# 2016 Vegetable Trial Report

**January 2017**

**MP-164.7**

**Department of Horticulture and Landscape Architecture**
**Division of Agricultural Sciences and Natural Resources**
**Oklahoma State University**

The Department of Horticulture and Landscape Architecture, cooperating departments and experimental farms conducted a series of experiments on field vegetable production. Data were recorded on a majority of aspects of each study, and can include crop culture, crop responses and yield data. This report presents those data, thus providing up-to-date information on field research completed in Oklahoma during 2016.

Small differences should not be overemphasized. Least significant differences (LSD) values are shown at the bottom of columns or are given as Duncan's letter groupings in most tables. Unless two values in a column differ by at least the LSD shown, or by the Duncan's grouping, little confidence can be placed in the superiority of one treatment over another.

When trade names are used, no endorsement of that product or criticism of similar products not named is intended.

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## Seed Sources

Abbott & Cobb
P.O. Box 307
Feasterville, PA 19053
www.acseed.com

BHNseed
P.O. Box 3267
Immokalee, Fl  34143
www.bhnseed.com

Crookham Co.
P.O. Box 520
Caldwell, ID 83606-0520
www.crookham.com

Dewitt Seeds
P.O. Box 5556
Norman, OK 73070
www.dewittseed.com

Illinois Foundation Seed
1178 CR 900 N
Tolono, IL 61880
www.ifsi.com

Harris Seeds
355 Paul Rd.
P.O. Box 24966
Rochester, NY 14624-0966
www.harrisseeds.com

Harris Moran
P.O.Box 4938
Modesto, CA 95352
www.harrismoran.com

Johnny's Selected Seeds
955 Benton Avenue
Winslow, ME 04901
www.johnnyseeds.com

Otis S. Twilley Seed Co., Inc.
P.O. Box 4000
Hodges, SC 29653
www.twilleyseed.com

Rupp Seeds
17919 County Road B
Wauseon, OH 43567-9458
www.ruppseeds.com

Seedway
99 Industrial Rd.
Elizabethtown, PA 17022
www.seedway.com

Seminis Vegetable Seeds
6224 Whittondale Drive
Tallahassee, Fl. 32312-1571
www.seminis.com

Stokes
P.O. Box 548
Buffalo, NY 14240-0548
www.stokeseeds.com

Syngenta Seeds, Inc. (Rogers)
P.O. Box 4188
Boise, ID 83711-4188
www.syngenta.com

Sakata
18095 Serene Drive
Morgan Hill, CA 95037
www.sakata.com

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# Crop Culture

## Spring 2016 Beet Variety Trial, Perkins, Oklahoma

**Brian Kahn and Lynda Carrier**

**Introduction:** Beets tend to be more popular in northern states, but are in demand by health-conscious consumers at local outlets and farmers markets.

**Objectives:** Objectives of this trial were to evaluate 13 cultivars of round red beets for yield and overall quality.

**Materials and Methods:** The study was conducted at the Cimarron Valley Research Station in Perkins. The study originally was planted on March 11 using a precision planter to sow packets of 120 seedballs per 20-ft. plot. This planting failed due to severe soil crusting. A new area was rototilled and planted on March 24. Plots were not precision-sown; instead a hand-pushed Planet Jr. seeder was used with plate hole #22 and a standard shoe set in the third notch from the shoe. The planting rate was about 8 seedballs/foot; however, seedball size varied among cultivars. As a result, ‘Ruby Queen’ was under-seeded and ‘Red Cloud’ was over-seeded. Plots were 15 feet long with 2 feet between rows. Cultivars were replicated 3 times in a randomized block design. Plots were sprayed with S-metolachlor herbicide on March 25 at the rate of ¾ pint/acre and two rows of microsprinklers were installed. Plots were fertilized with 75 lbs. N/acre plus 0.5 oz. of borax per 100 ft2 on March 26. Plants were sidedressed with urea to supply 50 lbs. N/acre on May 8, followed by hand cultivation. Harvests began on May 27. Once a cultivar appeared to have several large roots, all plants in a 5-ft. section of row were removed and sorted into “strings” and undersized culls (roots < 1.5 in. diameter), full-sized cull roots, and marketable roots. Marketable roots were weighed with tops. Five representative samples per plot were chosen for measurement of top length, after which tops were removed and the weight of all topped marketable roots recorded. The five sample roots were washed; rated for uniformity of shape and smoothness; cut in half and rated for zoning and internal color; and measured for diameter. The process was repeated one week later for each given cultivar and data combined over harvests. Dates of initial harvest for each cultivar are shown in Table 1.

**Results and Summary:** Results are shown on the following pages. Differences in overall yield should not be overemphasized as planting rates were unequal. However, there were clear differences in quality. Open-pollinated cultivars have inexpensive seed and may be adequate for certain markets. ‘Detroit Dark Red’ and ‘Ruby Queen’ appeared suitable. Hybrid cultivars offer the potential for uniform roots with minimal zoning and deep red interior color. Any of the tested hybrid cultivars may be worthwhile for grower trial with the possible exception of ‘Robin’, which produced a high number of culls.

**Acknowledgments:** We thank Lynn Brandenberger and Josh Massey for assistance.

## SPRING BEET VARIETY TRIAL (REPLICATED) – PERKINS, 2016

Summary of notes recorded by B.A. Kahn from 27 May through 17 June. All notes based on three plots per variety.

| Variety | Notes |
|---|---|
| Boro | One of two with the best color and minimal zoning. Promoted in catalogs for baby beets. Recommended for Oklahoma. |
| Detroit Dark Red | Had the (numerically) poorest quality index and intermediate yield. Acceptable for an open-pollinated variety. |
| Detroit Supreme | Usually statistically similar to 'Detroit Dark Red.' |
| Eagle | Could have been harvested earlier; had the heaviest roots in the trial. Intermediate in overall quality. Needs further trials. |
| Early Wonder | Poor ratings for zoning and color. There are better open-pollinated (Smooth Leaf)varieties. |
| Falcon | Good yield and root shape but showed some zoning. Needs further trials. |
| Kestrel | Intermediate in yield and overall quality. Better root interiors than 'Falcon.' Needs further trials. |
| Merlin | Good yield and overall quality. Recommended for Oklahoma. |
| Moneta | Monogerm; seeding rate was not adjusted so yields were low. Early, with good root interiors. Recommended for trial if a monogerm variety is desired. |
| Red Ace | Good yield and overall quality. Recommended for Oklahoma. |
| Red Cloud | Small seedballs led to a high rate of seeding and late yield; however, performed well overall. One of two with the best color and minimal zoning; however, skins could be rough. Promising, but needs further trials. |
| Robin | Good root interiors, but quality index similar to open-pollinated cultivars due to the (numerically) highest cull production in the trial (data not presented). Many roots had splits, holes, and black spots. |
| Ruby Queen | Large seedballs led to a low rate of seeding that limited yield; also may have been harvested a few days early. Quality index comparable to most hybrids but more zoning than 'Detroit Dark Red.' Acceptable for an open-pollinated variety. |

**Table 1.** Spring Beet Replicated Variety Trial – Perkins, 2016[Z]

| Cultivar | Source | Genetics | Date of 1st harvest | Marketable roots (no./A) | % Market number[y] | Top Length (in.) |
|---|---|---|---|---|---|---|
| Falcon | Sakata | F1 | 6/6 | 124,146 | 44.5 | 14.4 |
| Red Cloud | Seedway | F1 | 6/10 | 112,530 | 26.9 | 15.6 |
| Merlin | Sakata | F1 | 6/6 | 92,928 | 50.4 | 15.2 |
| Red Ace | Sakata | F1 | 6/4 | 92,202 | 38.4 | 15.9 |
| Kestrel | Sakata | F1 | 6/6 | 87,120 | 38.9 | 14.7 |
| Eagle | Sakata | F1 | 6/4 | 71,874 | 58.4 | 15.1 |
| Early Wonder (S.L.) | Seedway | OP | 6/3 | 69,696 | 38.2 | 16.1 |
| Boro | Seedway | F1 | 5/30 | 64,614 | 51.8 | 13.7 |
| Detroit Dark Red | Seedway | OP | 6/3 | 63,888 | 40.3 | 15.2 |
| Robin | Sakata | F1 | 6/6 | 60,984 | 34.7 | 14.4 |
| Moneta | Seedway | F1 | 5/30 | 58,806 | 46.7 | 14.6 |
| Detroit Supreme | Sakata | OP | 6/3 | 52,998 | 29.1 | 14.5 |
| Ruby Queen | Sakata | OP | 5/27 | 45,738 | 42.7 | 13.6 |
| Mean | | | | 76,733 | 41.6 | 14.8 |
| LSD 0.05 | | | | 35,830 | 15.8 | NS |

**Table 2.** Spring Beet Replicated Variety Trial – Perkins, 2016[Z]

| | Topped Marketable Roots | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cultivar | Total weight (lbs./A) | Avg wt. (lbs.) | Dia (in.) | Shape[x] | Smoothness[x] | Zoning[x] | Color[x] | Qindex[w] |
| Falcon | 18,353 | 0.15 | 2.2 | 1.8 | 2.7 | 3.0 | 3.3 | 13.7 |
| Red Cloud | 14,789 | 0.13 | 2.0 | 1.7 | 3.7 | 1.8 | 1.7 | 10.8 |
| Merlin | 18,281 | 0.20 | 2.2 | 2.0 | 3.3 | 2.6 | 2.5 | 11.8 |
| Red Ace | 13,257 | 0.14 | 2.0 | 2.1 | 2.7 | 2.3 | 2.2 | 10.6 |
| Kestrel | 12,879 | 0.15 | 2.1 | 2.2 | 3.6 | 2.3 | 2.5 | 13.0 |
| Eagle | 17,707 | 0.25 | 2.3 | 2.8 | 3.2 | 2.7 | 2.6 | 14.4 |
| Early Wonder (S.L.) | 12,618 | 0.18 | 2.2 | 3.0 | 3.1 | 3.9 | 4.2 | 18.6 |
| Boro | 10,542 | 0.17 | 2.1 | 1.9 | 2.3 | 1.2 | 1.1 | 9.1 |
| Detroit Dark Red | 11,384 | 0.18 | 2.1 | 3.0 | 3.5 | 2.8 | 2.8 | 20.1 |
| Robin | 12,233 | 0.20 | 2.2 | 2.0 | 3.5 | 2.1 | 2.1 | 18.1 |
| Moneta | 9,336 | 0.16 | 2.0 | 2.7 | 3.2 | 2.0 | 1.9 | 12.5 |
| Detroit Supreme | 7,608 | 0.14 | 1.9 | 3.2 | 3.4 | 3.0 | 3.1 | 17.7 |
| Ruby Queen | 6,316 | 0.14 | 1.8 | 2.4 | 2.9 | 3.4 | 3.3 | 13.8 |
| Mean | 12,716 | 0.17 | 2.1 | 2.4 | 3.2 | 2.5 | 2.6 | 14.2 |
| LSD 0.05 | 6,664 | 0.04 | 0.2 | 0.6 | 0.6 | 0.6 | 0.7 | 6.3 |

[z] Seeded March 24, 2016. Plot size: 2' x 15' (3 replications). Each variety was harvested twice. Five feet per plot were harvested initially and then another 5' per plot were harvested one week later. Data from the two harvest dates were combined for a given variety before analysis.

[y] Percent market number = No. of marketable roots / (No. of roots < 1.5 in. wide + no. of full-sized culls + no. of marketable roots). The low data point for 'Red Cloud' is an artifact; a high rate of seeding led to many undersized culls.

[x] Ratings: 1=excellent, 5=poor.

[w] Quality index: Derived by adding number of full-sized culls and ratings for root shape, smoothness, zoning, and color. Since a low number of culls is desired and a low numerical rating corresponds to excellent, lower scores on the quality index are better. Thus, for example, 'Boro' had the (numerically) best quality index.

