequently observed within 4 weeks after planting.

At the first stand count (12 to 17 days after planting), populations of sugarbeet varied among each location (Table 3). Overall, every field had higher stands from Ultipro-treated seed with 0, 20, and 45 g of Tachigaren compared to standard (non-primed) seed treated with 0, 20, and 45 g of Tachigaren (Table 3). In both replicated trials at Crookston, Ultipro with 0, 20, and 45 g of Tachigaren resulted in equal and significantly higher stands compared to populations from the standard with 0, 20, or 45 g of Tachigaren, which were the same. In replicated trials at Kindred-2 and Perley, there were no statistical differences among seed treatments but Ultipro with 0, 20, or 45 g of Tachigaren resulted in better stands than standard seed with 0, 20, or 45 g Tachigaren. Stands were low at Kindred-2 because of hard rain, standing water, and water-logged soil after planting. Across the 10 locations, stands from standard seed with 0, 20, and 45 g of Tachigaren averaged 73, 74, and 72 plants per 100-ft row, respectively, while for Ultipro with 0, 20, and 45 g of Tachigaren averaged 107, 103, and 93, respectively. Comparison of average stands across the 10 sites to the standard (non-primed, no Tachigaren) treatment indicated that without priming, the 20 and 45 g rates of Tachigaren (101 and 99%, respectively) did not improve stands (Table 3). However, the combination of Ultipro with 0, 20, and 45 g of Tachigaren increased stands by 147, 141, and 127%, respectively compared to the standard with no Tachigaren. For all locations, stands with Ultipro and 45 g of Tachigaren tended to be somewhat lower than from Ultipro with 0 or 20 g of Tachigaren. By the second stand count (14 to 25 days after planting), however, there no longer were differences in plant stands among seed treatments (Table 3). This trend continued at the third stand count (Table 3).

Frequent stand counts for both planting dates (May 2 and 11) at Crookston, MN, illustrates emergence patterns for the various seed treatments (Fig. 3). For the first planting date, seed treated with Ultipro and 0, 20, and 45 g of Tachigaren resulted in nearly equal and significantly higher stands compared to the standard with 0, 20, and 45 g of Tachigaren until about 14 days after planting, when there were no significant differences among the six treatments (Fig. 3A). There was a slight tendency for standard and Ultipro-primed seed with Tachigaren to delay emergence for about 3 days (Fig. 3A). For the second planting date, emergence began 7 days after planting (Fig. 3B). Seed treated with Ultipro and 0, 20, and 45 g of Tachigaren resulted in equal and significantly higher stands compared to the standard with 0, 20, and 45 g of Tachigaren but by 10 days after planting, all seed treatments resulted in equal stands. There were no effects of Tachigaren in delaying emergence in this planting (Fig. 3B).

Yield and quality. Symptoms of mid to late-season Aphanomyces root rot (or "recovery" from seedling infections) was noted at all sites except at Felton, where the Aphanomyces soil index value had been low (= 6). Felton plots had some Rhizoctonia root and crown rot at harvest and that pathogen had been detected at low levels when indexing soil samples (= 2). There was slight scarring of roots typical of "recovery" from seedling infections by *Aphanomyces* for trials at Warren, Stephen, Hallock, Kindred-2, Crookston-1, Crookston-2, and Perley. Evidence of chronic root rot caused by *Aphanomyces* was reported in trials at Hillsboro and Kindred-1. Soil index values for *Rhizoctonia* were low at all locations (Table 1) and this pathogen contributed far less potential for root rot than *Aphanomyces*. Rhizoctonia root and crown rot, however, was observed at Hallock, Perley, and Crookston-1. At Hallock, about 15% of the crop was affected by the disease.

Root yields, percent sucrose, pounds of recoverable sucrose per ton, and pounds of recoverable sucrose per acre varied considerably among fields and in general, were fair to excellent (Table 4). These variables were consistently low at Perley, MN because the sugarbeet plots were planted late (May 16) and perhaps because the previous crop was corn, which can tie-up nitrogen and/or result in carry-over of herbicides. Overall, there were no clear-cut trends indicating benefits from any particular seed treatment on sugarbeet yield and quality, however, in three out of 10 sites, the highest amounts of recoverable sucrose per acre occurred when seed had been treated with Ultipro and 45 g Tachigaren. There were no statistical differences among seed treatments for yield and quality in the replicated trials at Crookston (both planting dates), Kindred-2, and Perley, MN.

