

## ASPARAGUS PROGRESS REPORT 2010

**Title:** Comparing establishment of asparagus through direct seeding, transplants and crowns

**Objectives(s)/Sub-Objectives:**

- 1) Investigate seeding date and in-row spacing of direct seeded asparagus; and
- 2) Compare weed management for asparagus established by crowns, direct seed and transplants

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**Abstract of 2010 Progress:** Seeding dates showed total crowns, total weight and weight/crown significantly greater seeded June 3 than July 30. Carbohydrate level did not differ. Total number of crowns was significantly less at 10-inch seed spacing than all others. For weed management, Lorox treatment controlled broadleaf weeds for all establishment methods with little injury. Lorox was applied postemergence only on direct seeded asparagus; weeds emerging prior to crop were controlled by Touchdown HiTech. Basagran, Matrix, and Sandea as used in this study were all safe. Gallery was safe on crown planted asparagus, but did not totally control all weed species at rates tested.

**Justification:**

Washington asparagus growers seek new production methods to reach marketable yields rapidly, while reducing production costs to remain internationally competitive. By direct seeding or using transplant asparagus, establishment costs and time to first harvest may be reduced. Primary questions for success of direct seeding and transplant asparagus in Washington are optimum direct seeding date and spacing, and the impact of the herbicide program as compared to crown-established asparagus. These studies compare crop response to two planting dates and four seed spacings for direct seeding, and two herbicide regimes for direct seed, transplant and crown-established asparagus.

**Materials and Methods:**

**Direct seeding:** This field experiment was planted at Schreiber and Sons Farm in Eltopia, Washington in 2009 and completed in October 2010. The experimental design was a randomized split plot with four replications. The main plot was time of seeding, June 3 and July 30, and the subplot was in-row seed spacing, 4, 6, 8, and 10 inches. Subplot size was 15 feet long and three beds wide. Spacing between beds was 40 inches center-to-center. Asparagus cultivar Jersey Night was selected for this experiment based on grower input and seed availability. A furrow 6 inches deep was established and a single row was planted in the furrow at a depth of 1.5 inches.

First seeding occurred on June 3 and the second seeding on July 30. The first planting date was based on anticipated soil temperatures where past research shows soil temperature of 70°F or greater promotes rapid asparagus seed germination. The second planting date was based on wheat harvest in the area so that asparagus planting follows wheat harvest. The first planting was done at 4, 6, 8, and 10 inch spacing. Due to poor stand count, the second seeding was made at 2 inches and plots were thinned to the required plant spacing. The planting was fertilized following standard practices for the establishment year and based on soil test results.

Four applications of a liquid mix 6-0-0-1S fertilizer (Wilbur Ellis, Pasco, WA) were applied at a rate of 10 lbs/acre for the first three applications and 20 lbs/acre for the fourth application on June 23, July 6, July 28, and September 8, respectively. Total N application was 3 lbs/acre and total S application was 0.5 lbs/acre. Irrigation was done with an overhead center pivot at the rate of approximately 0.25 inches three times per week from June 3 until July 1. After July 1, irrigation was at 0.40 inches two times per week as temperatures increased to maintain 50% soil moisture in the top 12 inches throughout the growing season. On September 5 the irrigation schedule returned to 0.25 inches per week. Irrigation ceased on October 15. In September, 5 inches of soil was moved into the furrow to create a flat bed.

On March 11, 2010, a dry fertilizer mix (Wilbur Ellis, Pasco, WA) was broadcast with a commercial granular fertilizer spreader to apply 60 lbs N, 15 lbs S, 5 lbs Zn, and 5 lbs Mn. Between March 11 and August 30, 32-0-0 liquid fertilizer (Wilbur Ellis, Pasco, WA) was applied at 10 lbs N/acre eleven times through the center pivot during irrigation. Total N application for the season was 170 lbs N/A. Weed control was done once with Prowl H<sub>2</sub>O (BASF Corporation, Research Triangle Park, NC), at the rate of 2 pint/acre on April 30.