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## Swiss Chard and Beet Observational Trials

**Cimarron Valley Research Station**
**Lynn Brandenberger, Lynda Carrier, Josh Massey**
**Oklahoma State University**

**Introduction:** Swiss chard and beets are considered to be highly nutritious leafy greens and beet is also used as a root crop. The objective of this trial was to observe two cultivars of each species for their adaptability to central Oklahoma growing conditions in overwintering plantings.

**Methods and Materials:** Both Swiss chard and beet cultivars were direct seeded on 10/7/15 at a seeding rate of approximately 500,000 seeds per acre using a research planter with nine rows six inches apart. Following planting a preemergence application of Dual Magnum for weed control was done at a rate of 0.75 lbs. ai/acre. Trial plots were arranged in a randomized block design with three replications and plots were 4.5' x 20'. Crop fertility needs were met with 50 lbs. per acre of actual nitrogen (Urea) applied on 11/3/15 and another 50 lbs. actual nitrogen (Ammonium nitrate) applied on 2/17/16 (total of 100 lbs. nitrogen per acre). Crop water needs were provided by micro sprinkler irrigation. Crop ratings for color, savoyness (leaf crinkle), and flowering were made just prior to harvest 3/25/16. Yield data was recorded at harvest on 3/25/16 for each plot from a 4.5 x 5.0 foot harvest area and per acre yields were calculated from that data.

**Results and Discussion:** Swiss chard yield varied significantly and was 19,489 and 11, 229 lbs. per acre for Celebration and Peppermint, respectively (Table 1). Color ratings did not vary significantly and was 2.8 for Celebration and 2.5 Peppermint on a 0 to 5 rating scale where 0 would represent a very pale green and 5 would represent a very intense color. Savoyness ratings also utilized a 0 to 5 scale where 0 would represent a very flat leaf texture and 5 would represent a very crinkled texture. Both cultivars had a savoy rating of 2.7. Flowering in leafy greens is termed bolting. Bolting ratings were on a percentage basis i.e. 0 to 100% equaling the percentage of plants in a given plot that were flowering. Both Celebration and Peppermint exhibited no signs of bolting.

Beet cultivars in the trial were not harvested due to a separate beet trial being carried out at the same location, but both cultivars were rated for color, savoyness, and bolting. Color ratings did not vary significantly (Table 2). Ratings were 3.0 for Robin and 3.5 for Vulture on a 0 to 5 rating scale. Savoyness ratings also utilized a 0 to 5 scale. Ratings for savoyness varied significantly with Robin having a rating of 1.0 and Vulture having a rating of 1.8. Bolting ratings were 0% for both cultivars.

**Conclusions:** Both Swiss chard and beet cultivars in these trials exhibited no bolting and no differences in color ratings. There was some difference recorded for yield in Swiss chard and both crop species did vary in savoy ratings. Since both of these trials included only two cultivars, the authors would suggest that the cultivars in these small trials be included in future variety trials with a larger number of cultivars included, they would also merit trial by commercial farms.

**Acknowledgements:** The authors want to thank Cimarron Valley research station for support, maintenance, and care of this trial.

**Table 1.** 2015-16 Swiss Chard Study, Perkins, OK

| Variety | Source | Plant Counts acre | yield (lbs./acre) 3/25/16 | Color[z] | Savoy[z] | % Bolting |
|---|---|---|---|---|---|---|
| Celebration | Sakata | 90,992 a | 19,489 a | 2.8 a | 2.7 a | 0 a |
| Peppermint | Sakata | 42,592 a | 11,229 b | 2.5 a | 2.7 a | 0 a |

[z] Color & Savoy= 0-5 rating, 0=light color and smooth leaf, 5= most intense color and savoy leaf.
[y] Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

**Table 2.** 2015-16 Beet Study, Perkins, OK

| Variety | Source | Color[z] | Savoy[z] | % Bolting |
|---|---|---|---|---|
| Robin | Sakata | 3.0 a | 1.0 a | 0 a |
| Vulture | Sakata | 3.5 a | 1.8 b | 0 a |

[z] Color & Savoy= 0-5 rating, 0=light color and smooth leaf, 5= most intense color and savoy leaf.
[y] Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

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## 2016 Oklahoma State University Lavender Trial Report

**Dr. Bruce Dunn, Dr. Lynn Brandenberger, Lynda Carrier, and Stephen Stanphill**

**Introduction:** *Lavendula* L., belonging to the Lamiaceae family, is a perennial, evergreen shrub cultivated as an ornamental or medicinal herb used most often for fragrance. Lavender oil contains more than 100 compounds, with two major constituents being linalool and linalyl acetate, which are components of essential oils. The first written records about *Lavendula* date back to Theophrastus (370-285 BC). There are 39 species and multiple cultivars within each species, with most of Mediterranean (Southern Europe) origin. The five most important species within the genus are English lavender (*Lavandula angustifolia* also synonymous with *L. officinalis* or *L. vera*), lavandin (*Lavandula x intermedia* also synonymous with *L. hybrida*), spike lavender (*Lavandula spica* also synonymous with *L. latifolia)*, Spanish or stoechas lavender (*L. stoechas*), and French lavender (*Lavandula dentate*). All cultivars prefer a well-drained soil with a pH above 6, at least 5 hours of sunlight, and lots of good air flow around the plant. Mature size ranges from 2 to 4 feet and a diameter of 2 to 3 feet though dwarf cultivars are available. With good management, a plant can live and be productive for 15 to 20 years. Spanish lavender is typically grown in the southern U.S., because it is considered more drought and humidity tolerant than the other species. English lavender and lavandin lavender are more winter hardy to Zone 5 or 6 compared to zone 8 or 9 for Spanish and French lavender and 7 to 8 for spike lavender. Thus, it is important to select species and cultivars that will go well in Oklahoma, however information is limited as no long term trials have been completed. The goal of this research was to identify *Lavandula* cultivars that are adopted to Oklahoma as a potential specialty crop.

Plants, growth conditions, and data collection.

Rooted cuttings grown in 4 in. diameter pots *of Lavender angustifolia* Mill. 'Vera' and 'Jean Davis' were received from Lavender Valley Acres (Apache, OK) on 28 May 2016. Rooted cuttings in 6 in. diameter pots of *Lavender angustifolia* 'Munstead' and 'Hidcote' along with *Lavender x intermedia* Emeric ex Loisel. 'Alba', 'Cathy Blanc', 'Grosso', and 'Provence' were received from Prairie Wind Nursery (Norman, OK) on 28 May 2016. Plants were put in the Department of Horticulture and Landscape Architecture departmental greenhouses (Stillwater, OK) until field planted in 6 in. raised beds consisted of a 5 foot alley and were 2 feet apart at the Cimarron Valley Research Station in Perkins, OK. The experiment was arranged in a randomized block design with 10 plants per cultivar and three reps. Plants were planted on 23 May 2016 and any dead plants were replaced through 10 June 2016.

Soils are classified as Konawa and Teller fine sandy loam. Beds were sprayed with a mixture of Surflan Pro (Agrisel USA, Inc., Atlanta GA) and Tomahawk 4 (United Suppliers, Inc., Eldora, IA) herbicides on 9 May 2016. Follow up applications of Surflan Pro were made on 16 June 2016 and 28 June 2016. Poast (BASF Corp., Research Triangle Park, NC) was sprayed on 22 July 2016. A single drip irrigation line was buried and plants were watered twice a week for a month then put on a timer set to water twice a week for 4 hours. On 5 August 2016, Tomahawk 4 was sprayed again. Three pounds of 46-0-0 (figured at 50 lbs per acre) was added on 8 August 2016 and 2 lbs was added on 22 August 2016 and 9 September 2016 through an injector attached to the irrigation line. On 19 August 2016 a soil sample was taken indicating $NO_3$ of 145 ppm, P of 54 ppm, K of 257 ppm, and a pH of 5.9. Data was collected on Plant height and width was taken at time of planting. On 14 October 2016, data was collected on plant height, width, survival, if plants had flowered, number of panicles, and length of panicles.

**Results:** Although this is only the first year of the lavender trial and should only be considered preliminary, results are summarized in Table 1. Plant survival percent ranged from 30% ('Jean Davis') to 100% ('Grosso'). All plants increased in height with 'Provence' and 'Spanish' being the greatest and 'Jean Davis' being the smallest. All plants increased in width with 'Grosso' and 'Provence' both having the greatest increase and 'Jean Davis' again showing the smallest increase. 'Hilde', 'Munstead', and 'Provence' all flowered the first year, but only about half of 'Hilde' and 'Munstead' plants flowered compared to 'Provence' at 97%. 'Provence' had the greatest number of spikes (30) per plant and the longest spike (11.9 in.).

**Table 1.** Lavender field trial results from 2016 after being planted at the Cimarron Valley Research Station in Perkins, OK. (n = 30)

| Cultivar | Avg. Start Height (in.) | Avg. End Height (in.) | Avg. Start Width (in.) | Avg. End Width (in.) | Flowered 1st Year | Avg. No. of Panicles | Avg. Spike Length (in.) | % Flower | % Survival |
|---|---|---|---|---|---|---|---|---|---|
| Alba | 6.6 | 12.2 | 6.4 | 14.7 | No | n/a | n/a | 0 | 96.7 |
| Cathy Blanc | 4.5 | 12.0 | 5.2 | 14.2 | No | n/a | n/a | 0 | 56.7 |
| Grosso | 5.7 | 12.7 | 6.1 | 16.1 | No | n/a | n/a | 0 | 100.0 |
| Hidcote | 5.6 | 10.2 | 5.5 | 9.6 | Yes | 8.3 | 4.2 | 43.3 | 63.3 |
| Jean Davis | 5.2 | 6.3 | 5.4 | 6.4 | No | n/a | n/a | 0 | 30.0 |
| Munstead | 6.1 | 12.2 | 6.1 | 12.5 | Yes | 16.7 | 8.7 | 56.7 | 83.3 |
| Provence | 6.2 | 15.3 | 6.2 | 16.3 | Yes | 11.2 | 11.9 | 96.7 | 96.7 |
| Spanish | 8.5 | 17.9 | 7.6 | 16.2 | No | n/a | n/a | 0 | 86.7 |

Alba

Jean Davis

Cathy Blanc

Munstead

Grosso

Provence

Hidcote

Spanish

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# Citizen Scientist and Professional Grower Lavender Trials

**Research Results – 2016**

**Dr. Adam B. Cobb, Lori Coats**
**Oklahoma State University & Myriad Botanical Gardens, OKC**

**Introduction**: Lavender (*Lavandula* L. *spp.*) is a small perennial shrub and a member of the mint family. It is a widely planted herb, in both home landscapes and commercial operations, with uses that include essential oil extraction, medicinal applications (Cavanagh and Wilkinson, 2002), and culinary flavoring. Lavender was well known in ancient history, with multiple cultivated and wild species, varieties, and hybrids distributed across a wide geographic range (Europe, Africa, South Asia). Because of these diverse environments and plant-traits, lavender performance can vary by location, climate, soils, and other growing conditions. The objectives of this trial were to determine the suitability of different lavender varieties for both professional and home growers in Oklahoma by assessing plant survivorship after one growing season.