Gross return (dollars per acre) varied considerably among fields and there were no significant differences among seed treatments at the four sites with replicated trials (Crookston-1, Crookston-2, Kindred-2, Perley) (Table 4). Comparison of average gross return across the 10 sites to the standard (non-primed, no Tachigaren) treatment indicated that Ultipro with no Tachigaren, standard with 45 g Tachigaren, and Ultipro with 45 g Tachigaren result in

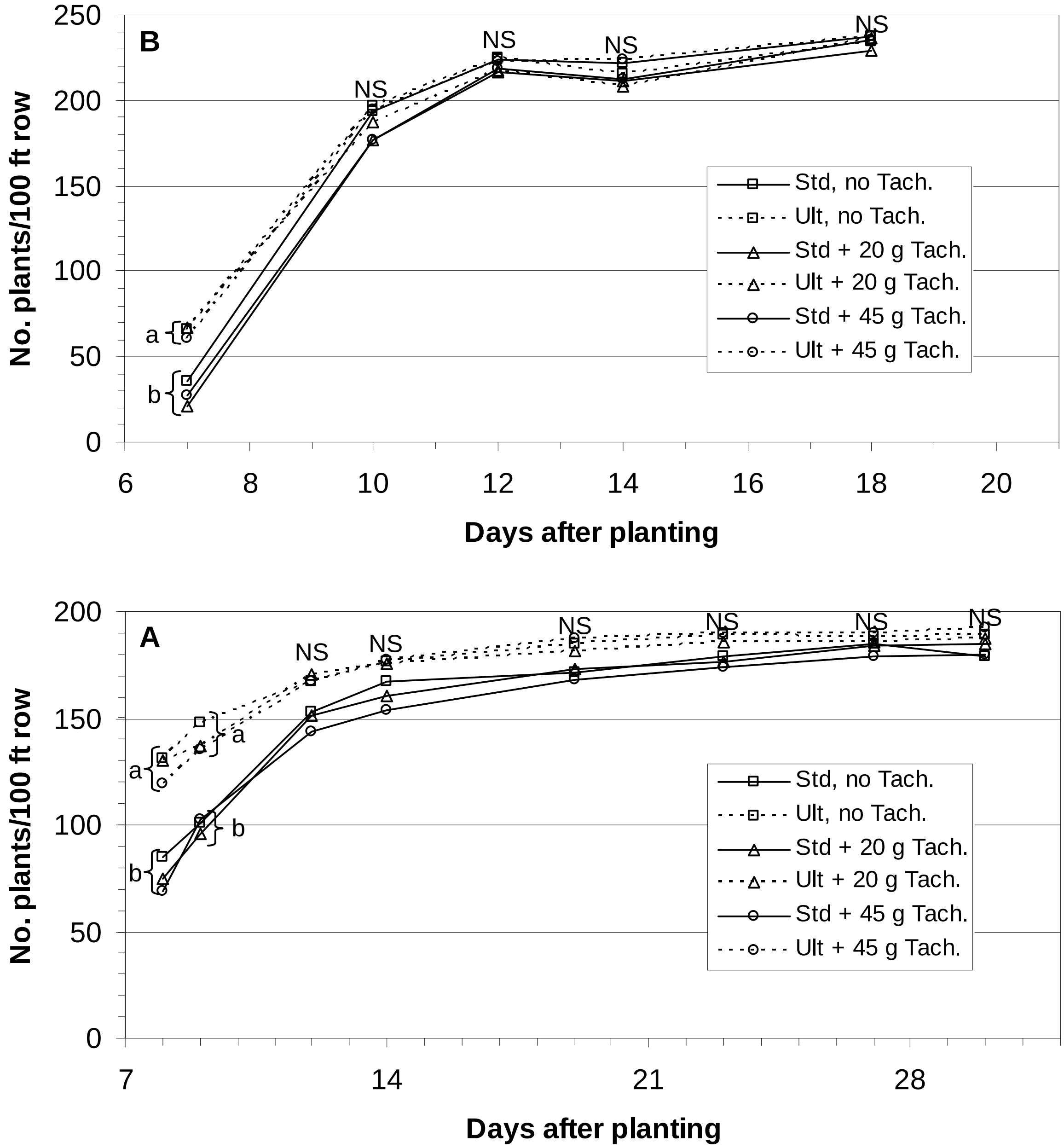

Fig. 3. Sugarbeet emergence from sowing seed of Beta 1305R that was non-primed (standard = std) or primed (Ultipro – Ulti) and treated with 0, 20, or 45 g Tachigaren (Tach, 70WP per unit seed) in the Aphanomyces Nursery at the University of Minnesota, Northwest Research and Outreach Center, Crookston on **A)** May 2, 2007 and **B)** May 11, 2007. For each date of stand counts, values followed by the same letter are not significantly different (P = 0.05): NS = not significantly different.

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a slightly increased gross return of 103, 103, and 104%, respectively. Results in individual fields varied, with the greatest gross dollar return per acre from Ultipro and 45 g Tachigaren in 3 of 10 sites, from 20 g Tachigaren (with or without Ultipro) in 4 of 10 sites, and Ultipro and no Tachigaren in 3 of 10 fields (Table 4).

Table 4. Sugarbeet yield, quality, and gross economic return of planting Beta 1305R with a standard seed (no priming) and Ultipro (primed) seed supplemented with 0, 20, or 45 g of Tachigaren (Tach, 70 WP product/unit of seed). Trials were established at ten sites throughout the Red River Valley in 2007.

	Location (Date of harvest)											
