2011 Vegetable Trial Report

MP-164.2

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 2011.

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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Crop Culture

Basil Variety Investigations

Niels Maness, Elif Kalkan, Donna Chrz, Robert Havener, Robert Adams and Rodney Farris

Introduction and objective: Basils vary dramatically in their chemical content, as can easily be noted in their aroma and flavor. Their value is related to herb production potential and more specifically their leaf production potential. We are working with Ambient Temperature Extraction Partners (ATEP) to develop extraction processes that yield both extracted oil and a shelf stable, flavorful dry herb leaf. Basil can be mechanically harvested with a greens harvester, at multiple times during the season. In past years we have harvested basil on approximately monthly intervals and have noticed high production of stems and flowering structures, which are of lower commercial value compared to leaves. In 2011, we conducted a harvest frequency study which included 3 week and 2 week harvesting intervals, and we are in the process of separating leaves from dried product to assess whether harvest frequency might impact leaf yield as a component of total yield.

Methods: The five varieties studied can be grouped into three categories based on their typical use/aroma characteristics: a) pesto type basils ('Genovese'), b) fruity or spice flavored basils ('Mrs. Burns' Lemon' and 'Cinnamon') and c) regional specialty basils ('Sweet Thai' and 'Blue Spice'). Plants were established from transplants on April 26, 2011, in two row plots which were 37.5 feet long with 3 feet between row and approximately 1.5 foot between plants in each row (50 plants per replication). Plants were fertilized with 60 lbs N/acre at planting and 30 lbs N/acre following each harvest. Harvests were initiated in late June and ended in mid-October, using a cutting floor of 11 inches above the soil surface (6 inches for 'Sweet Thai'), with a Kinkaid forage harvester. Fresh plot weight was determined and subsamples were transported back to Stillwater for washing and subsequent oven drying. Oven dry samples were stored in a freezer to await leaf separation and extraction processing.

Results and discussion: Our basil yields in 2011 were decidedly lower (Table 1) than in 2010 (Table 2) or any other previous year we have evaluated basil yield. Early in 2011 a lightning strike damaged two of the five irrigation pumps which supply the overhead watering system and water availability was limited throughout almost all of the growing season. Combined with record-breaking heat and drought conditions, we believe the decreased yields were caused by combined drought/heat stress. The stressful conditions in 2011 may have provided a means to test the basil varieties for stress tolerance – a comparison of yields for varieties harvested at 3 week intervals in 2011 (Table 1) to those harvested at approximately monthly intervals in 2010 (Table 2) segregated varieties by the degree of decrease in yield into approximately 3 categories: those achieving greater than 50 % yield under stress ('Genovese'), those achieving 30 to 40 % yield under stress ('Sweet Thai', 'Cinnamon' and 'Mrs. Burns' Lemon') and those achieving less than 20 % yield under stress ('Blue Spice').

The more frequent harvests at 2 week intervals (Table 3) did not result in increased yield for any variety and some varieties exhibited decidedly decreased yield (particularly 'Mrs. Burns' Lemon'). Leaf yield data has been completed for harvests through July, 2011. Our total leaf yields for the month of July for plots harvested on three week (Table 4) versus two week (Table 5) intervals show no advantage for the more frequent harvest. Although we will complete leaf separations and calculate leaf yields for the remainder of the 2011 season, we do not anticipate that leaf yields will be increased by more frequent harvests to a level which might justify the added expense of increased basil harvests.

Table 1. Fresh yields (lbs/acre) of basil varieties harvested at 3 week intervals in 2011.

Harvest Date	Blue Spice	Cinnamon	Genovese	Mrs. Burns' Lemon	Sweet Thai
62911	0	111	1358	847	851
72111	144	864	2655	1960	1363
80911	284	465	1449	734	1021
83111	2023	2799	3704	3400	2458
92111	102	227	948	263	157
101211	2276	2658	5227	3028	3858
Total yield	4829	7124	15340	10232	9707

Table 2. Fresh yields (lbs/acre) of basil varieties harvested at 3-4 week intervals in 2010.

Harvest Date	Blue Spice	Cinnamon	Genovese	Mrs. Burns' Lemon	Sweet Thai
70710	1161	2360	3297	5024	2642
80310	6903	7018	6684	10641	7235
83110	7442	6745	9389	10489	7452
93010	15337	2911	4550	8257	7151
Total yield	30843	19035	23921	34411	24479

Table 3. Fresh yields (lbs/acre) of basil varieties harvested at 2 week intervals in 2011.

Harvest Date	Blue Spice	Cinnamon	Genovese	Mrs. Burns' Lemon	Sweet Thai
62911	0	302	1822	644	895
71311	286	1377	2553	1493	872
72611	23	105	299	144	490
80911	30	276	981	192	424
82411	1652	1473	2421	1501	1314
90711	30	165	471	101	153
92111	31	287	1034	93	241
100411	1315	1427	2845	1076	1649
101911	210	491	644	373	1000
Total yield	3576	5905	13070	5618	7038

Table 4. Fresh leaf yields (lbs/acre) during July for basil varieties harvested at 3 week intervals in 2011.

Harvest Date	Blue Spice	Cinnamon	Genovese	Mrs. Burns' Lemon	Sweet Thai
72111	48	180	920	361	328
80911	85	169	823	166	401
Total yield	133	350	1743	527	728

Table 5. Fresh leaf yields (lbs/acre) during July for basil varieties harvested at 2 week intervals in 2011.

Harvest Date	Blue Spice	Cinnamon	Genovese	Mrs. Burns' Lemon	Sweet Thai
71311	85	422	965	259	295
72611	7	29	173	28	182
80911		95	580	34	161
Total yield	92	546	1718	322	639

High Tunnel Leafy Greens Trial, Tulsa, Oklahoma 2010-2011

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Cooperating with Rex and Marie Koelsch "Our Farm"

Introduction: High tunnel vegetable crop production is used in the U.S. and worldwide. High tunnels (hoop houses) are basically plastic covered frames that receive only passive solar heat for warmth. High tunnels are used to extend the growing season of warm season vegetable crops such as tomatoes, peppers, and cucurbits. These structures allow farmers to start these crops much earlier in the spring and to continue production much later in the fall. This is a good use for these structures, but without supplemental heat, warm season crops cannot be grown in these structures during the coldest months of the year (December-February). A key aspect of fresh market growing is producing and selling crops year round. The objective of this trial was to observe different cool season leafy green crops to determine the feasibility of production in high tunnels during fall, winter, and spring.

Methods and materials: The trial was completed at "Our Farm" located in west Tulsa County. The site is a commercial fresh market farm growing both field and high tunnel crops for sale on a local basis. The high tunnel used for the trial has metal bows 18 feet in diameter and is 100 in length and is covered by a single layer of clear polyethylene film. There were nine different cool season greens that were grown including spinach, Swiss chard, romaine lettuce, broccoli raab, collard, kale, mustard, spinach mustard (mild type mustard), and turnip. Raised soil beds within the hoop-house were prepared for planting in early September including soil testing to determine the levels of nitrogen, potassium, and phosphorus and soil pH. Fertility levels were targeted at 120 lbs of nitrogen and 150 lbs of phosphorus and potassium per acre. Plots were direct seeded with a hand push planter (Johnny's 9156 seeder) with rows 4.5 inches apart and approximately 8 to 9 seeds/linier foot on 9/24/10. Plant stands of collard, kale, and lettuce were less than optimal and these species were reseeded on 10/8/10. Plots were replicated four times in a randomized design and consisted of an area of approximately 16 sq. ft. per plot. Harvests began on 10/20/10 and were completed on 5/10/11 (36 different harvest dates). Data recorded included fresh weight at each harvest and recording of pest and other issues with the plantings.

Results: Overall yields were highest for Swiss chard compared to spinach, romaine lettuce, collard, kale, mustard, and spinach mustard (Table 1). Yield ranged from a low of 0.6 pounds for romaine lettuce to 2.7 pounds of Swiss chard per sq. ft. The highest early yields (October-November) came from broccoli raab, turnip, spinach mustard, mustard, kale, Swiss chard, and spinach (Figure 1). Early yields ranged from 2.2 lbs per sq. ft. for broccoli raab to 0.26 lbs for spinach. Pest problems encountered included aphids and cabbage loopers which were controlled by insecticidal soap or *Bacillus thuringiensis*, respectively. Tolerance to cold varied between different crops that were grown. Observations of the various crops following a very low temperature event (-20ºF or lower) in early February, 2011 indicated that spinach, Swiss chard, broccoli raab, collard, and kale were very cold resistant. During this low temperature event no supplemental heat or additional covering of the crops in the high tunnel was done. Prices for the duration of the trial ranged from $1.30-1.50/lb. for most of the crops to $4.00/lb. for spinach, $2.00/lb for Swiss chard and kale, and $3.00 per plant for lettuce.

Based on these results, the authors would conclude that production of cool season leafy greens is possible during the coldest months of the year. We did see differences in yield potential and also cold tolerance of crops included in the trial. Other issues to note included some problems with the planter. When planting in plots that contained plant debris we experienced soil being pushed along by the planter instead of planting through it. Plans for this coming season include dropping broccoli raab due to low market demand, adding another leaf lettuce to the trial, and the use of transplants for leaf lettuces only.