Spear count was measured in the center 10 feet of each row. Plant height was measured from the soil surface to the tip of the tallest fern for 10 plants per plot. Stem diameter was measured 1 inch above the soil level for 10 plants per plot. On October 18, plants were mowed and crowns were dug mechanically. Crowns were weighed and counted for each plot and mean crown weight and carbohydrate content were calculated. The cost of seed per acre was calculated for each seed spacing for cultivar Jersey Knight.

***Establishment method and herbicide application:*** This field experiment was planted at the E19 block of the Roza Farm at WSU Prosser IAREC in 2010 and will be completed in 2012. The experimental design was a randomized split plot with four replications. The main plot was establishment method and the subplot was herbicide application. Main plots were 4 rows wide and 40 feet long. Subplots were 4 rows wide and 20 feet long. A flat bottomed furrow 8 inches deep was established and spacing between beds was 40 inches center-to-center. Asparagus cultivars Jersey Night (direct seed, crowns, speedlings) and Jersey Supreme (crowns) were selected for this experiment based on grower input and seed and crown availability.

On April 20, 2010, 150 lbs N/acre 45-0-0 (Simplot, Prosser, WA) was broadcast applied and incorporated in the field. Irrigation was applied with an overhead linear move sprinkler system at the rate of approximately 0.50 inches two times per week from May 6 until May 15. From May 15 to July 24, irrigation was at 0.30 inches two times per week. After July 30 the irrigation schedule was increased to 0.75 inches three times per week as temperatures increased. Irrigation ceased on October 19. The trial was treated with Warrior with Zeon (Syngenta Seeds, Prosser, WA) at 2.5 lb ai/a and Lorsban 4E (Dow AgroSciences, Indianapolis, IN) at 1 lb ia/a on June 15, 2010 to control asparagus beetle and aphids. Assail (DuPont, Wilmington, DE) was applied at 0.1 lb ai/a on August 12 to control asparagus beetle. Soil and air temperature were

recorded at four locations within the field by a Hobo™ Weather Station (Onset Computer, Bourne, MA) from March 3 to October 30. Soil and air temperature were recorded at four locations within the field by a Hobo™ Weather Station (Onset Computer, Bourne, MA) from March 3 to October 30.

Spear count was measured in the center 10 feet of the middle two rows. Plant height was measured from the soil surface to the tip of the tallest fern for 10 plants per plot. Stem diameter was measured 1 inch above the soil level for 10 plants per plot. In the crown-established subplots, the number of common lambsquarters (*Chenopodium album*) and percent control of barnyard grass (*Echinochloa crus-galli*) were also measured (Table 9). Hand weeding times were recorded for each establishment method (Table 10).

**Crowns.** Jersey Supreme was planted on March 23 and Jersey Knight was planted on March 25. Spacing in the row was 10 inches. The two herbicide treatments were:

Treatment 1. Lorox (NovaSource, Phoenix, AZ) was applied on April 14 and June 11 at 1 lb ai/acre and 0.5 lb ai/acre, respectively. Select Max (Valent, Walnut Creek, CA) was applied on June 17 and July 30 at 0.1 lb ai/a for control of barnyard grass. Plots were hand weeded four times on June 11, July 8, July 30, and August 31 to control escaped weeds.

Treatment 2. Gallery (Dow AgroSciences, Indianapolis, IN) was applied on April 14 at 0.75 lb ai/acre. Basagran (AgriSolutions, St. Paul, MN) was applied on May 14 at 1 lb ai/acre for control of common lambsquarters. Select Max was applied on June 3 and July 30 at 0.1 lb ai/acre on June 3 and July 30 for control of barnyard grass. Plots were hand weeded four times on June 3, June 29, July 30, and August 31.

**Speedling Transplants.** Jersey Knight was seeded in the greenhouse in 72-cell trays on March 18 and was transplanted to the field on May 10 every two inches. Based upon previous experience and various production guidelines, on May 24 when seedlings were well established, 1.5 inches of soil was placed into the furrow by hand (hoe) to gradually add more soil over time until the transplants are at the same depth as the crowns. The two herbicide applications were:

Treatment 3. Lorox was applied on June 3 and July 30 at 0.5 lb ai/acre. Select Max was applied on June 3 and July 30 at 0.1 lb ai/acre for control of barnyard grass. Plots were hand weeded three times on June 29, July 30, and August 31.