Seed Treatment[A]	Warren (Oct. 2)	Stephen (Oct. 3)	Hallock (Oct. 15)	Hillsboro (Oct. 12)	Felton (Oct. 12)	Kindred-1 (Oct. 14)	Kindred-2 (Sept. 28)	Crookston-1 (Oct. 1)	Crookston-2 (Oct. 1)	Perley (Sept. 28)	Average	% of Standard[C]
							Root weight (Tons/Acre)					
Standard (Std) + 0 Tach	26.0	23.1	21.4	28.9	27.9	21.1	19.0	33.4	30.4	12.4	24.4	100
Ultipro (Ulti) + 0 Tach	26.3	24.3	22.1	29.8	29.1	21.4	19.1	32.7	30.3	12.4	24.8	102
Std + 20 g Tach	25.4	24.9	21.2	30.2	26.5	19.4	19.1	35.9	30.3	11.4	24.4	100
Ulti + 20 g Tach	26.4	25.8	22.0	31.3	28.8	21.8	18.7	34.2	24.6	12.1	24.6	101
Std + 45 g Tach	25.3	24.3	21.2	30.6	28.4	21.8	18.4	34.8	27.4	11.8	24.4	100
Ulti + 45 g Tach	25.6	24.1	20.6	31.5	28.6	22.4	18.7	34.8	28.1	11.6	24.6	101
Average	25.8	24.4	21.4	30.4	28.2	21.3	18.8	34.3	28.5	12.0	24.5	
LSD (P=0.05)[B]							NS	NS	NS	NS		
							Sucrose (%)					
Std + 0 Tach	19.0	18.9	18.1	16.5	17.0	16.5	16.8	16.5	16.5	15.0	17.1	100
Ulti + 0 Tach	18.8	19.1	18.6	17.0	16.5	16.6	16.9	16.5	16.7	15.2	17.2	101
Std + 20 g Tach	18.6	18.5	19.3	16.6	16.7	16.6	16.8	17.0	16.5	15.1	17.2	101
Ulti + 20 g Tach	18.9	18.8	18.0	16.3	16.7	16.7	16.7	16.7	16.7	15.2	17.1	100
Std + 45 g Tach	18.7	18.8	18.7	17.2	16.7	16.7	16.8	16.6	17.0	15.2	17.2	101
Ulti + 45 g Tach	19.0	18.4	18.7	16.9	17.0	17.0	16.7	17.1	16.8	15.0	17.3	101
Average	18.8	18.8	18.6	16.8	16.8	16.7	16.8	16.7	16.7	15.1	17.2	
LSD (P=0.05)[B]							NS	NS	NS	NS		
							Recoverable sucrose (Pounds/Ton)					
Std + 0 Tach	363	361	343	313	324	314	311	300	303	279	321	100
Ulti + 0 Tach	360	364	352	323	315	318	313	301	307	282	324	101
Std + 20 g Tach	356	352	365	314	318	316	310	312	303	279	323	100
Ulti + 20 g Tach	362	357	341	308	318	319	308	303	305	283	320	100
Std + 45 g Tach	358	357	355	327	318	320	311	303	312	280	324	101
Ulti + 45 g Tach	362	349	353	323	324	326	309	314	309	280	325	101
Average	360	357	352	318	320	319	310	306	307	280	323	
LSD (P=0.05)[B]							NS	NS	NS	NS		