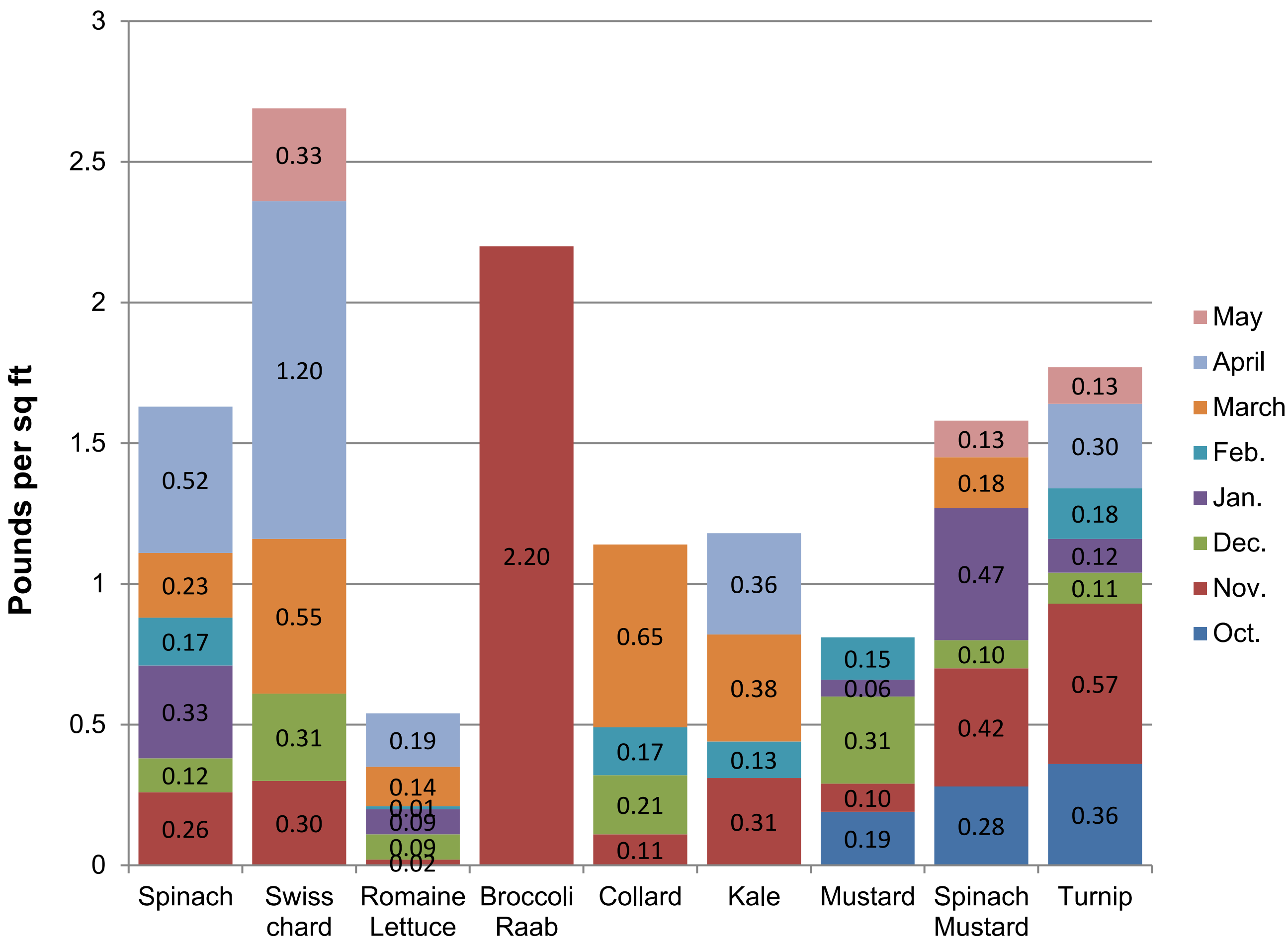
Acknowledgements: The authors wish to thank the Koelsch family for their interest and support of this project and the Oklahoma Department of Agriculture Food and Forestry for their support of the project through the specialty crop grant program.

Table 1. 2010-11 Leafy Greens Variety trial, Koelsch Farm, Tulsa, OK.

Crop	Variety	Source	Yield (lbs) per sq.ft.	
Spinach	Olympia	Chriseed	1.6	b-c[z]
Swiss chard	Rhubarb Chard	Harris	2.7	a
Romaine Lettuce	Green Towers	Seedway	0.6	d
Broccoli Raab	Zamboni	Seedway	2.2	a-b
Collard	Champion	DeWitt	1.1	b-d
Kale	Vates Blue Curled Scotch	DeWitt	1.2	b-d
Mustard	Southern Giant Curled	DeWitt	0.8	c-d
Spinach Mustard	Savanna	Chriseed	1.6	b-c
Turnip	Southern Green	Chriseed	1.8	a-c

[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.

Figure 1. 2010-2011 monthly and total yields of leafy greens, Koelsch farm, Tulsa, OK.



Thinning & Weeding

Multi-row planter

Spring 2011

Kale

Spinach Mustard

Swiss Chard

Spring 2011 Green Leaf Lettuce Trial

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Oklahoma State University

Cooperating with
Brad Bailey and Nelson Frantz
Oklahoma Department of Corrections

Introduction: Fresh lettuce is consumed both in salads and as a garnish for sandwiches. During the past few years, leaf lettuce has grown in popularity possibly due to its somewhat higher nutritive value compared to head types. Both Romaine and leaf lettuce have higher levels of vitamin C, A and calcium compared to head types, but still lag behind other leafy greens in nutritive value. In Oklahoma, leaf lettuce is produced for fresh market due to a shorter growing season and improved chances of success compared to head types. The objectives of this trial were to observe the feasibility of growing leaf lettuce in western Oklahoma using drip irrigation and to determine the yield and quality characteristics of different leaf lettuce cultivars.

Methods and materials: Ten lettuce cultivars were included in the trial with a range of green colors. Each cultivar was direct seeded on 3/31/11 in Speedling® trays (128 cells/tray) in the greenhouse and plants were transplanted on 5/4/11 at the James Crabtree Correctional Center farm at Helena, OK. Plots consisted of ten transplants spaced approximately one foot apart in the row with one row per free-standing raised bed. The trial was arranged in randomized block design with three replications. The growing system included free-standing raised beds on five foot centers covered with black plastic mulch film and drip irrigation installed under the plastic mulch. Irrigation was on an as needed basis with approximately 43 lbs of nitrogen/acre applied through the drip system. Plots were harvested on 6/6/11 (33 days after field transplanting) by cutting each plant at its base, dividing up harvested plants into marketable and cull plants and then counting and weighing the plants in each category. Color ratings were based on a 1 to 5 scale where 1 = light green and 5 = darkest green.

Results: No differences were observed between cultivars for marketable number of plants or weight per acre or for the average weight of harvested plants (Table 1). Differences were observed for the number of cull plants per acre with 'Black Seeded Simpson', 'Green Salad Bowl', 'Green Star', 'Simpson Elite', and 'Tropicana' having no culls per acre and 'Grand Rapids' and 'Waldmann's Dark Green' both having 1,694 culls per acre. Color ranged from a low of 1 for 'Black Seeded Simpson' to a high of 4.5 and 5 for 'Tropicana and 'Two Star', respectively. Based on the results, the authors would conclude that a majority of lettuce cultivars in this study had reasonable marketable yields although both 'Grand Rapids' and 'Waldmann's Dark Green' did have more culls than other cultivars primarily due to tip burn. Decisions about what cultivars to produce should be based upon color preferences of the farmer and consumer. Figures 1 and 2 have photos of each cultivar in the trial and should be helpful in making cultivar decisions based on color preference.

Figure 1. Lettuce cultivar photos: spring 2011, Helena, OK

Bergam's Green

Black Seeded Simpson

Grand Rapids

Green Bay

Green Salad Bowl

Green Star

Figure 2. Lettuce cultivar photos, spring 2011, Helena, OK

Simpson Elite

Tropicana

Two Star

Waldmann’s Dark Green

Table 1. 2011 Spring Green Leaf Lettuce Trial, Oklahoma Department of Corrections, Helena, OK

Cultivar/seed source	Marketable plants/acre[v]	Marketable pounds/acre[w]	Average Market pounds/plant	Number Culls/acre[x]	Color ratings[y]
Bergam's Green Stokes	6776 a[z]	4235 a	0.62 a	726 ab	3
Black Seeded Simpson Johnny's	7502 a	5130 a	0.69 a	0 b	1
Grand Rapids Stokes	6050 a	3194 a	0.53 a	1694 a	2
Green Bay Stokes	6776 a	4671 a	0.70 a	484 ab	4
Green Salad Bowl Stokes	7502 a	3703 a	0.49 a	0 b	2
Green Star Johnny's	7018 a	4041 a	0.58 a	0 b	4
Simpson Elite Stokes	7260 a	3654 a	0.50 a	0 b	2
Tropicana Johnny's	7018 a	3582 a	0.51 a	0 b	4.5
Two Star Johnny's	7260 a	4525 a	0.62 a	242 b	5
Waldmann's Dark Green Johnny's	5324 a	3340 a	0.63 a	1694 a	4

[v] Marketable plants/acre = yield of non-cull plants per acre.
[w] Marketable pounds/acre = yield in pounds of non-cull plants per acre.
[x] Number Culls/acre = number of cull plants per acre. Predominant cull reason= tip burn.
[y] Color ratings 1-5 scale, 1=light green, 5=dark green
[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.