Treatment 4. Basagran was applied on June 3 at 1.0 lb ai/acre. Select Max was applied on June 3 and July 30 at 0.1 lb ai/acre for control of barnyard grass. Instead of hand weeding the first time Matrix (DuPont, Wilmington, DE) was applied on June 29 at 0.07 lb ai/acre to control pigweed. Plots were hand weeded two times on July 30 and August 31 along with one application of Sandea (Gowan, Yuma, AZ) on July 30 at 0.1 lb ai/acre.

**Direct Seeded.** Jersey Knight was seeded in the field on May 10 every two inches at 0.5 inches. Based upon previous experience and various production guidelines, on July 30 after asparagus emergence was complete, 1.5 inches of soil was placed (hoed) into the furrow. The two herbicide applications were:

Treatment 5. Touchdown HiTech (Syngenta, Greensboro, NC) was applied pre-emergence on June 3 at 1 lb ai/acre. Lorox was applied on June 23 and July 30 at 0.5 lb ai/acre. Select Max was applied on June 29 and July 30 at 0.1 lb ai/acre for control of barnyard grass. Plots were hand weeded three times for control of broadleaves on July 8, July 22, and August 31.

Treatment 6. Touchdown HiTech was applied pre-emergence on June 3 at 1 lb ai/acre. Basagran was applied on June 23 at 1 lb ai/acre. Select Max was applied on June 29 and July 30 at 0.1 lb ai/acre for control of barnyard grass. Plots were hand weeded three times on July 8, July 30, and August 31 and Sandea was applied on July 30 at 0.047 lb ai/acre.

## Results and Discussion:

**Direct seeding date and spacing.** The number of asparagus spears was equivalent for both seeding dates at the end of the season in 2009, was significantly greater for the June 3 seeding throughout the 2010 growing season but was equivalent by the end of the 2010 growing season (Figure 1). The number of spears tended to be greatest for the 4-inch seed spacing, tended to be the same for the 6 and 8-inch spacings, and tended to be the lowest for the 10-inch spacing (Table 1). Spear diameter measured at the end of the 2010 growing season was greater for the June 3 seeding date than the July 30 seeding date, and did not differ due to seed spacing (Table 2). Fern height was significantly greater for the June 3 seeding date than for the July 30 seeding date throughout the 2010 growing season (Figure 2). Fern height was lowest for the 10-inch seed spacing at the beginning of the 2010 growing season but was equivalent for all plant spacings throughout the remainder of the 2010 growing season (Table 3). Total number of crowns, total weight of crowns and weight per crown were significantly greater for the June 3 seeding date than the July 30 seeding date, however level of carbohydrates did not differ due to seeding date (Table 4). The total number of crowns was significantly less for the 10-inch seed spacing than for all other spacings, however total crown weight, weight per crown and carbohydrate level did not differ due to seed spacing. The cost of seed per acre for cultivar Jersey Knight is provided in Table 5, and ranges from \$294 per acre for a 10-inch spacing to \$1,050 per acre for a 4-inch spacing.