**Methods and Materials**: The nine lavender cultivars included in these trials were (English Lavenders, *Lavandula angustifolia*) Alba, Hidcote, Jean Davis, Munstead, Vera (Lavandins, *Lavandula x intermedia*) Grosso, Phenomenal, Provence, and (Spanish Lavender, *Lavandula stoechas*) Otto Quast. A group of citizen scientists were gathered at the Myriad Botanical Gardens in Oklahoma City. These home gardeners were given a questionnaire to assess their experience and knowledge of lavender, and then allowed to take home four lavender plants (of their choosing), which had been acquired as 5-6 inch cuttings from two commercial growers (*Prairie Wind Nursery* and *Lavender Valley Acres*). They were allowed to make their own choices as to variety, planting location, fertilization, and watering. All citizen science participants were asked to record plant outcomes, including survivorship, fragrance, flowering, foliage appearance, and pollinator visitations observed each month. Additionally, the two commercial growers were asked to test several lavender cultivars along with *The Kerr Center for Sustainable Agriculture*. Prairie Wind Nursery is location in Norman, OK. They planted lavender cultivars in full sun in rows that were 3 feet apart with 6 feet of space between rows. The soil in the area is a sandy loam. Plants were not fertilized and placed in mid-June. Lavender Valley Acres is located in Apache, OK. They planted lavender cultivars in partial shade to full sun in rows that were 3 feet apart with 5 feet of space between rows. The soil in the area is a mixture of clay and sandy loam. Plants were not fertilized and placed in early June. The Kerr Center is located in Poteau, OK. They planted lavender cultivars in full sun in a single row with 2 feet of space between plants. The soil in the area is a silty loam. Plants were not fertilized and placed in late-May.

**Results and Discussion**: The citizen scientists had relatively little success in keeping their selected lavender varieties alive compared to the professional growers (Table 1). There was high survivorship for the lavender cultivars grown at Prairie Wind Nursery and Lavender Valley Acres. The Kerr Center reported some issues with disease in their trials, which were analyzed at the OSU Plant Disease and Insect Diagnostic Lab, and determined to be *Phytophthora (spp.)* root and crown rot and *Fusarium (spp.)* wilt. These common lavender infections may explain the lower survivorship of the plants at the Kerr Center. Parts of the field were reported to have poor drainage, which can encourage lavender diseases. Citizen scientists did not observe pollinator visitations to their lavender plants; however, one of the three professional growers (Lavender Valley Acres) recorded substantial pollinator attraction to the lavender at their location.

The citizen scientists who indicated they had previous lavender growing experience accounted for 87% of all the surviving plants from the group; however, only three of these growers were able to keep 50% of their plants alive through the season. There were no discernable patterns between the growing conditions and success of lavender cultivated by the citizen scientists. The Provence and Grosso cultivars (*L. x intermedia*) were among the most successfully cultivated lavender varieties in these trials (Table 1). Alba, Vera, and Jean Davis (*L. angustifolia,* not grown by the citizen scientists) were also successful for the professional growers, although The Kerr Center lost half their plantings of Jean Davis. Otto Quast (*L. stoechas*) was one of the most successful for the citizen scientists, and was highly successful at Lavender Valley Acres.

**Conclusions**: The low success of the citizen scientists indicates a significant need for extension education about home lavender cultivation in Oklahoma. Many of these participants reported "sudden death" of their plants that may have caused by either disease or under-watering. The results of this trial also suggest that cultivars of *L. x intermedia* and *L. stoechas* may be well suited for Oklahoma, and easier for home growers. During their fourteen years of operation, Lavender Valley Acres has observed that *L. stoechas* can better recover from dry periods and generally grow more successfully as compared to cultivars of *L. angustifolia* and *L. x intermedia* (personal communication, Anita Sodhi Thomasser). We recommend more research comparing the cultivars of different lavender species for their suitability in Oklahoma.

**Reference**: Cavanagh, H.M.A. and Wilkinson, J.M., 2002. Biological activities of lavender essential oil. *Phytotherapy Research*, *16*(4), pp.301-308.

**Table 1.** The number planted and percentage of surviving lavender plants for each variety cultivated by citizen scientists and professional growers

| *Lavender Cultivar* | *Citizen Scientists* | *Prairie Wind Nursery* | *Lavender Valley Acres* | *The Kerr Center* |
|---|---|---|---|---|
| Alba | NA | 18 (100%) | NA | 16 (100%) |
| Hidcote | 14 (21%) | 18 (94%) | 8 (88%) | 16 (62%) |
| Jean Davis | NA | 18 (100%) | 8 (88%) | 16 (50%) |
| Munstead | 1 (0%) | 18 (100%) | 8 (63%) | 18 (33%) |
| Vera | NA | 18 (100%) | 20 (100%) | NA |
| Grosso | 1 (100%) | 18 (100%) | 20 (100%) | 16 (87%) |
| Phenomenal | 1 (0%) | 18 (100%) | NA | NA |
| Provence | 13 (30%) | 18 (100%) | 20 (100%) | 16 (62%) |
| Otto Quast | 10 (30%) | NA | 30 (100%) | NA |

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## Irrigation Requirements of Select Indigenous Crop Varieties
**(First Year Report for 2016)**

**Joshua Ringer, Lynda Carrier, Lynn Brandenberger, Justin Moss, Jim Shrefler**
**Oklahoma State University**
**Study Site: Cimarron Valley Research Station**

**Introduction:** Small holder producers in both disadvantaged and Native American communities strive to produce marketable legumes that receive higher economic value. There is great demand from schools, smaller grocery chains, local food focused restaurants, and Native American nations to buy locally produced food. These entities require a consistent high quality product in order for them to buy from small holder producers. Small holder producers need to know how to grow and produce traditional heirloom varieties of legumes from Native American communities to have higher value products to sell to these consumers. This project will focus on using three promising varieties of legumes supplied from Sovereign Tribal Nations that are based in Oklahoma.

The purpose of this study is to understand the response of three different traditional heirloom legumes to three different moisture regimes to provide information for Native American producers to plan for irrigation systems to support market gardening production.

**Methods and Materials:** The study was designed as a 3x3 factorial arranged in a randomized complete block design with three replications. Plots were organized so that each irrigation treatment plot area had each of the three species randomized within it. The study had nine treatment/plots per row. Each plot was a single row 20 feet long direct seeded with four seeds per foot on 5/5/16. To ensure there was no effect between irrigation treatments, spacing between each row and plot alley was 10 feet. The rows were orientated to north to south.

<u>Varieties</u>

- Pottawatomie Pea – *Vigna* species
- Hidatsa Indian Red Bush Bean - *Phaseolus vulgaris*
- Battered Buffalo Skull Peas - *Vigna* species

<u>Preparation</u>

The soil was tilled in order to have a clean planting area free of debris and weeds. A pre-emergence herbicide (Dual Magnum at 0.95 lbs. A.I.) was applied for weed control immediately following seeding on 5/5/16 using a back-pack sprayer. One weeding pass between rows was done mechanically with a tractor PTO driven tiller after the first month. All subsequent weeding was manually done using a Rogue Hoe™ Scuffle Hoe which is commonly used by market gardeners.

Wildlife pests are a concern for growing vegetables on the OSU Perkins Research Station. Previous experience has shown this is especially true for pea and bean species (*Vigna* sp. and -*Phaseolus vulgaris)*. To prevent damage an 8 foot high flexible deer fence was built to encircle the plots. This fence was supported with telephone poles for corner posts and 10 foot T-posts. This fence effectively prevented deer, feral hog, and jack rabbit grazing damage to the bean plots throughout the duration of the growing season.

Irrigation Set up

The irrigation system was built using drip irrigation to provide for different irrigation treatments. The system consisted of the T1 irrigation line and a T2 irrigation line. Each line was sourced from the Research Station water source. The source line was connected to an Orbit™ battery operated digital irrigation timer which provided water at the required intervals. A Dywer™ WM2-A-C-03 analog water meter allowed for accurate measurement of the irrigation water flow throughout the study. During times of heavy rainfall the irrigation timers were delayed.

The three water treatments were:

- T0 as a control with no irrigation
- T1 as critical point or mid-point irrigation
  - T 1 ran for 30 minutes every other day. Each T1 treatment received a total of 540 gallons of irrigation water for the season. On a per acre basis this was equivalent to 392,166 gallons.
- T2 as full irrigation
  - T2 ran for 90 minutes every other day. Each T2 treatment received a total of 953 gallons of irrigation water for the season. On a per acre basis this was equivalent to 691,966 gallons.

Monitoring

Data Collection and monitoring was done twice a week and increased to three times a week during peak growth periods. During the monitoring, plant conditions were noted and photos were taken of representative plants (Figure 1). Data collection included assessing insect damage and any disease. Notes were taken of the date of emergence, first flowering, and pod set. The irrigation system was checked for leaks. If necessary repairs were made and notes were made of what repairs were made. If there were any weeds these were removed by hand hoeing.

Harvesting

Due to the small size of the plots and the indeterminate production of the Vigna species a decision was made to use multiple hand-harvesting for the plots. First harvest began on the Pottawattamie peas on Aug. 8, 2016. Due to the need for research station infrastructure development the study was terminated in October and the last harvest was conducted Oct. 11, 2016. This most likely lowered production from all three bean species that would have continued until first frost which did not occur until late November this year.

Processing

Due to hand harvest of the bean species it was necessary to shell and clean the harvested beans using a standalone thresher or other smaller scale processing methods. Although time consuming this replicates the scale level that many Native American producers may face who have smaller production areas and will not likely have a large scale processor/combine. The harvested beans were kept separately in their labeled harvesting bags in cold storage in to prevent possible post-harvest insect damage. A Kincaid standalone threshing machine was used to thresh a small test section of the Battered Buffalo Skull Peas. This resulted in a large percentage of cracked and shattered beans. This undesired result may be due to the low moisture content of the beans. After the initial shelling test all the harvested beans were hand shelled and cleaned.

Data Collection
Data collection consisted of weekly gathering of irrigation levels and plant development. Harvesting data includes dried pod weight and shelled bean and pea weight. Due to manual hand shelling the shelled bean and pea weight has not been included in this report.

**Results and Discussion:** The data is summarized in Table 1. Overall yields for Pottawatomie Pea did not vary significantly, but ranged from a low of 6193 for the no irrigation treatment to a high of 6752 lbs. per acre for full irrigation. Overall yields for the Hidatsa bean did not vary significantly although they ranged from zero to 184 lbs. per acre. Overall yield of Battered Buffalo Skull peas ranged from a low of 2788 lbs. per acre for the no irrigation treatment to 3161 and 3710 lbs. per acre for the T1 and T2 irrigation treatments, respectfully. This means that you should not expect to see a significant increase in yield if drip irrigation was provided to these species. These results were not expected. In accordance with the ODAFF second year of research following this protocol will be conducted to confirm the results from the first year of data.

**Table 1.** 2016 ODAFF Native American traditional legumes study, Perkins, OK

| | Weight in-shell lbs./acre | | |
|---|---|---|---|
| **Water treatment** | **Pottawatomie Pea** | **Hidatsa Indian Red Bean** | **Battered Buffalo Skull Pea** |
| No irrigation | 6193 a[z] | 0 a | 2788 a |
| Mid-point irrigation (T1) | 6265 a | 77 a | 3161 a |
| Full irrigation (T2) | 6752 a | 184 a | 3710 a |

[z] Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

Possible explanations for the lack of statistical difference could be that rainfall was sufficient during July and August to encourage production, or possibly the need for an increase in the number of study replications. Full irrigation did produce earlier production in the Pottawatomie Pea and Battered Buffalo Skull Pea then did no irrigation. Full irrigation also enabled the Hidatsa Indian Red Bean to survive the hot summer months and then regrow leaves and resume bean production in the fall.

Hidatsa Indian Red Beans are more adapted to cool season growing. These beans were preserved by northern tribal nations. Therefore these should be planted in early fall when temperatures begin dropping or early spring. Pottawatomie and Battered Buffalo Skull as Cowpeas (*Vigna sp.*) have shown the ability to grow well in the warm season. As with all Cowpeas these must be planted when soil temperatures are higher than 70$^{o}$ F.

Extended harvest requiring hand labor
It was noted that hand harvesting of these indeterminate cowpea heirloom varieties is time consuming and that steps need to be taken to consider if manual labor is available in sufficient quantities to provide timely harvesting to take place. In comparison to current determinate varieties of improved cowpeas these two Native American heirloom cowpea (Vigna) varieties produce from early August till first frost (~Oct. 31 – Nov. 28). The improved determinate pea varieties produce peas that are upright, have minimal amounts of vegetation, and are easy to machine harvest. The drawback for the Native American heirloom cowpea varieties is that production is spread over several months and requires hand harvest four to six times during the 3 to 4 months of production. This may be an advantage for small scale operations, community gardens, or school gardens. This is a problem for machine harvesting and would require spraying of a desiccant to kill the plant and enable machine harvesting. The positive benefit is that this

variety would be an excellent variety for home gardens and for school gardens because it provides several cycles of flowering, pod set, and harvest for teaching and learning opportunities.