2011 Pumpkin Variety Trial

OSU Cimarron Valley Research Station-Perkins, OK
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[1]Oklahoma State University and
[2]Oklahoma Department of Agriculture Food &Forestry

Introduction and Objectives: Pumpkin is a popular seasonal crop in the U.S. Fall pumpkins are normally planted in June and harvested in late September and early October in Oklahoma. During 2010 a pumpkin variety trial was completed at the Vegetable Research station in Bixby, OK. That trial included 14 different cultivars in a conventional open field system with overhead irrigation. The 2011 trial at Perkins was designed to observe not only performance characteristics (yield, fruit quality, color) of the same 14 hybrid and open-pollinated cultivars, but also to demonstrate the use of plasticulture methods for growing commercial pumpkins.

Materials and Methods: Field preparation included deep tillage of the plot area in preparation for planting. ODAFF's plasticulture program installed free-standing raised beds for planting using a bed shaper that also installed drip irrigation tape and plastic mulch. Drip irrigation and other supplies were provided by Oklahoma State. Plastic mulch was 1.25 mil thick white on black embossed film and drip tape was 15 mil T-tape with 12 inch emitter spacing with a capacity of 0.45 gallons per minute per 100 feet of drip tape. Plastic mulch was installed with the white side up to reduce soil heating. All plots were hand seeded on 6/22/11 on top of the mulched raised beds with 20ft. bed centers and a finished plant spacing of three feet between plants in the 24ft. long plots (8 plants/plot). Strips of sorghum x sudan haygrazer were planted between raised beds on 6/22/11 as windbreaks and to aid in virus control. The windbreaks were mown three times during the season to a height of 2 ft. to reduce competition with the pumpkin crop. Plots received a total of approximately 70 lbs. of nitrogen per acre from 20-20-20, injected into the drip system during irrigations. Insect control consisted of two applications of insecticide during the season. Crop water needs were met using regular scheduled irrigations from the drip irrigation system. Plots were harvested three times on 9/23/11, 9/27/11, and 10/17/11. Data recorded at harvest included individual fruit weight, uniformity ratings for size shape and color based on a 1 to 5 scale where 1 = least uniform and 5 = most uniform, handle (peduncle) and fruit circumference and fruit height and width in inches.

Results and Discussion: No differences were observed between cultivars for either powdery mildew infection or vine damage (data not shown). Very low levels of powdery mildew were observed, this is likely due to extremely high temperatures during the growing season which prohibit powdery mildew from initiating infections.

Cultivars were organized into five groups. Each group was comparable in average weight per fruit, and included at least one hybrid cultivar.

Group 1: Within Group 1, 'Baby Pam' was similar in average fruit size to 'Touch of Autumn', but the handles on 'Baby Pam' were longer and tan. In 2010 and 2011 'Baby Pam' lacked early seedling vigor. 'Touch of Autumn' had the highest number of fruit per acre on a trial-wide basis (Table 1). Its fruit were relatively uniform and very attractive, showing a nice contrast of orange skin and green handles (Table 2). The edge in this group definitely went to the hybrid 'Touch of Autumn.'

Group 2: 'Orange Smoothie', 'Small Sugar', and 'Winter Luxury were similar in fruit number and overall yield (Table 1). The hybrid 'Orange Smoothie' was the most uniform of the three for shape and color, but did not vary in handle or fruit circumference compared to the other two (Table 2). 'Orange Smoothie' showed why it was chosen as an All-America™ winner because of its yield of smooth, attractive fruit that would be ideal for display or painting. 'Small Sugar' is a classic pie pumpkin and appearance is less of a concern. 'Winter Luxury' is another classic pie pumpkin that had a unique appearance, with rough white netting, almost like a netted muskmelon.

Group 3: 'Charisma' performed well particularly regarding uniformity. It had the highest ratings for size, shape, and color for this group (Table 2). 'Orange Bulldog' was unique in that it belongs to a different species (*Cucurbita maxima*) from other entries. It is still segregating and had a lot of genetic variation for fruit size, fruit shape, and rind color. It may hold promise as a novelty that would attract attention for displays. 'Orange Bulldog' produced the highest number of fruit and yield in this group (Table 1). 'Tom Fox' was not especially impressive overall, yielding less than the other two cultivars and was generally inferior to the hybrid 'Charisma' within this group.

Group 4: Average weights per fruit ranged from 7.3 to 12.1 lbs., indicating that this group could be used for a number of purposes. Although the hybrid cultivar 'Magician' produced the smallest fruit in the group it had the highest number of fruit and yielded nearly as much as 'Howden' (15,549 and 15,811 lbs/acre, respectively) (Table 1). 'Howden' and 'Trojan' were statistically comparable to 'Magician' in many traits and would be good open-pollinated alternatives in this group, with perhaps a slight edge to 'Howden' for yield (Table 1). 'Wolf' had rank vine growth and late maturity, as per its catalog description. We would hesitate to recommend 'Wolf' except as a specialty item for growers with a market for a pumpkin with huge, distinctive handles.

Group 5: The two pumpkins in this group varied considerably in fruit number and overall yield per acre (Table 1). 'Mustang' yielded higher than 'Gold Rush' 26,580 to 6,937 lbs/acre, respectively, but also was the overall high yielding cultivar in the trial. 'Mustang' had the largest fruits on a trial-wide basis (Table 1). The handles on 'Gold Rush' were nearly as thick as those on 'Wolf' (Table 4), although they were shorter (data not presented). Of these two cultivars 'Mustang' out performed 'Gold Rush' primarily in yield with few differences observed in uniformity or other quality issues.

Conclusions: The authors would conclude that the plasticulture system used for this trial worked very well. The season was extremely hot and dry with more than 60 days of 100°F or higher temps and only 0.6 inches of precipitation during the month of July. Installation of the plastic mulch with the white side up allowed soil temperatures to moderate enough to allow normal germination and growth of the crop. Additional advantages of using the plastic mulch was reduced weed competition in the crop row, particularly from bermudagrass which was prevalent in the field. The drip irrigation system did well providing water for the crop, although we did experience several leaks in the system due to wildlife chewing on the drip tape for their water needs.

In general several of the cultivars in the trial had reduced yields when compared to the 2010 trial, but overall we were pleased with the performance of most cultivars in 2011. Both 'Mustang' and 'Orange Bulldog' yielded as well as they did in 2010 which is amazing considering the hot and dry conditions that the trial encountered. Based upon the results several hybrids have potential for use in Oklahoma including 'Touch of Autumn', 'Orange Smoothie', 'Charisma', and 'Mustang'. Open pollinated cultivars including 'Winter Luxury', 'Howden', and 'Orange Bulldog' may also have a place in producer's fields.

Table 1. 2011 Pumpkin variety trial, Perkins, OK. Seed sources and yields.

Cultivars	Type	Source	Average weight per fruit (lbs.)	Number of fruit per acre	Weight of fruit per acre (lbs.)
Group 1					
Baby Pam	O.P.	Seedway	1.4 a [z]	4477 b	6816 b
Touch of Autumn	Hybrid	Seedway	1.6 a	8188 a	14359 a
Group 2					
Orange Smoothie	Hybrid	Twilley	3.4 ab	3912 a	13391 a
Small Sugar	O.P.	Willhite	2.8 b	3428 a	10446 a
Winter Luxury	O.P.	Johnny's	4.4 a	2420 a	12503 a
Group 3					
Charisma	Hybrid	Johnny's	9.3 a	1815 a	17989 a
Orange Bulldog	O.P.	UGA	5.2 b	4033 a	21982 a
Tom Fox	O.P.	Johnny's	7.6 ab	847 b	7905 a
Group 4					
Howden	O.P.	Willhite	10.7 a	1412 a	15811 a
Magician	Hybrid	Seedway	7.3 a	1876 a	15549 a
Trojan	O.P.	Seedway	12.1 a	887 a	12463 a
Wolf	O.P.	Seedway	12.0 a	787 a	9196 a
Group 5					
Gold Rush	O.P.	Seedway	14.2 a	484 b	6937 b
Mustang	Hybrid	Seedway	17.8 a	1573 a	26580 a

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

Table 2. 2011 Pumpkin Variety Trial, Perkins, OK. Uniformity and fruit characteristics.

Cultivar	Uniformity ratings[x]	Circumference [y]	Fruit Shape [y]

	Size	Shape	Color	Ped. (in.)	Fruit (in.)	Height (in.)	Width (in.)
Group 1							
Baby Pam	2.9 a [z]	4.0 a	3.4 b	2.5 a	15.4 a	3.5 b	4.4 a
Touch of Autumn	3.6 a	4.4 a	4.2 a	3.3 a	15.5 a	4.1 a	4.4 a
Group 2							
Orange Smoothie	3.3 a	4.3 a	4.5 a	3.1 a	19.4 ab	6.1 a	5.5 a
Small Sugar	3.6 a	3.4 b	3.5 b	2.8 a	18.3 b	5.2 a	5.2 a
Winter Luxury	3.9 a	4.1 a	3.5 b	2.8 a	22.3 a	5.8 a	6.4 a
Group 3							
Charisma	3.9 a	4.1 a	4.4 a	3.4 a	29.8 a	8.0 a	8.5 a
Orange Bulldog	1.9 b	1.6 b	1.4 c	1.9 b	25.3 a	6.1 b	7.3 a
Tom Fox	2.3 b	3.5 a	3.4 b	4.1 a	27.5 a	7.6 a	7.7 a
Group 4							
Howden	3.2 a	3.3 a	3.8 a	4.1 b	27.8 a	9.5 a	7.7 a
Magician	3.3 a	3.1 a	3.4 a	4.9 b	26.3 a	8.5 a	7.5 a
Trojan	2.1 a	2.0 b	2.5 a	4.7 b	30.5 a	9.9 a	8.7 a
Wolf	2.8 a	3.5 a	2.8 a	7.9 a	31.9 a	9.3 a	8.7 a
Group 5							
Gold Rush	3.4 a	3.1 a	3.4 a	6.1 a	34.1 a	9.5 a	9.4 a
Mustang	3.2 a	3.4 a	3.7 a	4.6 b	34.0 a	11.1 a	9.6 a