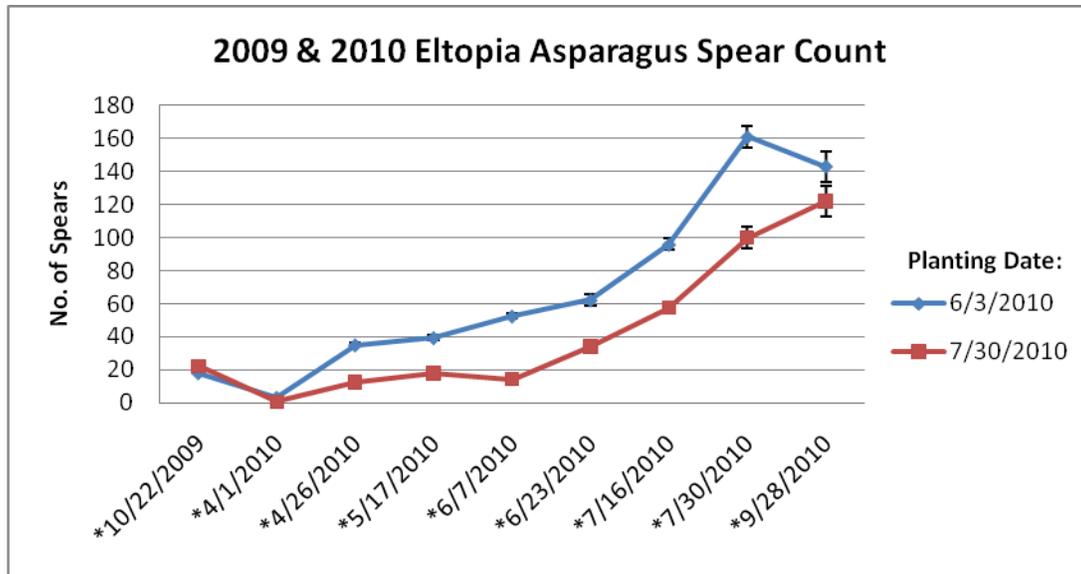
**Establishment method and herbicide application.** The number of spears early in the season, measured on April 20, for crown-established asparagus was not significantly affected by herbicide application (Table 6). For all establishment methods, the number of spears differed significantly throughout the growing season and was consistently greatest for transplanted asparagus and tended to be least for crowns (Table 7). Fern height and spear diameter differed significantly due to establishment method, and both were greatest for Jersey Knight Crown and lowest for direct seeded asparagus (Table 8). The number of common lambsquarters was significantly greater in the Gallery herbicide treatment of crown-established asparagus than in the Lorox herbicide treatment, however percentage of barnyard grass control was significantly less in the Gallery treatment (Table 9). The amount of time spent hand weeding and the cost per acre for hand weeding were significantly greater for direct seeded asparagus than for crown or transplant established asparagus (Table 10). The amount of time spent weeding and the cost per acre for hand weeding transplant asparagus tended to be less than for crown established asparagus, however these differences were not significant. Maximum soil temperature exceeded 70 °F in mid May (Figure 3), indicating this may be the earliest date for direct seeding. Maximum air temperatures exceeded 70 °F essentially throughout the entire growing period, from March 30 to October 26 (Figure 4).

The standard Lorox treatment in asparagus controlled most broadleaf weeds well in all establishment methods with very little injury to asparagus. Russian thistle (*Salsola kali*) and puncturevine (*Tribulus terrestris*) were the two most common weeds that escaped Lorox treatments and required removal by hand. Lorox is labeled as a preemergence treatment on direct seeded asparagus, with the requirement of a band of activated carbon applied directly over the seed row to protect emerging asparagus seedlings. This requires specialized equipment and is somewhat expensive and difficult to apply. In this trial, Lorox was applied only postemergence on direct seeded asparagus and weeds that emerged prior to the crop were controlled with a

timely application of Touchdown HiTech, eliminating the need for a preemergence application of Lorox. Basagran, Matrix, and Sandea were all safe on asparagus as used in this study. Some temporary chlorosis was evident on asparagus following Matrix applications, but asparagus fully recovered after several weeks. Gallery was safe on crown planted asparagus, but at the rates tested did not totally control the spectrum of weeds in this study.

### **References**

- Clore, W. J., and R. E. Early. 1976. Direct-seeded vs. crown-planted asparagus. WSU Bulletin 838. 5 pp.
- Sandsted, R.F., D. A. Wilcox, T. A. Zitter, and A. A. Muka. 1985. Asparagus. Cornell Cooperative Extension Publication Information Bulletin 202.
- Sims, W. L., F. Takatori, J. Johnson, and B. Benson. 1971. Direct seeding of asparagus. Univ. of California Agric. Ext. Bulletin. AXT-348. 14 pp.



**Figure 1.** Mean number of spears in 10-row feet for each planting date at Schreiber & Sons in Eltopia, Washington in 2009 and 2010.

**Table 1.** Mean number of spears for 10-row feet for each seed spacing at Schreiber & Sons in Eltopia, Washington in 2009 and 2010.