Processing methods

The researchers are also working on appropriate mechanical and hand processing methods for these crops. This will involve looking at the scale and financial resources of the producers to see what is most appropriate. These varieties also appear to be good options for fresh harvest and selling at farmers markets. Die back during summer months for Hidatsa Indian Red Beans (90 – 120 day pinto bean variety). The Hidatsa variety died back during the summer months even with full irrigation. This indicates that this variety is not well adapted to high air temperature and high humidity that is common during Oklahoma summers. When air temperature dropped in September the Hidatsa variety began to recover, re-growing leaves, flowers, and setting of viable pods. This indicates a need to move to early spring planting for the Hidatsa variety.

**Conclusions:** This trial showed that Vigna species are robust and can adapt to low moisture conditions and recover even when stressed by lack of rainfall. The drawbacks to these varieties is that if produced at large production scale then issues related to machine harvesting must be considered and viable economic solutions found.

Plans for next year include increasing the number of replications to determine if the lack of significance between different treatments is due to plot variability or to environmental conditions. We also plan to examine the possibility of using once-over machine harvest to reduce the labor costs associated with multiple hand harvests.

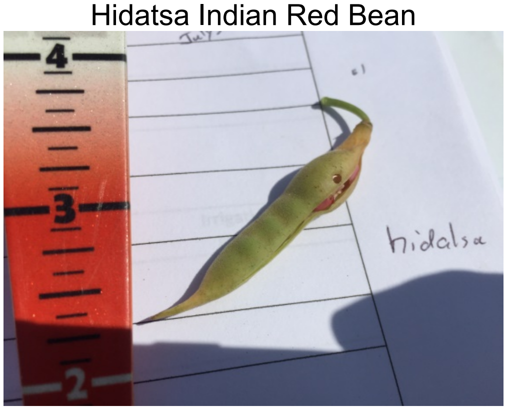
**Acknowledgements:** The Oklahoma Department of Agriculture, Food, & Forestry (ODAFF) provided funding for this study. The authors also want to thank Cimarron Valley Research Station Manager Josh Massey, and private collaborators for support, maintenance, and care of this trial. Special acknowledgement is given to Lynda Carrier for assisting with this study throughout 2016.

**Figure 1.** 2016 Photo record of summer legumes.

Battered Buffalo Skull Pea growth

Battered Buffalo Skull Pea pod-set

Hidatsa Indian Red Bean




Pottawattamie shelled pea

Battered Buffalo Skull Pea Flower

Pottawattamie vine with mature peas

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## Overwinter Spinach Cultivar Trial

**Cimarron Valley Research Station**
**Lynn Brandenberger, Lynda Carrier, Josh Massey**
**Oklahoma State University**

**Introduction:** Spinach is considered to be a highly nutritious leafy green that is in great demand by consumers. This leafy green has high levels of vitamins and minerals and can demand premium prices when sold as a fresh market crop. The objective of this trial was to study several new cultivars of spinach for their adaptability to central Oklahoma growing conditions and to compare them to existing high performing cultivars.

**Methods and Materials:** Nine spinach cultivars (Figure 1) were direct seeded on 10/7/15 at a seeding rate of approximately 500,000 seeds per acre with a research planter in nine rows six inches apart. Following planting a preemergence application of Dual Magnum for weed control was done at a rate of 0.75 lbs. ai/acre. Trial plots were arranged in a randomized block design with three replications with plots being 4.5 x 20'. Crop fertility needs were met with 50 lbs. per acre of actual nitrogen (Urea) applied on 11/3/15 and another 50 lbs. actual nitrogen (Ammonium nitrate) applied on 2/17/16 (total of 100 lbs. nitrogen per acre). Crop water needs were provided by micro sprinkler irrigation. Crop ratings for color, savoyness (leaf crinkle), and flowering were made just prior to harvest 3/25/16. Yield data was recorded at harvest on 3/25/16 for each plot from a 4.5 x 5.0 foot harvest area and per acre yields were calculated from that data.

**Results and Discussion:** Spinach yield varied significantly and ranged from a low of 13,455 to a high of 29,282 lbs. per acre (Table 1). The three highest yielding cultivars in the trial were Emperor, Persius, and Avon with yields of 29,282, 28,120, and 27,491 lbs. per acre, respectively. Color ratings utilized a 0 to 5 rating scale where 0 would represent a very pale green and 5 would represent a very intense dark green (nearly black). Color varied significantly ranging from a low of 1.9 to a high of 4.0 (Table 1). The four highest color ratings were from Banjo, Emperor, Avon, and Riverside which had ratings of 4.0, 3.8, 3.6, and 3.6, respectively.

Savoyness ratings also utilized a 0 to 5 scale where 0 would represent a very flat leaf texture and 5 would represent a very crinkled texture. Savoyness ratings ranged from 1.0 to a high of 3.6 and varied significantly between cultivars (Table 1). Seaside had the lowest savoyness rating of 1.0 while Emperor, Banjo, and Viceroy had the highest ratings with 3.4, 3.6, and 3.6, respectively.

Flowering in leafy greens is termed bolting. Bolting ratings were on a percentage basis i.e. 0 to 100% equaling the percentage of plants in a given plot that were flowering. Persius had the highest percentage of bolting with 5% of the plants exhibiting bolting while the remainder of the cultivars ranged from 0 to 3% bolting.

**Conclusions:** Results from this trial will provide growers with enough information to make good decisions regarding spinach cultivars for overwintering production. Included in the trial were Avon, Baker, and Olympia which are still available, but have been in the market for several years. Of these three Avon was in the top three yielding cultivars and all three performed well and have very low levels of bolting. The two highest yielding cultivars in the trial were Emperor and Persius, but Persius also had the highest level of bolting in the trial. Based upon the results the authors would encourage farmers to study the results to select the cultivars that best meet their needs and then trial those themselves.

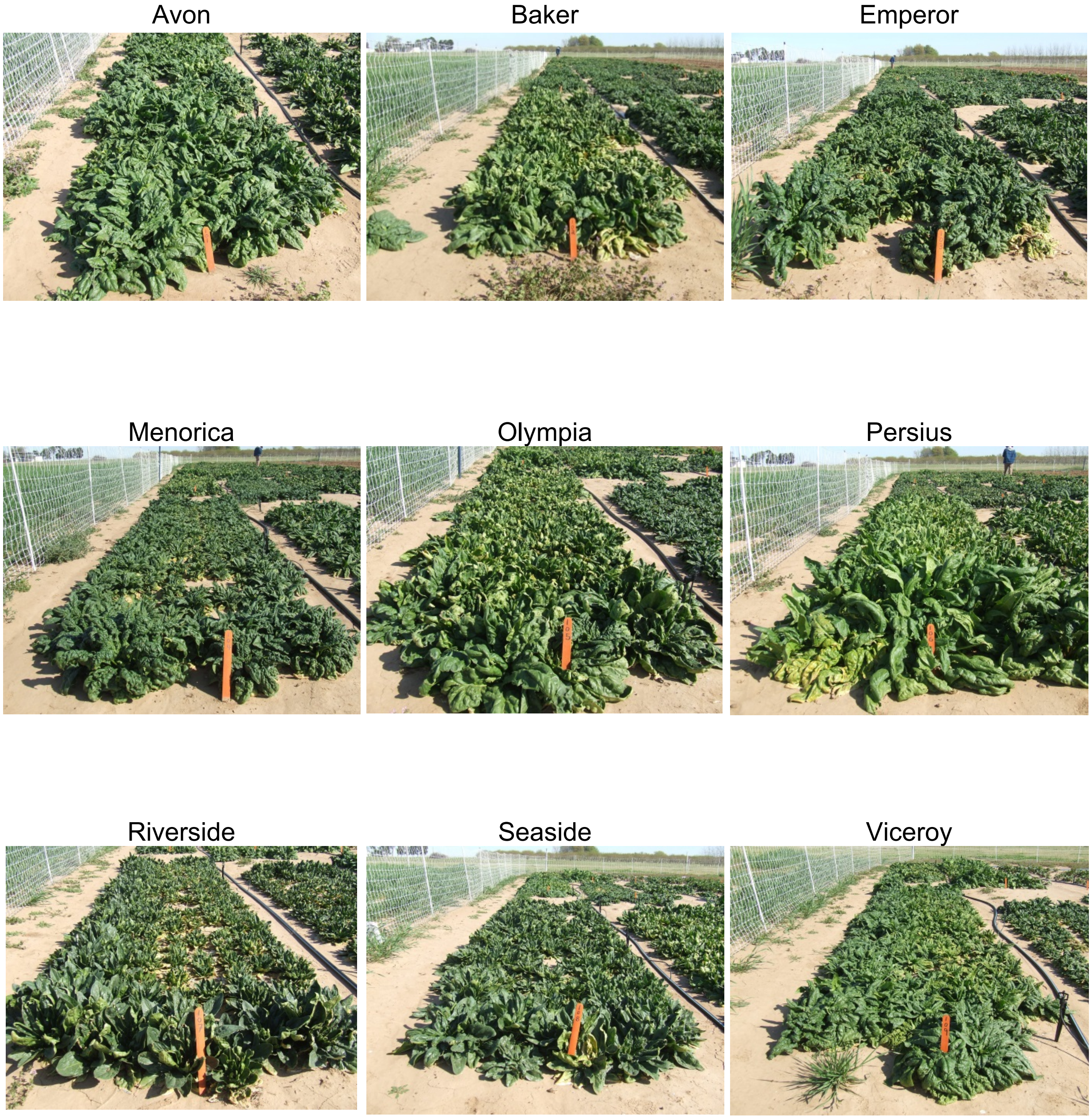
**Acknowledgements:** The authors want to thank Cimarron Valley research station for support, maintenance, and care of this trial.

**Table 1.** 2015-16 Spinach Variety trial Perkins, OK

| Variety | Source | yield (lbs./acre) 3/25/16 | Color[z] | Savoyness[z] | % Bolting |
|---|---|---|---|---|---|
| Avon | Sakata | 27,491 a[y] | 3.6 a | 3.1 a | 1 b |
| Baker | Sakata | 20,764 ab | 2.4 b | 1.3 b | 0 b |
| Emperor | Sakata | 29,282 a | 3.8 a | 3.4 a | 2 b |
| Banjo | Seedway | 20,134 ab | 4.0 a | 3.6 a | 0 b |
| Olympia | Sakata | 23,087 ab | 1.9 b | 1.1 b | 0 b |
| Persius | Sakata | 28,120 a | 2.4 b | 1.3 b | 5 a |
| Riverside | Sakata | 20,812 ab | 3.6 a | 1.5 b | 0 b |
| Seaside | Sakata | 13,455 b | 3.4 a | 1.0 b | 0 b |
| Viceroy | Sakata | 21,248 ab | 3.5 a | 3.6 a | 3 ab |

[z] Color & Savoy= 0-5 rating, 0=light color and smooth leaf, 5= darkest color and savoy leaf.
[y] Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

**Figure 1.** 2016 Overwintering Spinach Trial at Perkins, OK.

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## Overwinter Fresh Market Spinach Trial

**2015-2016**
**Three Springs Farm Oaks, OK**
**Mike Appel and Emily Oakley**

**Oklahoma State University**
**Lynn Brandenberger, Lynda Carrier**

**Introduction:** Overwinter spinach can be used to get an early start in the spring for fresh market growers along with other leafy cool season greens. Overwintered spinach is planted in fields in fall after temperatures have cooled off and is held in the field throughout the winter with its production being completed in early spring. Traditionally it is grown in Oklahoma for the processing market, but can also be grown for fresh market. The objective of this trial was to trial several spinach cultivars for overwinter fresh market production on a certified Organic farm.