Table 4. **Continued.** Sugarbeet yield, quality, and gross economic return of planting Beta 1305R with a standard seed (no priming) and Ultipro (primed) seed supplemented with 0, 20, or 45 g of Tachigaren (Tach, 70 WP product/unit of seed). Trials were established at ten sites throughout the Red River Valley in 2007.

	Location (Date of harvest)											
Seed Treatment	**Warren (Oct. 2)**	**Stephen (Oct. 3)**	**Hallock (Oct. 15)**	**Hillsboro (Oct. 12)**	**Felton (Oct. 12)**	**Kindred-1 (Oct. 14)**	**Kindred-2 (Sept. 28)**	**Crookston-1 (Oct. 1)**	**Crookston-2 (Oct. 1)**	**Perley (Sept. 28)**	**Average**	**% of Standard**
						Recoverable sucrose (Pounds/Acre)						
Std + 0 Tach	9423	8337	7330	9050	9022	6633	5904	10029	9184	3469	7838	100
Ulti + 0 Tach	9473	8847	7766	9616	9164	6795	5974	9870	9307	3499	8031	102
Std + 20 g Tach	9050	8765	7728	9460	8407	6126	5915	11194	9154	3177	7898	101
Ulti + 20 g Tach	9536	9236	7482	9650	9147	6942	5747	10330	7501	3440	7901	101
Std + 45 g Tach	9069	8695	7516	9993	9025	6991	5708	10546	8528	3323	7939	101
Ulti + 45 g Tach	9278	8384	7250	10172	9259	7292	5788	10897	8681	3228	8023	102
Average	9305	8711	7512	9657	9004	6797	5839	10478	8726	3356	7938	
LSD (P=0.05)[B]							NS	NS	NS	NS		
						Gross return ($/Acre)						
Std + 0 Tach	1351	1191	1011	1167	1195	857	728	1121	1037	385	1004	100
Ulti + 0 Tach	1351	1270	1092	1270	1187	887	741	1111	1071	393	1037	103
Std + 20 g Tach	1281	1232	1111	1221	1097	796	727	1307	1033	351	1016	101
Ulti + 20 g Tach	1364	1311	1028	1228	1194	907	702	1164	854	387	1014	101
Std + 45 g Tach	1290	1274	1063	1333	1177	918	703	1192	995	372	1032	103
Ulti + 45 g Tach	1329	1171	1020	1342	1277	970	710	1280	1002	357	1046	104
Average	1328	1242	1054	1260	1188	889	719	1196	999	374	1025	
LSD (P=0.05)[B]							NS	NS	NS	NS		

[A] All seed treatments were treated with standard rates of Apron and Thiram for control of seed rot and damping-off caused by species of *Pythium* and *Rhizoctonia solani* (these fungicides do not control Aphanomyces damping-off).

[B] This notation only pertains to columns identified as Kindred-2, Crookston-1, Crookston-2, and Perley (other locations were strip trials, which could not be statistically analyzed); LSD = Least significant difference, P = 0.05; NS = no significant differences among treatments.

[C] Each value is compared to the “standard = 0 Tachigaren” treatment.