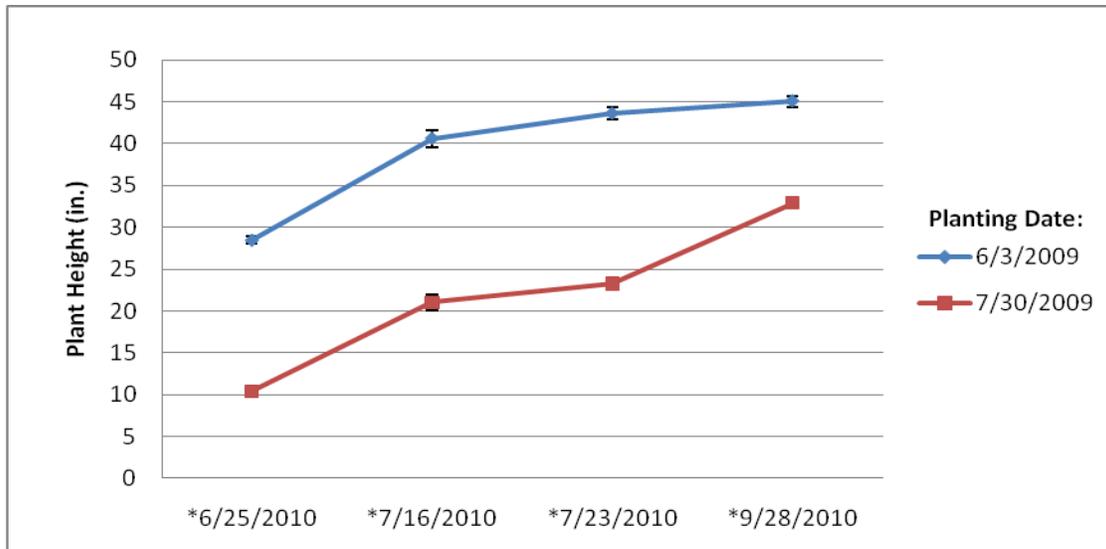
Seed Spacing (inches)	2009	2010							
	22-Nov	1-Apr	26-Apr	17-May	7-Jun	23-Jun	16-Jul	30-Jul	28-Sep
4	25.38 a*	2.71	29.83 a	37.04 a	41.04 a	54.71	92.42 a	152.54 a	159.00 a
6	20.67 b	1.63	23.29 b	28.50 b	35.63 ab	44.04	77.08 b	132.71 ab	134.88 ab
8	18.92 b	2.25	22.83 b	26.29 b	30.29 bc	44.79	71.46 b	123.71 b	124.00 ab
10	16.38 c	1.92	19.21 b	23.08 b	26.29 c	49.21	65.50 b	112.29 b	111.88 b
<b>Significance</b>	<i>&lt;.0001</i>	<i>NS</i>	<i>.0019</i>	<i>.0001</i>	<i>.0029</i>	<i>NS</i>	<i>.0053</i>	<i>.0430</i>	<i>.0982</i>

\*Levels not connected by same letter are significantly different.

**Table 2.** Mean spear diameter (mm) for each planting date and each seed spacing at Schreiber & Sons in Eltopia, Washington on September 28, 2010.

		Spear Diameter (mm)
<b>Planting Date</b>	3-Jun-2009	7.12 a*
	30-Jul-2009	5.12 b
	<b>Significance</b>	<i>&lt;.0001</i>
<b>Seed Spacing (inches)</b>	4	5.89
	6	6.36
	8	6.16
	10	6.06
	<b>Significance</b>	<i>NS</i>

\*Levels not connected by same letter are significantly different.



**Figure 2.** Mean fern height (inches) for each planting date at Schreiber & Sons in Eltopia, Washington in 2010.

**Table 3.** Mean fern height (inches) for each seed spacing at Schreiber & Sons in Eltopia, Washington in 2010.

Seed Spacing (inches)	25-Jun	16-Jul	23-Jul	28-Sep
4	19.84 a*	32.38	34.11	39.35
6	19.48 a	30.66	33.51	39.24
8	20.83 a	30.58	33.84	39.81
10	17.55 b	29.63	32.26	37.49
<b>Significance</b>	<b>.0118</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

\*Levels not connected by same letter are significantly different.