**Methods and Materials:** The cultivars included in the trial were Avon, Viceroy, Emperor, Banjo, and Olympia. Plots were direct seeded with raw untreated seed at a seeding rate of approximately 750,000 seeds per acre with a Planet Jr. hand-planter on 10/22/15. Seeding included five rows per bed with beds being 3.5 feet wide and plot lengths being 20 feet in length. The trial had three replications arranged in a randomized block design. Crop fertility was provided by the pre-plant soil application of three tons per acre of chicken litter during soil preparation that provided approximately 180 lbs. per acre of nitrogen. Weed control was managed with a hand hoeing and weeding. The trial was hand harvested between 3/24/16 and 4/7/16, yields were recorded for each harvest and the total yield per cultivar is presented in the results.

**Results and Discussion:** Yields ranged from 10,579 to 15,558 lbs. of spinach per acre, that said there was flooding of the trial area in late fall and some plots that were in the lower area of the field never did fully recover. The three highest yielding cultivars in the trial were Avon, Olympia, and Emperor which had yields of 15,558, 14,749, and 12,757 lbs. per acre, respectively (Table 1). Although Olympia yielded well much of the leaves that were harvested were overly large and were not marketable.
Based upon the results and observations by the growers the preferred cultivar in the trial was Emperor and they would consider having another look at Avon for its potential as a fresh market spinach cultivar.

**Acknowledgements:** The authors want to thank Three Springs Farm for providing space, care, harvest, and data collection for this trial.

**Table 1.** 2015-16 Spinach Variety trial Three Springs Farm, Oaks, OK

| Variety | Source | yield (lbs. per acre) | Grower comments |
|---|---|---|---|
| Avon | Sakata | 15,558 | Has potential. Two of the reps were flooded |
| Emperor | Sakata | 12,757 | Nicest variety, didn’t get to harvest all of it |
| Banjo | Seedway | 10,579 | A good variety |
| Olympia | Sakata | 14,749 | Lots of spinach, but the leaves were the least marketable |
| Viceroy | Sakata | 11,637 | First to bolt |

# Winter Cover Crops Followed by Pumpkin
## 2016
## Cimarron Valley Research Station

**Lynn Brandenberger, Lynda Carrier, and Hailin Zhang**
**Oklahoma State University**

**Introduction:** Organic matter (O.M.) is a key ingredient to healthy soils since it helps to glue soil particles together (aggregation) stores and releases nutrients, creates channels for air and water in the soil, and provides feed stocks for soil organisms such as beneficial fungi, bacteria, and worms. Many soils in the southern plains have O.M. levels below 0.5% which creates problems for continued production of annual crops. Soils with adequate levels of O.M. will be more productive and will recover faster from the natural wear and tear of crop production. Cover crops are one means of improving soil quality for Oklahoma vegetable producers. One advantage that cover crops have over manures, composts, etc. is the much lower risk of food safety problems compared to animal manures or even some types of compost. Objectives for this multi-year study are to determine if increases in soil O.M. can be made with winter cover crops proceeding summer vegetable crops and what combinations of cover crops and summer vegetables will be compatible with one another.

**Methods and Materials:** Treatments included hard red winter wheat (*Triticum aestivum* L.), crimson clover (*Trifolium incarnatum*), Austrian winter pea (*Pisum sativum arvense*), a combination of crimson clover with Austrian winter pea, and a non-planted control (fallow) was also included in the study (Figure 1). Prior to fall seeding of cover crops, the entire experimental area was tilled using an offset disk-harrow and a field cultivator. Plots were direct seeded using a research seeding drill on October 20, 2015 in plots that were 45' in length and 13.5' wide. Seeding rates were 75, 15, and 75 lbs. per acre for wheat, crimson clover, and Austrian winter pea, respectively, with the combination treatment using the same seeding rates for clover and pea as the single species plots. No supplemental irrigation was provided for the cover crop treatments which depended entirely upon natural rainfall for germination and growth. The study was arranged in a randomized block design with five replications.
All cover crop plots were terminated on 5/03/16 using a combination of Poast (sethoxydim at 2 pts./acre) + glyphosate at 3 qts./acre + ammonium sulfate at a rate of 8.5 lbs./100 gallons of spray volume. Following herbicide burn-down each plot was mown with a brush-hog and strip-tilled with a 6' wide rototiller down the center of the 20' wide plot space on 6/09/16. Soil samples were collected from each plot on 6/21/16. All plots were rototilled a second time on 6/13/16 then bedded up using a mulch layer/bedder while laying a single drip irrigation tape per row center, but no mulch was applied. Each plot was direct seeded to Mustang PMR hybrid pumpkin with 10 feet between row centers, 2.5' spacing between planting spaces where two seeds were planted down the row on 6/23/15. A preemergence herbicide application was made over the top of the seeded beds on 6/15-16/16 using Sandea (halosulfuron-methyl) at 0.024 lbs. a.i. per acre + Curbit (ethalfluralin) at 0.56 lbs. a.i. per acre + Command 3ME (clomazone) at 0.15 lbs. a.i. per acre. Irrigation was started following the herbicide application to incorporate the herbicide and initiate seed germination. Crop nutritional needs were met with a total of 75 lbs. of nitrogen/acre from urea (46-0-0) one application on 7/01/16 (50 lbs. actual nitrogen per acre) to the soil surface and one application on 8/03/15 (25 lbs. actual nitrogen per acre) through the drip system. Disease control was managed by alternating applications of Bravo (chlorothalonil) and Quadris (azoxystrobin) fungicide for disease control every 10 to 14 days. Insect control measures were taken primarily for control of squash bug (Anasa tristis), but were not required until 8/15/16 and alternated applications of Asana (esfenvalerate), Warrior (lambda-cyhalothrin), PermaStar 8 (permethrin), and SpinTor (spinosad). Pumpkins were harvested on 9/22/16 and again on

10/03/16. During each harvest individual pumpkins were weighed to determine an overall plot yield and to determine number and weight of fruit per plot.

**Results and Discussion:** Marketable yield ranged from a low of 26,500 to a high of 34,083 and 31,321 lbs. of fruit per acre, respectively, for no cover (fallow treatment), Austrian Winter Pea, and the Austrian Winter Pea/Crimson Clover mix, (Table 1). The highest yielding treatment was Austrian winter pea, but there were no significant differences in yield between treatments. Fruit number per acre did not vary between treatments, but ranged from a low of 1,859 for Crimson Clover to a high of 2,362 fruit per acre for the Austrian winter pea. Average weight per fruit varied significantly ranging from 12.3 to 15.5 lbs. per fruit with crimson clover having the highest average weight.

No differences were observed between treatments for pH, phosphorus, potassium, or organic matter from results of the soil samples taken (Table 2). There were differences between treatments in the level of nitrogen found. Nitrogen levels ranged from a low of 21.2 and 26.2 lbs. of nitrogen per acre for winter wheat and no cover, respectively, to a high of 52.4 lbs. of nitrogen per acre for Austrian winter pea.

**Conclusions:** Yields did not vary between treatments, but there was a tendency for reduced growth and yield with the no cover and the winter wheat cover crop. Average fruit weight was lowest for winter wheat plots and was next to the lowest for overall yield. The authors hypothesize that this is likely due to the tie-up of nitrogen in the wheat cover crop versus the other cover crops which were winter legumes. That said, winter wheat had the lowest level of nitrogen in the soil test report and wasn't significantly different than the no cover treatment. Although not shown in the 2016 results, organic levels in general were higher in 2016 than in 2015 approximately 0.6% higher on average (See 2015 results at: http://www.hortla.okstate.edu/research-and-outreach/research/pdfs/2015_Vegetable_Trial%20Report%20.pdf).

In conclusion, the pumpkin crop appeared more vigorous and had a tendency to yield higher when winter legumes were used as cover crops compared to winter-wheat or the no cover treatment. Winter legumes definitely resulted in more nitrogen being available for crop growth and this was reflected by higher yields.

**Acknowledgements:** The authors want to thank Cimarron Valley research station for support, maintenance, and care of this trial.

**Figure 1.** 2016 Winter cover crop trial at Perkins, OK.

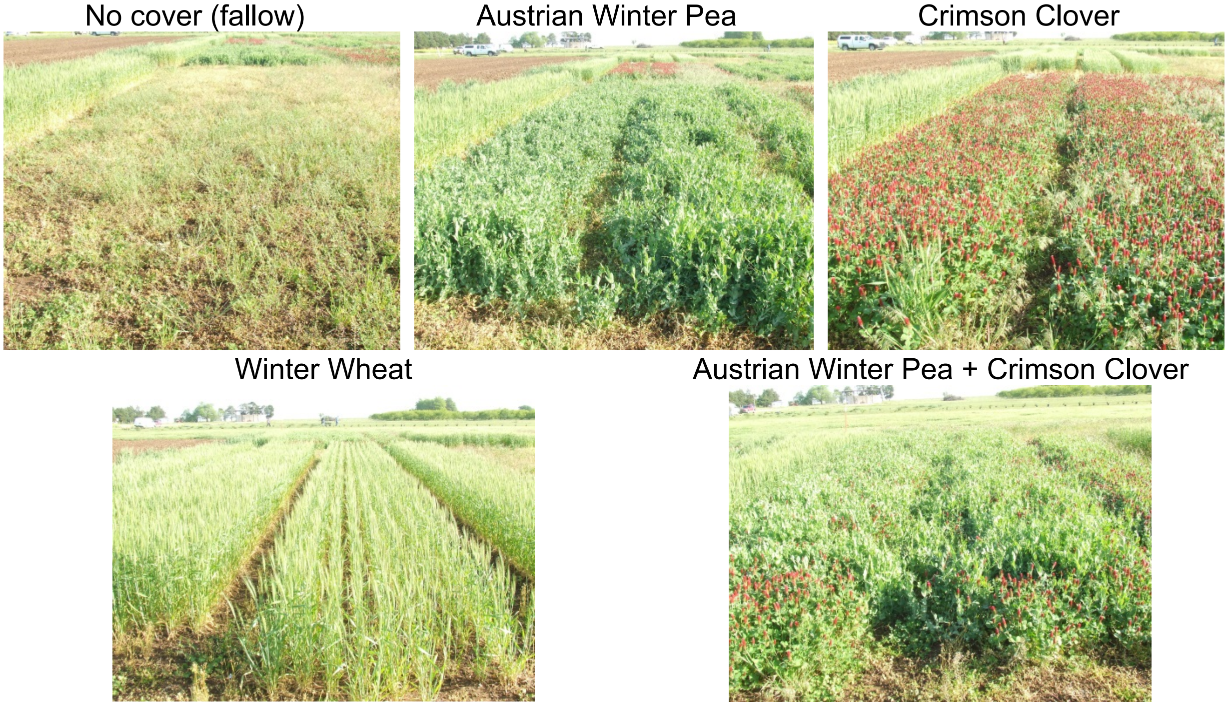


**Table 1.** 2016 Winter cover crop followed by Pumpkin. Perkins, OK, Harvested on 9/22/16 and 10/3/16.

| Treatment | Yield (lbs/acre) | Number fruit/acre | Average wt. (lbs.) |
|---|---|---|---|
| No Cover | 26,500 a [z] | 2,052 a | 13.4 ab |
| Austrian Winter Pea | 34,083 a | 2,362 a | 14.7 ab |
| Crimson Clover | 28,397 a | 1,859 a | 15.5 a |
| Winter wheat (HR) | 27,044 a | 2,265 a | 12.3 b |
| Winter Pea/Crimson Clover mix | 31,321 a | 2,285 a | 14.7 ab |

[z] Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

**Table 2.** 2016 Winter cover crop trial soil test results. Samples taken on 6/21/2016, Perkins, OK

| | | (lbs./acre) | | | (%) |
|---|---|---|---|---|---|
| **Treatment** | **pH** | **N** | **P** | **K** | **OM** |
| No Cover | 6.5 a [z] | 26.2 c | 48.6 a | 638 a | 2.3 a |
| Austrian Winter Pea | 6.3 a | 52.4 a | 41.0 a | 639 a | 2.3 a |
| Crimson Clover | 6.3 a | 33.6 bc | 44.4 a | 683 a | 2.6 a |
| Winter wheat (HR) | 6.4 a | 21.2 c | 40.4 a | 615 a | 2.3 a |
| Winter Pea/Crimson Clover mix | 6.4 a | 49.2 ab | 43.0 a | 672 a | 2.4 a |

[z] Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

## Summer Cover Crops and Amaranth Demonstration

**The Botanic Garden, Stillwater, OK**
**Lynn Brandenberger, Lynda Carrier**
**Oklahoma State University**

**Introduction:** Summer cover-crops are typically utilized to add organic matter at the end of the growing season, but can also to act as a way to manage weeds in otherwise open ground. Cover crops can reduce weed growth and weed seed production along with protecting soils from erosion. Soils in the southern U.S. are often low in organic matter (<0.5%) which can cause a number of problems including poor plant stands, low retention of water and plant nutrients and reduced infiltration of precipitation. The objective of this demonstration trial was to determine the amount of dry matter that can be produced by several different species of cover crops and to begin work with Amaranth as a summer green.