[x].Uniformity ratings= 1-5 scale, 1=least , 5=most uniform in size, shape, and color within a cultivar

[y] Circumference and fruit shape measurements taken on three fruit per plot that were closest to the average weight per fruit for that plot. Ped.= peduncle

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

Pumpkin pictures from 2010 trial at Bixby, OK

Orange Smoothie Twilley

Small Sugar Willhite


Howden
Willhite

Magician
Seedway

Trojan
Seedway

Wolf
Seedway

Gold Rush
Seedway

Mustang PMR
Seedway

Over-Winter Spinach Nitrogen Demonstration

Lynn Brandenberger and Lynda Carrier
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in Cooperation with
Triple S Farms Hydro, Oklahoma

Introduction: Over-winter spinach grown for the processing market is an important crop for Oklahoma producers in the eastern and western areas of the state. Nitrogen fertility for this commercial crop is critical for rapid growth and adequate yields. During the recent past availability of ammonium nitrate which is the preferred source of nitrogen for this cool season crop has changed. Due to potential restrictions for this source of nitrogen, producers want to investigate the use of other forms of nitrogen for over-winter spinach. A potential issue that arises from the use of different forms of nitrogen is availability of nitrate nitrogen. Ammonium nitrate is normally readily available for the crop even at cooler temperatures while urea, ammonium sulfate and N-28 are slower to convert to available forms of nitrogen. The objective of this demonstration was to determine if other forms of nitrogen fertilizer i.e. ammonium sulfate, urea, and liquid N-28 can replace ammonium nitrate in the production of over-winter spinach.

Methods: The demonstration site was direct seeded to spinach (cultivar 'Vancouver') on 10/21/10 utilizing a grain drill with a six inch row spacing (6" from row center to row center) at an approximate seeding rate of 700,000 seed per acre. Soil composite samples for the demonstration site were collected on 1/28/11 and tested for nitrogen levels. Soil test results reported low levels of nitrogen (26-31 lbs. NO_3/acre) which provided a suitable site for testing different nitrogen sources for spinach. The demonstration site was divided into four equal areas of 6.45 acres with each area receiving its nitrogen from one of the four different nitrogen treatments (Table 1). The demonstration was based upon large commercial field plots that were not replicated due to size constraints, therefore treatments were not replicated or randomized within the demonstration design. The four treatments consisted of similar rates of nitrogen supplied by combinations of N-32 and N-28 through overhead irrigation, 46-0-0, 21-0-0-24, and 34-0-0 as nitrogen sources. All treatment areas received 21 lbs. of nitrogen per acre at planting from N-32 applied through the overhead irrigation system and 21 lbs. of nitrogen per acre from 21-0-0-24 on 2/10/11. Each treatment predominantly used a given source of nitrogen, but each treatment received some nitrogen from different sources (Table 1). Color ratings and crop height measurements were recorded on 3/25/11 using a 0 to 5 scale where 0 = yellow and 5 = dark green color, height was measured in inches. Yields were recorded on 3/30/11 and 3/31/11 for semi-trailer loads harvested with a commercial greens cutter.

Results and discussion: Although it was not possible to statistically analyze the recorded data, there were some interesting trends that were found in the demonstration. Color ratings were similar for all treatments ranging from 3.5 to 4.0 on a 0 to 5 scale (Table 2). Three crop height measurements were taken per plot and averaged. Height ranged from 12.75 to 15.00 inches with the 34-0-0 treatment having the highest crop height. Yield ranged from a low of 20,124 to 25,412 lbs. per acre. The liquid nitrogen treatment had the highest yield of 25,412 lbs. per acre while 46-0-0, 21-0-0-24 and 34-0-0 recorded 22,983, 20,124 and 20,617 lbs. per acre, respectively.

Based on the results of this demonstration, the authors would conclude that there is potential for using different sources of nitrogen to produce over-winter spinach crops. Furthermore, the authors would strongly suggest that further studies under replicated conditions be used to determine if different sources of nitrogen can be used to produce over-winter spinach during the coldest months of the year.

Acknowledgements: The authors want to thank Allen's Quality Vegetables for partial funding of this demonstration and Dennis and Virgil Slagell of Triple S farms for their help and support which made this demonstration possible.

Table 1. Over-winter spinach nitrogen fertility demonstration, 2010-2011, Hydro, OK. Treatment descriptions including nitrogen applications by date and major source of nitrogen.

	Nitrogen treatments			
Date of application	**28-0-0 liquid**	**46-0-0 Urea**	**21-0-0-24 Ammonium sulfate**	**34-0-0 Ammonium nitrate**
10/21/10	21 from N-32	21 from N-32	21 from N-32	21 from N-32
2/10/11	21 from 21-0-0-24	21 from 21-0-0-24	21 from 21-0-0-24	21 from 21-0-0-24
2/22/11	44 from 28-0-0	69 from 46-0-0	55 from 21-0-0-24	44.5 (34 from 34-0-0 +10.5 from 21-0-0-24)
3/07/11	35 from 28-0-0	0	0	44.5 (34 from 34-0-0 +10.5 from 21-0-0-24)
3/15/11	21 from 21-0-0-24	67 (46 from 46-0-0 +21 from 21-0-0-24)	42 from 21-0-0-24	0
3/19/11	11.6 from 28-0-0	0	0	0
Total	153.6	178	139	131

Table 2. Over-winter spinach nitrogen fertility demonstration, 2010-2011, Hydro, OK. Color ratings, height, and yield.

	3/25/11		3/30-31/11
Treatments	**Color ratings[z]**	**Height**	**Yield**
	0 to 5 scale	Inches	Lbs. per acre
28-0-0 liquid	3.5	13.75	25,412
46-0-0 dry	4.0	12.75	22,983
21-0-0-24 dry	4.0	13.25	20,124
34-0-0 dry	3.5	15.00	20,617

[z]Color ratings were on a 0 to 5 scale where 0 = yellow and 5 = dark green.

Southern Cooperative Cowpea Trial

Spring/Summer, 2011, Perkins, Oklahoma

Lynn Brandenberger and Lynda Carrier

Introduction: The Southern Cooperative trials are an ongoing effort by scientists at 5 Land Grant Universities and the U.S.D.A to provide performance data for advanced breeding lines in a wide variety of production environments. It is carried out each year to provide Oklahoma farmers a chance to find out how these advanced lines will perform in our state when they are released as cultivars for the industry. This year's trial was located at the Cimarron Valley Research Station in Perkins, Oklahoma. The trial was a little different from past trials in that it was planted by no-till methods and received no supplemental irrigation (dryland).

Materials and Methods: Plots consisted of one row 20 feet long with 36 inches between rows. Seed were spaced 4 seeds per row foot and were planted on 6/8/11. A tank-mix of Dual Magnum (S-metolachlor) at 1.0 lb ai/acre + Pursuit (imazethapyr) at 0.063 lb ai/acre + glyphosate at 2% v/v was applied preemergence on 6/9/11 for weed control. Hand hoeing was also utilized to maintain weed-free plots. The trial area did not receive any supplemental irrigation during the trial. Plots were fertilized on 6/26/11 with 25 lbs N/acre using urea (46-0-0). The trial included 4 replications for the 13 replicated lines and 1 replication for the 7 observational lines (Tables 1, 2). No harvest data was collected due to wildlife grazing of the plots.

Conclusions: Although there is no data to report, the authors would like to share some observations regarding the trial. First, what a great year to do our first no-till dryland cowpea trial, weather conditions were very extreme during the cropping period. High temperatures this summer were record breaking with over 60 days of 100°F or higher daily highs. Rainfall was low during the summer. The trial site received about 2.6 inches of rainfall in June after planting, 0.6 inches during July and no other rainfall until early August (1.14 inches on 8/6/11). The rain that was received in June was enough to germinate the seed and the trial ended up with a reasonable stand. Following stand establishment very little rainfall occurred, but entries in the trial did grow a small amount. Crop height was around 10 to 12 inches for the remainder of the summer until rainfall in August. After 1.14 inches of rain in August, the cowpeas began to grow again and flowered shortly thereafter. Pod setting occurred on a majority of the trial entries and it appeared there would be enough for a modest harvest and was worthy of defoliating. The trial area was sprayed with gramoxone at 0.5 lbs. ai/acre on 9/27/11. Following defoliation the trial area was observed to determine if it was ready to combine, at this point it was found that all the dry grain had been consumed by wildlife and nothing was left to harvest. Therefore the reader can understand why we have no data to share.

That said, the authors wish to conclude by stating that the cowpeas included in this year's trial did exhibit remarkable tolerance to high temperatures and drought. We were amazed that a reasonable stand was established and that there was potential for harvest even if the wildlife beat us to the field. It is no wonder that this crop is an important staple in so many hot and dry developing nations.

Acknowledgements: The authors would like to thank Jerry Moore and Josh Massey for administrative assistance in completion of this trial. The authors would also like to thank equipment and field crews for assistance on the station.