**Table 4.** Mean crown number, total crown weight (kg), weight per crown (g), and level of carbohydrates per crown for each planting date and each seed spacing at Schreiber & Sons in Eltopia, Washington on October 18, 2010.

		Crown			
		Total Number	Total Wt. (kg)	Individual Wt.(g)	Carbohydrates
Planting Date	3-Jun-09	40.25 a*	8.61 a	217.11 a	371.00
	30-Jul-09	23.00 b	3.51 b	156.40 b	388.38
	<b>Significance</b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>	<b>0.0007</b>	<b>NS</b>
Seed Spacing	4	35.50 a	7.19	202.45	392.25
	6	33.50 a	6.13	166.89	381.00
	8	33.00 a	6.05	180.65	369.00
	10	24.50 b	4.88	197.05	376.50
	<b>Significance</b>	<b>0.0568</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

\*Levels not connected by same letter are significantly different.

**Table 5.** Cost of seed per acre for cultivar Jersey Knight.

Seed Spacing (in.)	No. of Seeds/ Acre <sup>1</sup>	Pounds Seed/ Acre <sup>1</sup>	Cost per Acre <sup>3</sup>
4	39,600	2.5	\$1,050
6	26,400	1.7	\$714
8	19,800	1.3	\$546
10	11,000	0.7	\$294

<sup>1</sup> Assumed 40 inch bed spacing

<sup>2</sup> Assumed 15,900 seeds per pound

<sup>3</sup> Assumed seed cost of \$420 per pound

**Table 6.** Mean number of spears for 10 feet of row for each herbicide treatment and variety of crown-planted asparagus at WSU Prosser IAREC Roza Farm on April 20, 2010.

Treatment	Variety	Spear Count
Gallery	J. Supreme	4.50
	J. Knight	4.31
Lorox	J. - Knight	5.00
	J. Supreme	6.44
<b>Significance</b>		<i>NS</i>

**Table 7.** Mean number of spears for 10 feet of row for each method of asparagus establishment at WSU Prosser IAREC Roza Farm in 2010.

Planting type	22-Jun	19-Aug	18-Oct
Crown J. Supreme	38.00 b*	96.16 c	101.00 c
Crown J. Knight	26.54 c	72.71 d	72.81 c
Transplant	104.87 a	217.13 a	341.81 a
Direct Seeding	31.96 bc	132.67 b	200.38 b
<b>Significance</b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>

**Table 8.** Mean fern height (in.) and spear diameter (mm) for 10 plants for each method of asparagus establishment at WSU Prosser IAREC Roza Farm in 2010.

Planting type	Fern Height (in)		Spear Diameter (mm)
	19-Aug	18-Oct	18-Oct
Crown J. Supreme	35.59 b*	37.99 b	5.84 a*
Crown J. Knight	39.46 a	42.81 a	6.45 a
Transplant	24.23 c	30.69 c	3.27 b
Direct Seeding	17.73 d	24.74 d	2.95 b
<b>Significance</b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>	<b>&lt;.0001</b>

\*Levels not connected by same letter are significantly different.

**Table 9.** Mean number of lambsquarters and percent barnyard grass control (10 ft. x 20 ft.) for each herbicide treatment of crown-established asparagus at WSU Prosser IAREC Roza Farm in 2010.