**Methods and Materials:** Four summer cover crop treatments and Amaranth were direct seeded on 6/15/16 in a Norge loam soil located in a field area at The Botanic Garden near Stillwater, OK. Species included in the study were sesbania (*Sesbania exaltata*), sorghum-sudangrass hybrid i.e. haygrazer (*Sorghum bicolor x S. bicolor var. Sudanese*), cowpea (*Vigna unguiculata*), lablab (*Lablab purpureus*), and red leaf amaranth (*Amaranthus species*). Seeding rates for each species were 35, 30, 37, 37 and 20 lbs. of seed per acre for sesbania, haygrazer, cowpea, lablab, and amaranth, respectfully. Plots were 15' in length and 4.5' in width and were planted in clean-tilled soil with a research planter using six inch spacing between rows. The study included two replications of the described treatments. The plot area received supplemental water from an overhead sprinkler to provide water for germination and crop growth. Samples for biomass were collected from each plot on 8/02/16 from a one square foot area in each plot. Supplemental weed control was provided through hand hoeing and a postemergence application of Poast (sethoxydim) to control crabgrass and bermudagrass. No fertilizer was applied to supplement what occurred naturally in the soil.

**Results and Discussion:** In general, each species germinated well and seedlings developed quickly due to the warm temperatures. The amaranth was planted at a higher seeding rate then the recommended seeding rate which was 2 lbs. per acre, but we used 20 lbs. per acre rate due to uncertainty about seed viability. It soon became evident that the amaranth had too dense of a stand and every other row was removed with a hoe and plants were thinned in the row to 3 to 4 inches between plants giving an average plant population of approximately 152,460 plants per acre (12" between rows and 3-4" between plants in the row). This plant population for amaranth was adequate, but may have still been a little too high. Other problems encountered with amaranth included crop damage from cucumber beetle and other chewing insects. Dry weight yield of amaranth was 4,792 pounds per acre (Table 1). In conclusion, red leaf amaranth appears to have potential as a summer green due to its rapid growth and development, nutritional content and the unique appearance of its red leaves (Figure 1).
Cover crops germinated and developed quickly as a result of the supplemental watering and warm temperatures. Following germination supplemental irrigation was reduced and most of the cover crops exhibited drought stress symptoms including leaf roll on the haygrazer and general wilting of all species except cowpea which was very tolerant of the droughty conditions. Yields in dry weight ranged from 1,089 to 12,850 lbs. per acre (Table 1). Cowpea, haygrazer, lablab, and sesbania yielded 5,445, 12,850, 5,227, and 1,089 lbs. of dry biomass per acre, respectively. Both cowpea and lablab had very similar yields which is not unexpected since they are both large seeded legumes. Sesbania had the lowest yield of biomass and haygrazer had the highest yield of biomass which is as expected since it is an annual warm season grass

(Figure 1). In conclusion, if producers are striving to only increase organic matter in their production soils then annual grass cover crops such as haygrazer are higher producers of biomass. If on the other hand there is a desire to have a cover crop that can fix nitrogen into the soil then legume crops such as cowpea have the most potential during the summer months to accomplish that.

**Table 1.** 2016 Dry weight yield of red leaf amaranth, cowpea, haygrazer, lablab, and sesbania. Summer Cover Crop Study, OSU Botanic Garden, Stillwater, OK

| **Treatment** | **Yield (lbs. dry weight/acre)** |
|---|---|
| Red Amaranth @ 20 lbs./acre | 4,792 |
| Cowpea @ 37 lbs./acre | 5,445 |
| Haygrazer @ 30 lbs./acre | 12,850 |
| Lablab @ 37 lbs./acre | 5,227 |
| Sesbania @ 35 lbs./acre | 1,089 |

**Figure 1.** 2016 Photo record of red leaf amaranth, cowpea, haygrazer, lablab, and sesbania.

Red leaf amaranth

Cowpea

Haygrazer

Lablab

Sesbania

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# Summer Cover Crops for Soil Improvement

**Southwood Urban Farm-Jenks, OK**
**Lynn Brandenberger, Lynda Carrier**
**Oklahoma State University**
**Kyle Dismukes Southwood Urban Farm**

**Introduction:** Soils in the southern U.S. are often low in organic matter (<0.5%). This can cause a number of production issues including poor plant stands, low retention of water and plant nutrients and reduced infiltration of precipitation. There are a number of methods that can be used to increase soil organic matter levels one method is to grow and incorporate cover crops into production field soils. In addition to adding organic matter cover crops can reduce weed growth and weed seed production along with protecting soils from erosion. The objective of this grower trial was to determine the amount of dry matter that can be produced by several different species of cover crops.

**Methods and Materials:** Four summer cover crop treatments were planted on June 17, 2016 into a Severn very fine sandy loam on an unirrigated field at Southwood Urban Farm near Jenks, OK. Species included in the study were sesbania (*Sesbania exaltata*), sorghum-sudangrass hybrid i.e. haygrazer (*Sorghum bicolor x S. bicolor var. Sudanese*), cowpea (*Vigna unguiculata*), lablab (*Lablab purpureus*), and sunflower (*Helianthus annuus* L.). Seeding rates for each species were 35, 30, 37, 104 and 34 lbs. of seed per acre for sesbania, haygrazer, cowpea, lablab, and sunflower, respectfully. Treatments included Red Ripper cowpea plus sunflower, haygrazer alone, Lablab plus sunflower, and sesbania plus sunflower. Plots were 20' in length and 4.5' in width and were planted in clean-tilled soil with a research planter using six inch spacing between rows. The study included six replications of the described treatments. Samples for biomass were collected from each plot on 9/18/15 from a 1.36 square foot area in each plot.

**Results and Discussion:** Biomass of summer cover crops varied significantly, ranging from 20,018 to 53,328 lbs. dry weight per acre (Table 1). Haygrazer produced the highest dry weights for biomass with 53,328 lbs. per acre, but did not vary significantly from LabLab + Sunflower or Sesbania + Sunflower which recorded 33,043 and 28,025 lbs. of dry weight per acre, respectfully. The Cowpea + Sunflower treatment produced significantly less biomass than the haygrazer treatment.

When considering what type of cover crop to use there are several points to consider. First, if the goal is only to add organic matter then haygrazer and other grass cover crops have been shown to be the highest producers of organic matter. Second, mixtures of cover crops can provide more than one advantage to soils. An example would be mixing grasses with legumes to provide higher levels of biomass plus fixing some nitrogen in the soil at the same time. That said, mixes of cover crops are more challenging to manage due to the complexity of each species needs and timing for best performance. In conclusion, on-farm trials of different cover crops can provide better information for decisions that growers will make and this is what the authors have attempted to do with this trial.

2016 Summer Cover Crop Study, Southwood Urban Farm, Jenks, OK

| Treatment | Yield (lbs. dry weight/acre) | |
|---|---|---|
| Red Ripper Cowpea + Sunflower | 20,018 | b[z] |
| Haygrazer (Sudan) | 53.328 | a |
| LabLab + Sunflower | 33,043 | ab |
| Sesbania + Sunflower | 28,025 | ab |

[z] Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

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## Summer Cover Crops for Spinach Establishment and Growth

**Cimarron Valley Research Station**
**Lynn Brandenberger, Lynda Carrier, Hailin Zhang, Josh Massey**
**Oklahoma State University**

**Introduction:** Production soils in the southern plains often have issues with compaction, poor infiltration of precipitation, and soil crusting due to low levels of organic matter (<0.5%). The objectives for this study were to determine if organic matter added to soil from summer cover crops can have a positive effect on spinach stand establishment and subsequent crop growth.

**Methods and Materials:** Four summer cover crop treatments were planted on July 13, 2015 at the Cimarron Valley Research Station near Perkins, OK on a Teller loam soil. The cover crops included in the study were sesbania (Sesbania exaltata), sorghum-sudangrass hybrid i.e. haygrazer (Sorghum bicolor x S. bicolor var. Sudanese), cowpea (Vigna unguiculata), and lablab (Lablab purpureus), a clean mown summer fallow treatment was also included in the study. Seeding rates for each species were 35, 30, 37, and 22 lbs. of seed per acre for sesbania, haygrazer, cowpea, and lablab, respectfully. Plots consisted of areas 40' in length and 9' in width and were planted in clean-tilled soil with a research planter using six inch spacing between rows. Summer fallow plots were mown twice to two inches above the soil line and haygrazer plots were mown at a height of approximately 12 inches twice also.

Samples for biomass were collected from each plot on 9/18/15 from a 2x10 foot area (20sq. ft.) all plots were mown to ground level following biomass harvest. After mowing all plots were tilled twice using an offset disk harrow and finished on 10/07/15 using a tractor mounted finishing tool (Triple K field cultivator) and planted to spinach on the same day using a research plot planter. Plots were planted to overwintering spinach (Olympia cultivar) at a seeding rate of approximately 500,000 seeds per acre followed by a preemergence application of Dual Magnum at a rate of 0.75 lbs. ai/acre. Crop fertility needs were met with 50 lbs. per acre of actual nitrogen applied on 11/10/15 and another 50 lbs. applied on 2/17/16 (total of 100 lbs. nitrogen per acre). Crop water needs were provided by micro sprinkler irrigation (see 2015 trial report MP-164). Crop ratings for percent stand were made on 11/10/15. Stand counts were made on 11/15/15 by counting the number of seedlings within a one square foot area approximately 10 feet into the plot from the front. Soil samples were collected from each plot on 11/03/15 and analyzed for pH, N-P-K, and organic matter and are reported in the 2015 Vegetable trial report (MP-164). Percent plant stands were recorded on 11/10/15, plant counts on 11/15/15 and Harvest data was recorded on 3/16/16 after using a hand scythe for harvesting.

**Results and Discussion:** Plant stands of spinach did not vary between treatments, but ranged from 68 to 86% on 11/10/15 (Table 1). The cover crop treatment with the highest spinach stand ratings was the haygrazer treatment with 86% stand the lowest was the cowpea treatment with 68% stand. The number of actual plants per square foot varied between treatments with the haygrazer treatment being highest and the cowpea treatment being lowest. Plant numbers ranged from a low of 3 plants per square foot (130,680 plants per acre) for the cowpea treatment to a high of 9 plants per square foot (392,040 plants per acre) for the haygrazer treatment.

Spinach yields did not vary significantly, but ranged from 19,771 to 28,072 lbs. per acre. Yield was highest for the summer fallow plots and lowest for the haygrazer plots. Treatment yields were 23,063, 19,771, 25,216, 28,072, and 23,934 lbs. per acre for sesbania, haygrazer, cowpea, summer fallow, and lablab treatments, respectively.