Table 1. Replicated entries for Southern Coop trial, Perkins, OK 2011

Entry	Type	Breeder
AR01-821	pinkeye	T. Morelock
AR01-1293	pinkeye	T. Morelock
AR01-1781	cream	T. Morelock
TX 2028-1-5-1-0 BEgc/gt	blackeye-gc/gt	J.C. Miller, Jr.
TX 2012-5-1-2-0 BE	blackeye	J.C. Miller, Jr.
TX 2044-5-1-0 PEgc	pinkeye-gc	J.C. Miller, Jr.
TX 2044-6-5-1-0 PEgc	pinkeye-gc	J.C. Miller, Jr.
LA96-4	cream	B. Buckley
LA96-74	pinkeye	B. Buckley
Arkansas Blackeye #1	blackeye	check
Charleston Greenpack	pinkeye-gc	check
Coronet	pinkeye	check
Early Acre	cream	check

Table 2. Observational entries for Southern Coop trial, Perkins, OK 2011

Entry	Type	Breeder
AR07-216	pinkeye	T. Morelock
AR01-1279	pinkeye	T. Morelock
LA97-8	pinkeye	B. Buckley
LA6-50	pinkeye	B. Buckley
LA6-52	pinkeye	B. Buckley
LA6-65	pinkeye	B. Buckley
Coronet	pinkeye	check

Soil Improvement Study, Bixby, Oklahoma

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Introduction: Growers in the southern U.S. face serious problems due to low levels of organic matter in production soils. Organic matter levels in agricultural soils of Oklahoma commonly are less than 1%. Low organic matter can have serious effects upon production including poor stands, poor retention of water and plant nutrients, and generally poor tilth of production soils. The objectives of this study are to compare different means of increasing soil organic matter and the effects that increased organic matter may have on crop establishment and growth over a four year period.

Methods and Materials: Plots were arranged in a randomized block design with five replications. Treatments included a clean fallow check, cowpea (Victor) cover crop, sorghum sudan cover crop (Hay Grazer BMR 6), sorghum sudan + cowpea cover crop combination, and clean fallow + compost. Study treatments were initiated on 6/21/10 by direct seeding all cover crops in plots that were 12' x 26' which included 18 rows on six inch row centers. All cowpea seed were inoculated prior to planting with *Bradyrhizobium* species at a rate of 2.5 oz of inoculum per 50 lbs of seed. Clean fallow and compost plots were rototilled during the summer growth period. Sorghum/sudan cover crop plots were mown with a rotary mower at a height of 4-6 inches twice during the summer and the entire study was mown prior to fall tillage.

Efforts in fall of 2010 included tilling the entire study area with a tractor mounted rototiller and applying spent mushroom compost to the clean fallow + compost plots at a rate of 8 tons of compost per acre. All plots were then rototilled to a depth of 3-4 inches on 9/27/10. Plots were planted to the strawberry cultivar 'Chandler' on 10/07/10. Strawberries were grown on raised beds utilizing drip irrigation and black plastic mulch. The annual strawberry system included two rows of strawberries per bed 24" apart with plants being staggered from side to side and 24" apart in each row. Alleys between strawberry beds were planted to wheat as a cover crop on 10/08/10 to prevent soil erosion and for stabilizing the sides of the raised beds. Strawberries received approximately 30 lbs. of nitrogen per acre applied through the drip irrigation system using a water soluble 20-20-20 fertilizer during the growing season. Plots consisted of one raised bed and were 26' long. Plots were harvested in spring 2011 beginning on 5/3/11 and ending on 5/25/11. Data recorded at harvest included number of fruit and total weight at each harvest.

Results and discussion: No differences were recorded between the different treatments for average fruit size, number of fruit harvested or overall yield (Table 1). Average fruit size ranged from 4.1 to 6.1 grams per fruit. Number of fruit harvested ranged from 41 to 61 fruit per plot while overall yield ranged from 234 grams to 400 grams per plot. The authors would conclude that several factors may have affected the results. First and foremost, we felt that we did not apply enough nitrogen to provide for adequate crop fertility. Second, the winter of 2011 was extreme with temperatures as low as -21°F. The study did not use any frost protection including row covers or overhead irrigation. This said the strawberry crop was very poor with yields much lower than would be commercially acceptable. Future plans include planting spinach in the 2011-2012 over-winter seasons with close observation of crop stands and growth.

Table 1. 2011 Soil improvement study, strawberry yield data, Bixby, OK.

Treatment	avg. fruit wt. (grams)	number fruit harvested	total fruit wt. (grams)
Clean fallow check	6.1 a	61 a	400 a
Cowpea cover crop	5.6 a	41 a	234 a
Sorghum sudan cover crop	4.8 a	53 a	285 a
Sorghum sudan + cowpea cover crop	4.1 a	53 a	263 a
Clean fallow + compost	4.6 a	50 a	277 a

[z] Strawberries were planted on two rows on top of plastic mulched beds with drip irrigation. There were 4 harvests from 5/3/11 to 5/25/11.

Spring 2011 Sweet Corn Variety Trial, Bixby, Oklahoma

Brian Kahn, Lynda Carrier, Robert Havener, and Robert Adams

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.

The genetics of sweetness in corn have become increasingly complicated. For many years, varieties could be classified as either normal sweet (su_1), sugary-enhanced (se), or supersweet (sh_2). 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 19 varieties (yellow or bicolor) for yield, earliness, and overall quality. All varieties were in the sh_2 isolation group.

Materials and Methods: Plots were fertilized with 50 lbs. N/acre, harrowed, and then direct seeded on April 19. 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 19, at the rate of ¾ pint/acre. Plots were rated for seedling vigor on May 17 and then given a preliminary thinning. Overall early vigor was good. Final thinning to 20 plants per row was completed on May 31, followed by a topdressing with urea to supply 100 lbs. N/acre. Insecticide applications began just before silking and continued throughout the harvest period. Supplemental water was applied with overhead 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', which showed less overall vigor than normal this year. Oklahoma suffered record heat in 2011 and all plants in the trial were sometimes under moisture stress despite irrigation. Corn earworm pressure also was severe. Plants were shorter than normal, but still produced marketable ears, although there were some problems with incomplete or irregular cob fill.

Marketable yields did not differ for number of ears, but varied for tonnage. 'Mirai 160Y' and 'Stellar' looked good for early cultivars. The numbered line '7143' had some open tips on the ears but otherwise looked nice, and it had the (numerically) highest tonnage in the trial. 'Passion' has performed well in previous trials and did so again in 2011, although it had a lot of tip damage from earworms. 'Overland' also had a lot of tip damage from earworms; tip cover problems have been noted on this variety in previous trials as well. 'Pickett' had nice flags and looked promising before picking, but had some fill problems and more than average corn earworm damage low on the ears; it should be trialed again. 'Samurai' is primarily a processing cultivar and it snapped hard. Finally, 'Marvel Edge' stood out with severe drought injury across all three replications. Crookham Company is urged to look at data on 'Marvel Edge' from other trials to see if this is a consistent problem with this cultivar.

Producers should consider data from several years before selecting varieties, and always test a new variety on a small acreage at first.

Table 1. Spring 2011 Sweet Corn Variety Trial, Bixby[z] .

Variety	Company/ Source	Vigor rating[y]	Market yield (sacks/A)[x]	Yield (tons/A) Market	Yield (tons/A) Culls	Number days to harvest	In-shuck rating[w]	Shucked rating[w]	Avg ear dia. (inches)	Avg ear length (inches)	Corn earworm damage[v]
BSS 0977	Syngenta	3.8	252	2.9	0.8	87	2.7	2.7	1.6	6.6	2.7
7143	Seedway	4.0	213	3.4	1.0	80	3.3	3.0	1.7	8.1	3.5
Mirai 160Y	Centest	2.7	209	3.0	1.0	77	3.5	2.2	1.6	6.9	3.2
Legion	Syngenta	2.2	194	2.1	1.0	84	3.3	4.0	1.6	6.4	3.8
Stellar	Seedway	4.5	180	2.6	0.6	77	3.0	3.3	1.7	6.8	4.2
Passion	Seedway	4.3	170	2.8	1.0	80	3.5	2.2	1.7	7.7	4.5
Mirai 351BC	Centest	3.5	168	2.6	1.0	77	3.5	3.8	1.7	7.5	4.2
Garrison	Syngenta	3.2	162	2.2	0.8	80	2.8	3.8	1.6	7.0	4.0
Mirai 336BC	Centest	3.8	154	2.5	0.9	77	3.7	4.0	1.7	7.6	4.5
Samurai	Crookham	3.3	150	1.6	0.5	87	4.0	3.3	1.7	7.2	4.8
Bueno	Crookham	3.0	141	1.7	1.2	87	3.0	3.8	1.8	6.7	5.0
Bountiful	Crookham	3.5	137	1.9	1.5	77	3.8	3.7	1.7	6.8	3.7
Overland	Syngenta	3.3	127	1.8	0.7	84	3.5	3.3	1.7	7.7	5.0
GSS 0966	Syngenta	3.0	125	1.5	0.7	80	3.2	3.3	1.5	6.2	2.5
Pickett	Seedway	4.0	117	1.3	1.2	84	4.0	3.8	1.7	6.3	4.3
BSS 8040	Syngenta	3.0	105	1.3	0.5	84	3.5	3.5	1.6	7.1	4.5
77958-Y	Centest	3.0	100	1.8	1.7	77	3.8	3.0	1.7	7.5	3.8
Starship II	Seedway	3.2	88	0.9	1.0	87	3.8	4.5	1.6	6.7	5.0
Marvel Edge	Crookham	3.7	70	0.9	1.2	84	4.8	3.5	1.8	7.0	4.8
	Mean	3.4	151	2.1	1.0	82	3.5	3.4	1.7	7.1	4.1
	$LSD_{0.05}$	0.9	NS	1.3	NS	--	0.5	0.8	0.07	0.5	0.6

[z]Seeded April 19, 2011; Plot size: 1.8m x 6.0m (2 rows/plot, 3 plots each variety, plots thinned to 20 plants/row.) Harvested 7/5/11 to 7/15/11.
[y]Vigor rating: 1=will not make stand, 5=thick stand and good vigor.
[x]One sack = 60 ears.
[w]Appearance rating: 1=best, 5=poorest.
[v]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: Pounce, Asana & Lannate were alternated and applied a total of 7 times between silking & harvest to entire planting.