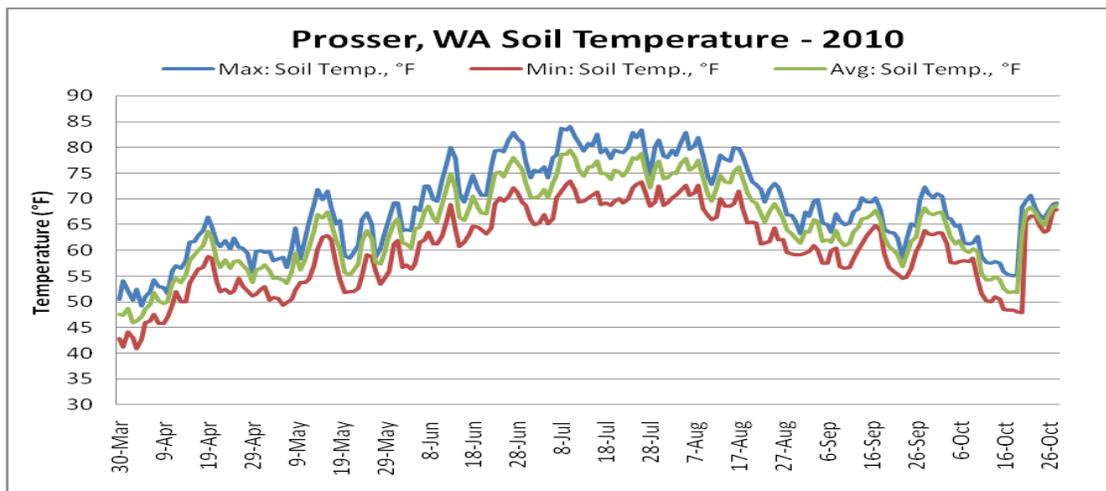
Treatment	No. of Lambsquarters			Grass Control (%) 21-May
	4-May	14-May	21-May	
Gallery	11.13 a*	45.75 a	11.75 a	20.00 b
Lorox	0.00 b	0.00 b	0.00 b	91.25 a
<b>Significance</b>	<b>.0163</b>	<b>.0142</b>	<b>.0218</b>	<b>0.0003</b>

\*Levels not connected by same letter are significantly different.

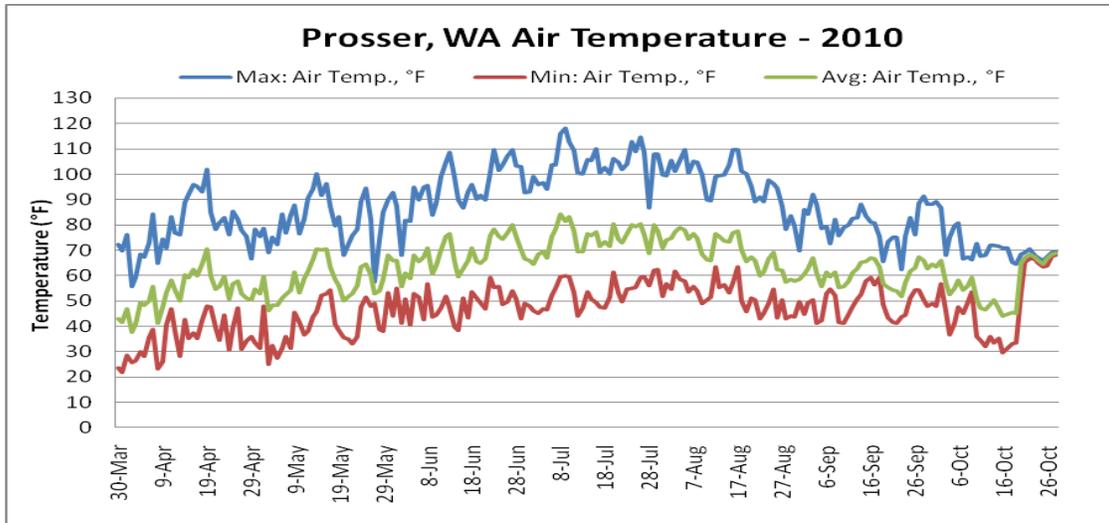
**Table 10.** Mean time per plot, time per acre, and cost per acre for total season hand weeding for each method of asparagus establishment at WSU Prosser IAREC Roza Farm in 2010.

Planting type	Total Time/plot (seconds)	Total Time/acre (hours)	Cost/acre (1 person @ \$10/hour)
Crown J. Supreme	128.63 b*	5.85 b	\$58.51 b
Crown J. Knight	133.88 b	6.09 b	\$60.90 b
Transplant	87.63 b	3.99 b	\$39.86 b
Direct Seeding	398.25 a	18.12 a	\$181.16 a
<b>Significance</b>	<b>0.0001</b>	<b>0.0001</b>	<b>0.0001</b>

\*Levels not connected by same letter are significantly different.



**Figure 3.** Average maximum, minimum, and average daily soil temperature at WSU Prosser IAREC Roza Farm in 2010.



**Figure 4.** Average maximum, minimum, and average daily air temperature at WSU Prosser IAREC Roza Farm in 2010.