**Conclusions:** This study exhibited some interesting results. First when considering crop stands haygrazer showed some real promise regarding higher plant stands since it had significant higher stands then the cowpea treatment and was generally higher than other treatments. Unfortunately this did not result in higher yields and in fact the haygrazer treatment had the lowest yield in the study. One conclusion may be that some soil nitrogen needed for crop growth and development was tied-up in the breakdown of the haygrazer organic matter. In past studies we have witnessed this response from other grassy cover crops. Possibly the addition of extra nitrogen may have the potential to rectify this result.

Acknowledgements: The authors want to thank Cimarron Valley research station for support, maintenance, and care of this trial.

**Table 1**. 2015-16 Spinach following summer cover-crops. Perkins, OK

| **Treatment** | **% Stand 11/10/15** | **Number plants (1 square ft.) 11/15/15** | **Yield (lbs./acre) 3/16/16** |
|---|---|---|---|
| Sesbania @ 35 lbs./acre | 74 a [z] | 7.5 ab | 23,063 a |
| Haygrazer @ 30 lbs./acre | 86 a | 9.0 a | 19,771 a |
| Cowpea @ 37 lbs/acre | 68 a | 3.0 b | 25,216 a |
| Summer Fallow | 73 a | 4.5 ab | 28,072 a |
| Lablab @ 22 lbs./acre | 73 a | 4.5 ab | 23,934 a |

[z] Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

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## Spring 2016 Sweet Corn Variety Trial, Perkins, Oklahoma

**Lynda Carrier, Lynn Brandenberger, Brian Kahn and Josh Massey**

**Introduction and Objectives:** High quality sweet corn is a very popular vegetable in Oklahoma. Small scale production can be sold directly on the farm or at roadside stands, farmer's markets and local stores. Large scale production requires a considerable investment in harvesting equipment and packing facilities. Corn earworm is a serious insect pest, and sweet corn production should not be attempted without an adequate insecticide spray program during the silking to harvest stages or using a cultivar that has been genetically engineered for corn earworm resistance (GMO).

The genetics of sweetness in corn have become increasingly complicated. For many years, varieties could be classified as either normal sweet (su1), sugary-enhanced (se), or supersweet (sh2). Now varieties with genetic combinations have been introduced to the market. Check with your seed company representative before planting a new variety to learn about isolation requirements.

Objectives of this trial were to evaluate 17 varieties (yellow or bicolor) for yield, earliness, and overall quality. All varieties were in the sh2 isolation group.

**Materials and Methods:** Plots were fertilized with 50 lbs. N/acre, harrowed, and then direct seeded on April 25. Plots were 20 ft long with 3 feet between rows and 2 rows per plot. Varieties were replicated 3 times in a randomized block design. Plots were sprayed with S-metolachlor herbicide on April 25, at the rate of 1 pint/acre. Plots were rated for seedling vigor on May 13 and then thinned to 20 plants per row. A top-dressing of urea was applied on May 19 and June 13 at a rate of 75 lbs. N/acre. Insecticide applications began June 20 before silking and continued through harvest period. Supplemental water was applied with micro sprinkler irrigation. Each variety was harvested one time at its peak maturity.

**Results and Summary:** Results are shown on the following page. The standard of comparison was 'GSS 0966' an Attribute® cultivar. Attribute is the trademark for Syngenta's genetically engineered earworm resistance (GMO) There were three cultivars with Attribute protection, all performed well in the trial, with GSS 0966 and BSS 0977 being the highest performing in Marketable yields. Battalion another Syngenta cultivar appeared to have good corn earworm control and does not have the Attribute protection (GMO), therefore should be a contender for trialing in the future. 'Cabo, which was trialed in 2014 and stood out in the mid-season group also performed well in 2016 having the top yield in tonnage. Harris recommended a few new cultivars, 7900R stood out as a solid performer, being the second highest yellow kernel type in Marketable yield and had the highest in-shuck rating in the trial, having nice dark green flags. A new variety Cumberland from Harris looked good for an early cultivar and had nice big full ears. Two other cultivars from Harris, Anthem XR and XTH 2472, were both harvested at 72 days and performed on the low end, but was expected as most early varieties do not perform well in our Oklahoma climate. During past trials the cultivars classified with approximately 80 days to harvest have been the highest yielding. Producers should consider data from several years before selecting varieties, and always test a new variety on a small acreage at first. Cultivar suggestions for the 2017 trial are welcome. Currently we are considering an SE isolation group for the trial.

**Table 1.** Spring 2016 Sweet Corn Variety Trial, Perkins[z].

| Variety | Source | C[y] | Vigor rating[x] | Market yield (sacks/A)[w] | Yield (tons/A) Market | Yield (tons/A) Culls | Number days to harvest | In-shuck rating[v] | Shucked rating[v] | Avg ear dia. (inches) | Avg ear length (inches) | Corn earworm damage[u] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BSS 0977 | Syngenta | BC | 4.5 | 357 | 5.1 | 0.6 | 81 | 2.6 | 1.8 | 1.7 | 7.2 | 2.2 |
| GSS 0966 | Syngenta | Y | 4.8 | 330 | 4.8 | 0.8 | 78 | 2.8 | 1.4 | 1.7 | 7.2 | 1.6 |
| Aces | Harris | BC | 3.5 | 287 | 4.8 | 0.6 | 79 | 3.5 | 1.7 | 1.8 | 7.5 | 2.2 |
| Cabo | Syngenta | BC | 4.2 | 275 | 5.7 | 0.5 | 79 | 3.7 | 1.8 | 2.0 | 7.9 | 2.9 |
| 7900R | Harris | Y | 4.0 | 269 | 4.6 | 0.9 | 78 | 1.5 | 3.1 | 1.8 | 7.5 | 3.3 |
| BSS 0982 | Syngenta | BC | 3.8 | 269 | 4.7 | 0.4 | 81 | 1.6 | 2.7 | 1.8 | 7.7 | 3.1 |
| Cumberland | Harris | BC | 4.2 | 267 | 5.3 | 1.0 | 75 | 2.3 | 2.2 | 2.0 | 8.2 | 3.5 |
| Battalion | Syngenta | BC | 2.7 | 238 | 3.7 | 0.9 | 78 | 2.7 | 2.6 | 1.6 | 7.1 | 1.9 |
| Vision MXR | Illinois | Y | 3.7 | 221 | 4.0 | 0.8 | 72 | 2.7 | 2.2 | 1.9 | 7.4 | 3.9 |
| Anthem XR | Harris | BC | 4.3 | 219 | 4.1 | 1.2 | 72 | 2.3 | 3.3 | 1.9 | 7.8 | 4.2 |
| Stellar XR | Illinois | BC | 4.5 | 219 | 3.9 | 1.2 | 75 | 2.8 | 3.2 | 1.8 | 8.2 | 3.4 |
| XTH 1876 | Illinois | Y | 4.5 | 195 | 3.6 | 1.5 | 78 | 2.1 | 3.2 | 1.8 | 8.5 | 3.7 |
| Awesome XR | Seedway | BC | 4.5 | 191 | 3.2 | 1.5 | 72 | 2.0 | 3.7 | 1.8 | 7.7 | 4.5 |
| XTH 1181 | Illinois | Y | 5.0 | 170 | 2.9 | 1.5 | 81 | 2.2 | 2.3 | 1.8 | 7.0 | 3.9 |
| Prestige XR | Illinois | BC | 4.8 | 139 | 2.3 | 1.1 | 79 | 3.0 | 3.5 | 1.8 | 7.6 | 3.8 |
| XTH 2472 XR | Harris | BC | 4.2 | 119 | 2.2 | 1.7 | 72 | 3.0 | 3.2 | 1.8 | 8.5 | 4.4 |
| Honor XR | Illinois | BC | 4.3 | 115 | 2.0 | 1.5 | 79 | 4.1 | 3.9 | 1.8 | 8.6 | 2.7 |
| | Mean | | 4.2 | 228 | 3.9 | 1.0 | 77 | 2.6 | 2.7 | 1.8 | 7.7 | 3.2 |
| | $LSD_{0.05}$ | | 0.7 | 63 | 1.5 | 0.7 | -- | 0.5 | 1.0 | 0.1 | 0.3 | 0.9 |

[z]Seeded April 25, 2016; Plot size: 6' x 20' (2 rows/plot, 3 plots each variety, plots thinned to 20 plants/row.) Harvested 7/5/16 to 7/14/16.

[y]C=kernel color.

[x]Vigor rating: 1=will not make stand, 5=thick stand and good vigor.

[w]One sack = 60 ears.

[v]Appearance rating: 1=best, 5=poorest.

[u]Rating: 1=no damage, 2=earworm damage <½" from tip, 3=earworm damage <1" from tip, 4=earworm damage <1½" from tip, 5=earworm damage >1½" from tip. Earworm control: Asana, Lannate, PermaStar,and Sevin were alternated and applied a total of 6 times between silking & harvest to entire planting.

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## Tomato Cultivar Trial

### T.J. Ammons Farm, Bennington, Bryan County

**Jim Shrefler, Robert Bourne, Marty Montague, Lynda Carrier and Lynn Brandenberger**
**Grower Cooperator – T.J. Ammons Family Farm**

**Introduction:** Local retailers have expressed interest in finding local sources of produce and tomatoes are a primary concern. Successful production of these crops requires the use of cultivars that are well adapted to the production location and that will provide adequate yields of marketable quality fruits. Recent tomato trials in other areas of Oklahoma identified several cultivars that perform well for summer field production. This trial was conducted on a local farm to evaluate some of these top performing cultivars and included Bella Rosa, Florida 91, Red Morning, Solar Fire and Valley Girl.

**Methods:** The trial site was previously used for forages and plowed early in 2016 to be used for vegetables. Composted manure was applied and incorporated prior to bedding and installing black plastic mulch on the beds. Beds were 3 feet wide and spaced on six foot centers. Tomato plants were grown in the OSU Horticulture greenhouses in Stillwater and transported to the trial location for transplanting on April 27, 2016. Experimental plots consisted of a 10 foot section of bed with six plants spaced 1.5 feet apart. There were four replications that included one plot of each of the tomato cultivars.

**Results:** Although not a certified organic farm, pesticide use was minimal and limited to non-synthetic products. Irrigation was achieved with drip irrigation installed below the plastic mulch. The initial harvest was done on June 30 and subsequent harvests made on July 6, 12 and 19. At each harvest, maturity of harvested fruits ranged from breaker stage (beginning to show pink color) to fully-ripened. A few fully developed green fruits were included in the earlier harvests. At each harvest fruit were classified as either marketable or non-marketable in the case of those that had more than minor blemishes. For the marketable category, fruit were counted and total weights and early harvest weights for the first two harvest dates were determined. The individual fruit weight for marketable fruits was calculated and the total weight for nonmarketable fruits was determined.

Yields data are shown in the table. Significant differences were found within the results for total number, total weight and weight per fruit for marketable tomatoes. Red Morning and Valley Girl were the varieties with the greatest yields in terms of fruit number and total fruit weight. Although not statistically significant, these varieties also tended to have the greatest early yield. There was not a significant difference across varieties for non-marketable fruit. However, Red Morning and Valley girl were among the varieties with the lowest yields of non-marketable fruits. Based on casual observation, the main causes of loss of marketability were blossom end rot, sunburn, insect feeding damage and decay that was often associated with minor insect damage. In summary, all varieties in the trial produced a substantial quantity of marketable quality fruit, indicating that selection of these varieties based on the previous trialing within the state was advantageous.