Disease Management

Evaluation of Fungicides for Control of Anthracnose in Fall-Cropped Spinach, 2010

John Damicone and Tyler Pierson
OSU Department of Entomology and Plant Pathology

The experiment was conducted at the Entomology/Plant Pathology Research Farm in Stillwater in a field of Norge loam previously cropped to wheat. Granular fertilizer (75-46-0 lb/A N-P-K) was incorporated into the soil prior to planting the cultivar 'Melody' on 20 Sep. The herbicide Dual II Magnum 7.6E at 0.67 pt/A was broadcast after planting. Plots were top-dressed with additional granular fertilizer (50-0-0 lb/A N-P-K) on 29 Oct. 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 26 gal/A at 40 psi. Treatments were applied on ca. 7-d intervals beginning at the first true-leaf stage on 13 Oct. Plots were inoculated with the anthracnose fungus (*Colletotrichum dematium*) on 14 Oct by spreading oat kernels colonized by the fungus over the plots at 50 ml/plot. Plots received 4.5 inches of sprinkler irrigation at 0.25 to 0.5 in. water per application as needed to promote crop and disease development. Rainfall during the cropping period (20 Sep to 23 Nov) totaled 0.25 in. for Sep, 1.73 in. for Oct, and 1.94 in. for Nov. Disease incidence (percentage of leaves with disease) and severity (percentage of leaf area with disease) were assessed on 23 Nov. Five, 6-in.-long row segments were harvested arbitrarily from the middle two rows of each plot. The harvested leaves were bulked, mixed, and disease severity was visually estimated on 30 blindly sampled leaves.

Rainfall was 3.39 in. below normal (30-yr avg) from Sep through Nov while average daily temperature was near normal during the cropping period. Anthracnose appeared in early Nov and reached moderate levels compared to previous trials at this site. None of the treatments resulted in statistically significant reductions in disease incidence and severity compared to the untreated check. Switch and LEM 17 at 24 fl oz/a provided the largest numerical reductions in levels of disease. YT 669 and Q8Y78 were phytotoxic, causing leaf yellowing and plant stunting.

Treatment and rate/A (timing)[z]	Anthracnose (%)		Phytotoxicity (%)[y]
	Incidence	Severity	
LEM 17 1.7F 16 fl oz (1-5)	31.7 abcd[x]	5.6 abc	0.0 c
LEM 17 1.7F 16 fl oz + 0.25% NIS[w] (1-5)	37.5 ab	6.0 abc	0.0 c
LEM 17 1.7F 24 fl oz + 0.25% NIS (1-5)	16.7 d	1.5 d	0.0 c
YT 669 2.08F 8 fl oz + 0.25% NIS (1-5)	36.7 abc	4.1 bcd	57.5 a
YT 669 2.08F 12 fl oz + 0.25% NIS (1-5)	45.0 a	5.4 abc	60.0 a
Q8Y78 2F 18 fl oz + 0.25% NIS (1-5)	29.2 abcd	4.0 bcd	52.5 b
Q8Y78 2F 24 fl oz + 0.25% NIS (1-5)	45.8 a	7.2 ab	55.0 ab
Endura 70WG 8 oz (1-5)	45.0 a	9.0 a	0.0 c
Tanos 50WG 10 oz + Kocide 3000 1 lb (1,3,5) Kocide 3000 1 lb (2,3)	32.5 abcd	2.4 cd	0.0 c
Quadris 2.08F 9.2 fl oz + Kocide 3000 1 lb (1,3,5) Kocide 3000 1 lb (2,3)	22.5 bcd	3.6 bcd	0.0 c
Switch 62.5WG 14 oz (1-5).	18.3 cd	1.3 d	0.0 c
Untreated check	34.1 abcd	5.1 abcd	0.0 c
LSD (P=0.05)[v]	18.8	3.8	7.0

[z] The numbers (1-5) correspond to the spray dates of 1=13 Oct, 2=21 Oct, 3=28 Oct, 4=4 Nov, 5=10 Nov.
[y] Visual estimation of plant stunting compared to the untreated check on 23 Nov.
[x] Values in a column followed by the same letter are not statistically different according to Fisher's least significant difference test.
[w] NIS=non-ionic surfactant as Induce. [v] Fisher's least significant difference.

Evaluation of Fungicides for Control of White Rust in Fall-Cropped Spinach, 2010

John Damicone and Tyler Pierson
OSU Department of Entomology and Plant Pathology

The experiment was conducted at the Entomology/Plant Pathology Research Farm in Stillwater in a field of Easpur loam previously cropped to spinach. Granular fertilizer (25-0-0 lb/A N-P-K) was incorporated into the soil prior to planting the cultivar 'Melody' on 20 Sep. The herbicide Dual II Magnum 7.6E at 0.67 pt/A was broadcast after planting. Plots were top-dressed with additional granular fertilizer (50-0-0 lb/A N-P-K) on 29 Oct. 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 (8002vk) spaced 18-in. apart with a CO_2-pressurized wheelbarrow sprayer. The sprayer was calibrated to deliver 26 gal/A at 40 psi. Treatments were applied on either 7-d or 10-d intervals beginning at the first true-leaf stage on 13 Oct. Plots received 4.5 inches of sprinkler irrigation at 0.25 to 0.5 in. water per application as needed to promote crop and disease development. Rainfall during the cropping period (20 Sep to 23 Nov) totaled 0.25 in for Sep, 1.73 in for Oct, and 1.94 in for Nov. Disease incidence (percentage of leaves with disease) and severity (percentage of leaf area with disease) were assessed on 23 Nov. Five, 6-in.-long row segments were harvested arbitrarily from the middle two rows of each plot. The harvested leaves were bulked, mixed, and disease severity was visually estimated on 30 blindly sampled leaves.

Rainfall was 3.39 in. below normal (30-yr avg) from Sep through Nov while temperature was near normal during the cropping period. White rust did not appear until Nov, reached only low levels compared to previous trials at this site, and was not evenly distributed across the trial area. Anthracnose also appeared during Nov and only reached low levels. Because of the low levels of disease, treatment effects on levels of white rust and anthracnose were not statistically significant. None of the treatments caused any phytotoxicity symptoms.

Treatment and rate/A (timing)[z]	White rust (%)		Anthracnose (%)	
	Incidence	Severity	Incidence	Severity
QGU42 100OD 4.8 fl oz (7-day)	4.2 a[y]	0.3 a	7.5 a	0.5 a
QGU42 100OD 2.4 fl oz (7-day)	4.2 a	0.2 a	13.3 a	0.7 a
QGU42 100OD 1.2 fl oz (7-day)	5.0 a	0.6 a	4.2 a	0.2 a
QGU42 100OD 4.8 fl oz (10-day)	2.5 a	0.2 a	9.2 a	0.7 a
QGU42 100OD 2.4 fl oz (10-day)	1.7 a	0.1 a	3.3 a	0.3 a
QGU42 100OD 1.2 fl oz (10-day)	12.5 a	2.4 a	5.0 a	0.4 a
Tanos 50WG 10 oz + Aliette 80WG 10 lb <alt>[x] Presidio 4F 4 fl oz (7-day)	0.8 a	0.1 a	4.2 a	0.2 a
Tanos 50WG 10 oz + Aliette 80WG 10 lb <alt> Presidio 4F 4 fl oz (10-day)	0.0 a	0.0 a	3.3 b	0.2 a
Quadris 2.08F 12.3 fl oz <alt> Presidio 4F 4 fl oz (7-day)	0.0 a	0.0 a	3.5 a	0.1 a
Check	0.8 a	0.1 a	7.5 a	0.7 a
LSD (*P*=0.05)[w]	NS	NS	NS	NS

[z] Spray dates for the 7-d schedule were 13 Oct, 21 Oct, 28 Oct, 4 Nov, and 10 Nov; and for the 10-day schedule were 13 Oct, 25 Oct, 4 Nov, and 16 Nov.

[y] Values in a column followed by the same letter are not statistically different according to Fisher's Least Significant Difference test.

[x] <alt> = applied in alternation.

[w] Fishers least significant difference, NS=treatment effect not significant at *P*=0.05.