DISCUSSION

Enhanced emergence of sugarbeet from primed (Ultipro) seed, with or without the addition of 20 or 45 g of Tachigaren, occurred across the 10 locations when stand counts were made within 14 days after planting. Stand counts made within a day or two after emergence were most effective in detecting differences in stand among seed treatments, especially for the mid May planting, where differences among stands diminished more quickly than in early-sown fields. *A. cochlioides* was present in the 10 fields and in nine of these locations, Aphanomyces soil index values indicated moderately high to severe disease potential when soil is warm and wet. Infection by *A. cochlioides* was insufficient, or symptom development occurred too late, to discern differences among 0, 20, and 45 g of Tachigaren on primed and non-primed (standard) seed. In a previous controlled environment study (1), Aphanomyces damping-off did not occur, even in severely infested soils, until the onset of environmental conditions (temperature and soil moisture) were favorable for infection and symptom development by *A. cochlioides*.

Despite the range of planting dates (April 25 to May 16) and geographical distances between sites (175 miles) to increase the odds of soil temperatures and moisture favorable for Aphanomyces damping-off, environmental conditions typically were not very conducive to disease in most plantings. Optimal growth of *A. cochlioides* is from 68 to 86 °F, and infection of roots seldom occurs on seedlings at soil temperatures less than 59 ^{0}F (4). Maximum air temperatures fell between 62 to 76 ^{0}F at planting and for the following 4 weeks, daily minimum air temperatures usually were from 40 to 50 ^{0}F, which accounts for limited infections and delayed development of symptoms. Soil temperatures at the 1.0 to 1.5-inch depth (where seed was sown), however, were not measured - but were below 60 ^{0}F at the 4-inch depth. Soil temperatures monitored at Crookston at 2 inches showed that conditions were slightly favorable for infection the first half of May (55 to 65 ^{0}F), and gradually increased over the next 2 weeks. Rainfall was limited at three sites for about 2 weeks after planting. For sites with sufficient moisture, temperatures were too low and fluctuated too quickly, to allow *A. cochlioides* to produce much inoculum and infect seedlings.

Sugarbeet stands were adequate at 4 weeks after planting and at this point, availability of Tachigaren was mostly exhausted (3). As the season progressed, Aphanomyces root rot and Rhizoctonia root and crown rot, and other factors influenced yields. Fortunately Beta 1305R has some tolerance to chronic Aphanomyces root rot, so overall yields were good (except at Perley, which was affected by the previous crop of corn). Sugarbeet yield and quality varied more among locations than seed treatments, but there was a trend for seed priming and Tachigaren (with or without seed priming) to provide somewhat higher gross economic returns compared to standard (non-primed) seed with no Tachigaren. Chronic Aphanomyces root rot occurred at Hillsboro and Kindred-1 and at both locations, sugarbeet yields, quality, and gross economic returns were highest in plots from seed treated with Ultipro and 45 g of Tachigaren. Similar trends from Tachigaren-treated seed sometimes have been noted in other field experiments (C.E. Windels, *unpublished*), which suggests the fungicide may protect roots from infection and/or stimulate root growth.

Protecting sugarbeet seed with Tachigaren is “insurance” against stand losses when conditions are favorable for disease. In 2007, environmental conditions became favorable for disease in about the third or fourth week in May, a time when Tachigaren would have decomposed in early-planted seed. In fields infested with *A. cochlioides*, it is a sound practice to sow seed of an Aphanomyces-tolerant variety treated with Tachigaren, especially when “planting-to-stand”, to avoid large gaps and low stands caused by seedling disease when soil is warm and wet early in the season.

CONCLUSIONS

1. Seedling stands were higher from Ultipro-treated seed with 0, 20, and 45 g of Tachigaren compared to standard (non-primed) seed treated with 0, 20, and 45 g of Tachigaren. These stand differences were most evident within 2 weeks after planting, especially in early-planted fields, and then stands were the same for all seed treatments.

2. Benefit of seed priming (with or without Tachigaren) tended to show slight increases in gross economic return.

3, Tachigaren seed treatment on an Aphanomyces-tolerant variety continues to be recommended when planting fields infested with *A. cochlioides* – this is an “insurance policy” in the event of warm and wet weather within 2 weeks after planting.

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