**Table 1.** Tomato cultivars, yields and fruit weights in the 2016 variety trial at Bennington.

| Cultivar | Marketable fruit / acre | | | Non-marketable fruit weight / acre (lbs) | Weight per fruit for marketable (lbs) |
|---|---|---|---|---|---|
| | Total Number | Total weight (lbs) | Early harvest weight (lbs) | | |
| Bella Rosa | 31473 | 10768 | 2858 | 8773 | 0.34 |
| Florida 91 | 20578 | 6473 | 972 | 7550 | 0.32 |
| Red Morning | 54270 | 18508 | 4631 | 5490 | 0.34 |
| Solar Fire | 39139 | 11757 | 2339 | 5448 | 0.3 |
| Valley Girl | 63954 | 16120 | 3506 | 3546 | 0.25 |
| | * | * | n.s. | n.s. | * |

* indicates that a statistical difference occurs for values within the column.

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# Pest Management

## Control of Anthracnose in Spring-Cropped Spinach, 2016.

**John Damicone and Tyler Pierson**
**Department of Entomology and Plant Pathology**
**Oklahoma State University**

**Introduction:** Anthracnose, caused by the fungus *Colletotrichum dematium*, is an emerging disease problem in spinach production in Oklahoma and surrounding states. Fungicide programs on spinach have relied on strobilurin fungicides such as Quadris or Cabrio to control white rust. Strobilurin fungicides remain highly effective against white rust but fail to control anthracnose, which has become a problem apparently as a result of fungicide resistance development. The objective of this trial was to evaluate experimental fungicides in comparison to Quadris and Switch. Switch has shown activity on anthracnose in previous trials.

**Materials and Methods:** The trial was conducted at the Entomology and Plant Pathology Research Farm in Stillwater in a field of Easpur loam previously cropped to spinach. Granular fertilizer (75-0-0 lb/A, N-P-K) was incorporated into the soil prior to planting the cultivar 'Avon' on 3 Mar 2016 at a seeding rate of two seeds per inch. The herbicide Dual II Magnum 7.6E at 0.75 pt/A was broadcast post-emergence on 23 Mar. Plots were top-dressed with granular fertilizer (50-0-0 lb/A, N-P-K) on 29 Mar. Plots consisted of 4-row beds, 20-ft long, with rows spaced 14 in. apart. The experimental design was a randomized complete block with four replications separated by a 5-ft-wide fallow buffer. Fungicides were broadcast using flat-fan nozzles (Tee-jet 8002vk) spaced 18-in. apart with a $CO_2$-pressurized wheelbarrow sprayer. The sprayer was calibrated to deliver 25 gal/A at 40 psi. Treatments were applied on 7-day intervals beginning at the first true-leaf stage. Plots were inoculated with the anthracnose fungus spreading 50 ml of oat kernels colonized by the fungus along the center of each plot immediately after the first application on 8 Apr. All plots received Presidio 4F at 4 fl oz/A on 4 Apr and 21 Apr, and Ridomil 4E at 3.2 fl oz/A on 15 Apr and 29 Apr to control white rust. These fungicides do not have activity on anthracnose. Plots received a total of 3.0 in. of sprinkler irrigation at 0.1 to 0.4 in. water per application as needed to promote crop and disease development. Rainfall during the cropping period (3 Mar to 6 May) totaled 2.87 in. for Mar and 5.56 in. for Apr. Anthracnose was assessed by visually estimating the percentage of foliage with symptoms in three areas of each plot on 6 May. Disease incidence (percentage of leaves with symptoms) and severity (percentage of leaf area with symptoms) were also assessed on 6 May. Five, 6-in.-long row segments were harvested arbitrarily from the middle two rows of each plot. The harvested leaves were bulked and mixed, and disease severity was visually estimated on 30 blindly sampled leaves.

**Results and Conclusions:** Rainfall was nearly normal (30-yr avg.) for March and 2 inches above normal (30-yr average) for April. Average daily temperature was above normal for both March and April. The warm wet weather favored anthracnose development which was severe compared to previous trials at this site (Table 1). Treatments reduced disease severity estimated in plots and on sampled leaves, but not diseased leaf area on sampled leaves. Switch, A19649, and A20560 generally had the lowest levels of anthracnose, although disease levels for these treatments were not always statistically lower that for Quadris. None of the treatments caused leaf injury (phytotoxicity). In general, treatments did not provide adequate disease control for processing spinach.

**Table 1.** Evaluation of fungicides for control of anthracnose disease on spinach (cv. 'Avon), 2016.

| | Anthracnose (%) | | |
|---|---|---|---|
| Treatment and rate/A (timing)[z] | Visual plot rating | Diseased leaves | Diseased leaf area |
| Untreated check | 32.9 a[y] | 75.7 | 31.5 a |
| Quadris 2.08F 12.3 fl oz (1-4) | 21.0 b | 68.2 | 22.3 b |
| Switch 62.5WG 14 oz (1-4) | 13.3 b | 62.5 | 16.6 bc |
| A19649 1.67F 5.13 fl oz (1-4) | 16.8 b | 59.0 | 16.4 bc |
| A20560 3.34F 6.84 fl oz (1-4) | 16.4 b | 56.7 | 14.1 c |
| A19649 1.57F 5.13 fl oz (1,3)<br>Switch 62.5WG 14 oz (2,4) | 19.6 b | 59.2 | 19.2 bc |
| LSD (P=0.05)[x] | 10.9 | NS | 6.0 |

[z] The numbers (1-4) correspond to the spray dates of 1=8 Apr, 2=15 Apr, 3=21 Apr, 4=29 Apr.
[y] Values in a column followed by the same letter are not statistically different according to Fisher's least significant difference test.
[x] Least significant difference, NS = treatment effect not significant at P=0.05.

**Acknowledgements:** Syngenta Crop Protection contributed financial support for this trial. The efforts of Rocky Walker and Robert Lopez at the Entomology/Plant Pathology Research Farm in establishing and maintaining the trial is greatly appreciated.

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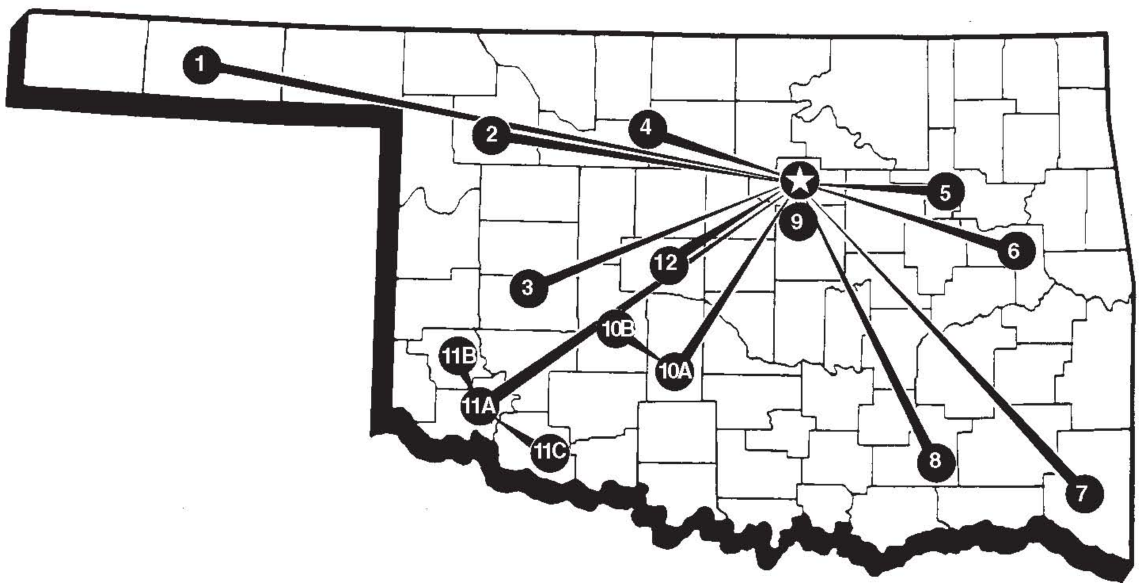
## SI (METRIC) CONVERSION FACTORS

| *Approximate Conversions to SI Units* | | | | | *Approximate Conversions from SI Units* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Symbol** | **When you know** | **Multiply by** | **To Find** | **Symbol** | **Symbol** | **When you know** | **Multiply by** | **To Find** | **Symbol** |
| | | **LENGTH** | | | | | **LENGTH** | | |
| in | inches | 25.40 | millimeters | mm | mm | millimeters | 0.0394 | inches | in |
| ft | feet | 0.3048 | meters | m | m | meters | 3.281 | feet | ft |
| yd | yards | 0.9144 | meters | m | m | meters | 1.094 | yards | yds |
| mi | miles | 1.609 | kilometers | km | km | kilometers | 0.6214 | miles | mi |
| | | **AREA** | | | | | **AREA** | | |
| $in^2$ | square inches | 645.2 | square millimeters | $mm^2$ | $mm^2$ | square millimeters | 0.00155 | square inches | $in^2$ |
| $ft^2$ | square feet | 0.0929 | square meters | $m^2$ | $m^2$ | square meters | 10.764 | square feet | $ft^2$ |
| $yd^2$ | square yards | 0.8361 | square meters | $m^2$ | $m^2$ | square meters | 1.196 | square yards | $yd^2$ |
| ac | acres | 0.4047 | hectacres | ha | ha | hectacres | 2.471 | acres | ac |
| $mi^2$ | square miles | 2.590 | square kilometers | $km^2$ | $km^2$ | square kilometers | 0.3861 | square miles | $mi^2$ |
| | | **VOLUME** | | | | | **VOLUME** | | |
| fl oz | fluid ounces | 29.57 | milliliters | mL | mL | milliliters | 0.0338 | fluid ounces | fl oz |
| gal | gallon | 3.785 | liters | L | L | liters | 0.2642 | gallon | gal |
| $ft^3$ | cubic feet | 0.0283 | cubic meters | $m^3$ | $m^3$ | cubic meters | 35.315 | cubic feet | $ft^3$ |
| $yd^3$ | cubic yards | 0.7645 | cubic meters | $m^3$ | $m^3$ | cubic meters | 1.308 | cubic yards | $yd^3$ |
| | | **MASS** | | | | | **MASS** | | |
| oz | ounces | 28.35 | grams | g | g | grams | 0.0353 | ounces | oz |
| lb | pounds | 0.4536 | kilograms | kg | kg | kilograms | 2.205 | pounds | lb |
| T | short tons (2000 lb) | 0.907 | megagrams | Mg | Mg | megagrams | 1.1023 | short tons (2000 lb) | T |
| | | **TEMPERATURE (exact)** | | | | | **TEMPERATURE (exact)** | | |
| °F | degrees Fahrenheit | (°F-32) /1.8 | degrees Celsius | °C | °C | degrees Fahrenheit | 9/5(°C)+32 | degrees Celsius | °F |
| | | **FORCE and PRESSURE or STRESS** | | | | | **FORCE and PRESSURE or STRESS** | | |
| lbf | poundforce | 4.448 | Newtons | N | N | Newtons | 0.2248 | poundforce | lbf |
| $lbf/in^2$ | poundforce per square inch | 6.895 | kilopascals | kPa | kPa | kilopascals | 0.1450 | poundforce per square inch | $lbf/in^2$ |

# THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION
## SYSTEM COVERS THE STATE




✪ **MAIN STATION—*Stillwater and adjoining areas***

1. **Oklahoma Panhandle Research and Extension Center—*Goodwell***
2. **Southern Plains Range Research Station—*Woodward***
3. **Marvin Klemme Range Research Station—*Bessie***
4. **North Central Research Station—*Lahoma***
5. **Oklahoma Vegetable Research Station—*Bixby***
6. **Eastern Research Station—*Haskell***
7. **Kiamichi Forestry Research Station—*Idabel***
8. **Wes Watkins Agricultural Research and Extension Center—*Lane***
9. **Cimarron Valley Research Station—*Perkins***
10. **A. South Central Research Station—*Chickasha***
    **B. Caddo Research Station—*Ft. Cobb***
11. **A. Southwest Research and Extension Center—*Altus***
    **B. Sandyland Research Station—*Mangum***
    **C. Southwest Agronomy Research Station—*Tipton***
12. **Grazingland Research Laboratory—*El Reno***