Effect of Fungicides on Control of Pod Decay Diseases of Snap Beans, 2011

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The objective of this trial was to evaluate fungicides for control of cottony leak (*Pythium* and *Phytophthora* spp.) and pod tip blight (*Rhizoctonia solani*). The trial was conducted at the Oklahoma Vegetable Research Station in Bixby, OK in a field of in a field of Wynona silty clay loam previously cropped to soybeans. Granular fertilizer (27-69-0 lb/A N-P-K) was broadcast and incorporated into the soil prior to planting the cultivar 'Roma II' on 7 Apr. The herbicides Basagran 4L at 1 pt/A, Reflex 2E at 0.75 pt/A, and Fusilade DX 2E at 0.75 pt/A were applied post emergence in a tank mixture on 17 May. Plots were top-dressed with granular fertilizer (50-0-0 lb/A N-P-K) on 5 May and 2 Jun. Plots consisted of four 20-ft-long rows spaced 36 in. apart. The experimental design was a randomized complete block with four replications separated by a 5-ft-wide fallow buffer. Treatments were applied at the first appearance of pods and again 7-d later. Fungicides were directed through three 8002vk flat-fan nozzles per row using a CO2 pressurized wheelbarrow sprayer. The sprayer was calibrated to deliver 31 gal/A at 40 psi. Rainfall during the cropping period (7 Apr to 15 Jun) totaled 6.45 in. for Apr, 4.70 in. for May, and 0.70 in. for Jun. Snap beans were harvested and disease was assessed on 15 Jun when the pods graded 115 mm (length of largest seed from 10 large pods). Cottony leak incidence was evaluated by counting the number of 6-in. row segments with disease. The counts were converted to the percentage of row length affected. Yield was assessed by hand harvesting 1-m of row from each plot. The pods were classified as either healthy, or diseased with symptoms of cottony leak or pod tip blight. Disease incidence on the pods was based on the percentage of the total pod weight.

Rainfall was above normal (30-yr. avg) in Apr but below normal in May and Jun. Average daily temperature was above normal in Apr, normal for May, and 7.4°F above normal in Jun when pods developed. The hot conditions in Jun resulted in poor pod set and development, and inhibited cottony leak development. Cottony leak did not develop in this trial and incidence of pod tip blight was low and did not differ among treatments. Yields also were low and did not differ among treatments. No phytotoxicity symptoms were observed for any of the treatments.

Treatment and rate/A[z]	Cottony leak (% row ft)	Pod tip blight (% pods)	Yield (cwt/A)
Kocide 3000 1.25 lb	0.0	0.7	27.9
Ridomil Gold/Copper 65W 2.5 lb	0.0	0.8	26.1
Ranman 3.3F 2.75 fl oz	0.0	0.0	27.0
Reason 4.13F 8.2 fl oz	0.0	1.3	28.1
K-Phite 4.4L 3 qt	0.0	0.0	24.8
Quadris 2.08F 10 fl oz + ProPhyt 4.2L 4 pt	0.0	0.7	27.0
Curzate 60DF 5 oz	0.0	0.4	23.6
Presidio 4F 8 fl oz	0.0	0.4	27.1
Revus 2.08F 8 fl oz	0.0	1.9	24.0
Check	0.0	0.0	27.4
LSD (*P*=0.05)[X]	NS	NS	NS

[Z] Treatments were applied on 1 Jun and 8 Jun.
[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.

Evaluation of Fungicides for Control of Watermelon Anthracnose, 2011

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The objective of this trial was to evaluate fungicide programs for control of anthracnose on watermelon caused by the fungus *Colletotrichum obiculare.* The experiment was conducted at the Entomology/Plant Pathology Research Farm in Stillwater, OK in a field of Easpur loam previously cropped to wheat. Granular fertilizer (50-0-0 lb/A N-P-K) was incorporated into the soil prior to direct seeding the cultivar 'Sunsugar' on 30 Jun. The herbicides Sonalan 3E at 3.5 pt/A and Permit 75DF at 0.75 oz/A were broadcast after planting to control weeds. Plots were top-dressed with granular fertilizer (50-0-0 lb/A N-P-K) on 26 Jul. Plots were single, 20-ft-long rows spaced 15 ft apart. Plots were thinned to a 2-ft within row spacing. Squash bugs were controlled with Warrior 1F at 3.84 fl oz/A on 19 Aug, 2 Sep, and 15 Sep. Treatments were arranged in a randomized complete block design with four replications and a 10-ft fallow buffer separating replications. Fungicides were broadcast through flat-fan nozzles (8003vk) spaced 18-in. apart using a CO_2-pressurized wheelbarrow sprayer. The sprayer was calibrated to deliver 33 gal/A at 40 psi. Treatments received six applications on ca. 7-d intervals beginning 17 Aug. Plots were inoculated with *C. obiculare* by spreading 50 ml of oat kernels colonized by the fungus along the center of each plot on 17 Aug and 26 Sep. Rainfall during the cropping period (1 July to 10 Oct) totaled 0.73 in. for Jul, 0.31 in. for Aug, 2.34 in. for Sep, and 1.8 in for Oct. Plots received 22 applications of sprinkler irrigation that totaled 8.75 inches of water. Disease incidence was assessed by visually estimating disease incidence (percentage of leaves with symptoms that included defoliation) and defoliation (percentage of leaves defoliated) in three areas of each plot. Yield of marketable watermelons weighing ≥12 lb was taken on 4 Oct. Watermelons were classified as diseased or healthy based on the presence or absence of anthracnose lesions.

Rainfall was 60% below normal and average temperature was above normal except for Sep compared to the 30-yr avg. The hot and dry conditions delayed anthracnose development until Sep. Disease reached high levels by harvest in Oct. All treatments except Cuprofix and Penncozeb reduced anthracnose incidence and defoliation compared to the untreated check on each of the disease assessment dates. All treatments except Cuprofix had higher yields of healthy melons than the untreated check, but treatment effects were not significant for yield of diseased and total melons. Phytotoxicity symptoms were not observed for any of the treatments.

Treatment and rate/A (timing)[z]	Anthracnose (%)[y]		Defoliation (%)[x]		Yield (cwt/A)[w]		
	26 Sep	10 Oct	26 Sep	10 Oct	Healthy	Diseased	Total
Bravo 6F 2 pt (1-6)	10.8 c[v]	70.8 b	4.2 c	50.0 b	248.2 a	185.9	434.1
Cuprofix 40WG 2 lb (1-6)	26.7 b	98.3 a	5.8 b	92.9 a	28.1 c	278.0	306.1
Bravo 6F 2 pt (1,3,5) Quadris Top 2.7F 14 fl oz (2,4,6)	6.6 c	54.2 b	2.1 c	32.5 b	228.9 ab	137.9	366.9
Penncozeb 75DF 2 lb + Topsin 70W 0.5 lb (1-6)	3.9 c	55.0 b	0.0 c	38.3 b	184.2 ab	194.1	378.3
Penncozeb 75DF 3 lb (1-6)	11.2 c	74.1 ab	3.3 c	50.8 b	147.6 b	228.4	376.0
Untreated Check	55.8 a	100.0 a	39.6 a	99.6 a	4.8 c	263.4	268.2
LSD (*P*=0.05)[u]	8.3	26.0	6.5	24.8	84.6	NS	NS

[z] Numbers 1 to 6 correspond to the spray dates of 1=17 Aug, 2=25 Aug, 3=2 Sep, 4=8 Sep, 5=15 Sep, and 6=23 Sep.
[y] Plot foliage with anthracnose (including defoliation).
[x] Leaves defoliated from anthracnose.
[w] Marketable watermelons weighing ≥12 lb with (diseased) and without (healthy) anthracnose lesions, and the total of diseased and healthy watermelons.
[v] Values in a column followed by the same letter are not significantly different according to Fisher's least significant difference test at *P*=0.05.
[u] Least significant difference, NS=treatment effect not significant at *P*=0.05.

Weed Management

Postemergence Weed Control in Pepper

Hydro, OK 2011
Lynn Brandenberger and Lynda Carrier
Oklahoma State University
In Cooperation with
Schantz Family Farms

Introduction: Peppers grown commercially have few herbicides available for weed control. Control of broadleaf weeds following crop establishment is normally handled by hand hoeing. Hoeing is expensive often costing several hundred dollars per acre if labor is available. Therefore there is a need to identify potential postemergence herbicides that can be utilized for controlling broadleaf weeds in pepper fields. The objective of this study was to screen several herbicides that may have potential for weed control in commercial pepper production when applied later in the season as a postemergence application with a shielded sprayer.

Methods and Materials: The study field was transplanted to the pepper cultivar 'Okala' on 4/15/11 with between row spacing of three feet and transplant in-row spacing of 17 inches. The study included nine different treatments utilizing five different herbicides (Lorox: linuron, Reflex: fomesafen, Aim: carfentrazone-ethyl, Sharpen: saflufenacil, Staple: pyrithiobac- sodium) (Table 1). All treatments were applied to plots four rows wide (12 feet) by 30 feet in length in a randomized design with three replications on 7/14/11. Treatment applications were with a shielded sprayer at an overall rate of 25 gallons of spray solution per acre. Treatments were rated for percent injury and control of Palmer amaranth (*Amaranthus palmeri*) and Morningglory (*Ipomoea* species) on 7/28/11 and fresh weights were recorded for three plants per plot on 11/16/11.

Results and Discussion: Injury ratings on 7/28/11 did not vary between the untreated check and any of the herbicide treatments (Table 1). The levels of injury were low and ranged between 0 to 13% for all treatments and the untreated check. Control of Palmer amaranth was high for all herbicide treatments (all 100%). Control of morningglory ranged from zero percent for the untreated check to a high of 100% for Lorox at 2.0 lbs ai/acre rate. Although there were no differences observed between herbicide treatments there were some interesting trends. All treatments of Lorox, Reflex, and Aim recorded high levels of morningglory control (92-100%) while treatments of Sharpen and Staple had levels of control ranging from 58 to 73%. There were no differences observed between treatments or the untreated check for fresh weight on 11/16/11. Fresh weight ranged from 2.8 to 4.7 lbs.

Conclusions: Based upon the results of this study, the authors conclude that Lorox, Reflex, Aim, Sharpen, and Staple when applied with a shielded sprayer at the rates used appear to have adequate crop safety for use in commercial pepper production. Furthermore, treatments that included Lorox, Reflex, and Aim showed a trend toward higher levels of morningglory control. Additional studies would be helpful in determining other tank mix combinations and application timings for use in pepper production.

Acknowledgements: The authors want to thank the Schantz family for all their help and support in completing this study. We also want to thank Tessenderlo Kerley for product and partial research support, BASF, FMC, and DuPont companies for product support.

Table 1. 2011 Postemergence weed control in pepper, Hydro, OK

Treatment lbs. ai/acre	% Injury	Palmer amaranth % control	Morning Glory % control	Yield of 3 plants pounds
Untreated check	5 a[z]	50 b	0 b	3.6 a
Lorox 1.0	7 a	100 a	93 a	3.6 a
Lorox 1.5	3 a	100 a	83 a	4.0 a
Lorox 2.0	10 a	100 a	100 a	2.8 a
Reflex 0.31	3 a	100 a	92 a	3.8 a
Aim 0.05	7 a	100 a	95 a	3.9 a
Sharpen 0.022	0 a	100 a	58 a-b	4.7 a
Sharpen 0.044	10 a	100 a	58 a-b	3.5 a
Sharpen 0.056	13 a	100 a	73 a	3.4 a
Staple LX 0.05	0 a	100 a	58 a-b	4.2 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.

Spinach Preemergence Weed Control

Spring 2011-Bixby, OK

Lynn Brandenberger, Lynda Carrier

Introduction: Currently Dual Magnum (S-metolachlor) is the only preemergence herbicide labeled for use in commercial spinach within the state of Oklahoma. Although this herbicide is useful, having only one preemergence herbicide puts this crop at risk for the development of herbicide resistant weed species and the additional risk of losing registration of Dual Magnum. The objective of this study was to compare different preemergence treatments to determine the level of crop safety and efficacy of several different pre herbicides both separately and together as tank mixes.

Materials and Methods: The study included preemergence treatments applied following direct seeding. There were six different compounds (Dual Magnum-S metolachlor, Lorox-linuron, Bolero-thiobencarb, Barricade-prodiamine, Command 3ME-clomazone, and Vida-pyraflufen ethyl) applied alone and in combination for a total of 24 treatments plus weeded and un-weeded checks (Table 1). All plots were arranged in a randomized block design with four replications. Plots included four rows of ‘Olympia’ spinach planted on one foot row centers with a 20 foot plot length. Seeding rate was approximately 1.8 million seeds per acre. Plots were planted on 3/30/11 with pretreatments being applied the same day. All treatments were applied with a CO_2 sprayer using a hand-boom with a six foot wide spray pattern. The entire study area received 0.5 inch of overhead irrigation on 3/30/11 following planting and treatment applications. Application rate for spraying was 25 gallons of spray material per acre for all applications. Plots received a total of 150 lbs. of nitrogen per acre split between three applications of 46-0-0 on 4/12/11, 5/03/11, and 5/17/11. Crop emergence ratings were recorded on 4/12/11, injury ratings on 4/28/11, plant counts on 5/03/11, efficacy ratings on 5/26/11, and yield on 5/31/11. The rating scale that was used was a 0 to 100 scale where 0 represents no visible crop emergence, weed control or crop injury and 100 represents 100% emergence of the crop, control and or death of the weed species or the crop.

Results: Emergence ranged from 65 to 89% on 4/12/11 (Table 1). Bolero and Vida alone recorded some of the highest levels of emergence with Bolero at 1.0 and 2.0 lbs. ai/acre rates having 89% emergence, Vida at 0.0015 and the tank-mix of Vida at 0.0015 + Lorox at 0.10 lbs. ai/acre also recording 89% emergence. Crop injury ratings were highest for Barricade at 1.0 lbs. ai/acre, Dual Magnum at 0.50 lbs. + Lorox at 0.20 lbs., ai/acre, Barricade at 0.5 + Lorox at 0.10, and Barricade at 1.0 + Lorox at 0.10, respectively, which recorded 60, 34, 54, and 56% injury. Plants per row foot ranged from a low of 7 and 5 for Barricade at 1.0 and Barricade at 1.0 + Lorox at 0.10 lbs. ai/acre. The treatment with the highest plants per row foot was Vida at 0.0015 lbs. ai/acre with 27 plants per foot. The highest yielding treatments in the study included Dual Magnum at 0.5 lbs. + Vida at 0.0015 lbs. ai/acre, Command 3ME at 0.15 and 0.30 lbs. ai/acre with yields of 9678, 8290, and 8399 lbs. per acre, respectively. The two lowest yielding treatments included Barricade at 1.0 + Lorox at 0.10 lbs. ai/acre and Barricade alone at 1.0 lbs. ai/acre. Yields for these two treatments were 1089 and 1579 lbs. per acre, respectively. The hand-weeded and non-weeded checks had yields of 5445 and 7228 lbs./acre, respectively.

Control of weedy species varied between treatments (Table 2). Palmer amaranth (*Amaranthus palmeri*) control ranged from a low of 73% for Vida at 0.0030 lbs. ai/acre to the upper 90’s for treatments including Dual Magnum, Barricade and tank-mixes containing these two. There were no differences observed for control of henbit (*Lamium amplexicaule* L.) except for the Dual Magnum at 0.50 + Lorox at 0.20 lbs. ai/acre rate that had 49% control compared to other treatments that ranged from 85 to 100% control. A majority of treatments provided good control of carpetweed (*Mollugo verticillata* L.) (89-100%) while Vida at both 0.0015 and 0.0030 lbs. ai/acre tank-mixed with Lorox at 0.10 lbs. ai/acre had 74-83% control. Overall weed control varied considerably from a low of 55% for Vida at 0.0030 + Lorox at 0.10 lbs. ai/acre to a high of 98% for Barricade at 1.0 + Lorox at 0.10 lbs. ai/acre. Six treatments had overall control ratings of 90% or higher, these included Dual Magnum at 0.65 lbs. ai/acre, Bolero at 2.0 lbs. ai/acre, Dual Magnum at 0.50 + Lorox at 0.10 lbs. ai/acre, Dual Magnum at 0.50 + Bolero at 2.0 lbs. ai/acre, Dual Magnum at 0.50 + Command 3ME at 0.30 lbs. ai/acre, and Barricade at 1.0 + Lorox at 0.10 lbs. ai/acre.

Conclusions: Treatments had little effect upon emergence of spinach, but those containing Barricade recorded the highest levels of crop injury and lower plant numbers later in the season. Injury ranged from 16% for Barricade at 0.5 lbs. ai/acre to a high of 60% for the one pound rate of Barricade. Barricade treatments at one pound per acre also recorded the lowest yields. The highest yielding treatment included Dual Magnum at 0.5 lbs. tank-mixed with Vida at 0.0015 lbs. ai/acre. Overall weed control was highest for Barricade at 1.0 lbs. tank-mixed with Lorox at 0.10 lbs. ai/acre, but several tank-mixes containing Dual Magnum, Lorox, Bolero, and

Command 3ME did well also. The authors would recommend further investigations using these materials along with reduced rates of Barricade.

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Table 1. 2011 Spring Spinach weed control preemergence study, Bixby, OK. Emergence, injury, number plants, and yield.

	Emergence 4/12/2011	**Injury 4/28/2011**	**Plants/row foot 5/3/2011**	**Yield 5/31/2011**
Treatment descriptions lbs. ai/acre	**-------%-------**	**-------%-------**	**--Plants/foot--**	**----lbs./acre----**
Dual Magnum 0.50	65 c [z]	15 c-f	21 a-b	7623 a-d
Dual Magnum 0.65	79 a-c	13 c-g	21 a-b	6153 b-d
Lorox 0.10	83 a-b	8 d-h	20 a-b	6507 a-d
Lorox 0.20	75 a-c	18 c-d	19 a-c	3730 d-f
Bolero 1.0	89 a	3 g-h	23 a-b	4342 b-f
Bolero 2.0	89 a	8 d-h	26 a-b	8685 a-b
Barricade 0.5	80 a-b	16 c-e	20 a-b	4669 b-f
Barricade 1.0	74 a-c	60 a	7 d	1579 e-f
Command 3ME 0.15	84 a-b	5 e-h	18 b-c	8290 a-c
Command 3ME 0.30	80 a-b	5 e-h	25 a-b	8399 a-c
Vida 0.0015	89 a	3 g-h	27 a	4152 b-f
Vida 0.0030	86 a-b	11 c-h	25 a-b	3975 c-f
Dual Magnum 0.50 + Lorox 0.10	88 a-b	8 d-h	20 a-b	5350 a-f
Dual Magnum 0.50 + Lorox 0.20	81 a-b	34 b	19 a-c	5309 a-f
Dual Magnum 0.50 + Bolero 1.0	85 a-b	3 g-h	19 a-c	6643 a-d
Dual Magnum 0.50 + Bolero 2.0	79 a-c	14 c-g	21 a-b	7160 a-d
Dual Magnum 0.50 + Vida 0.0015	83 a-b	5 e-h	21 a-b	9678 a
Dual Magnum 0.50 + Vida 0.0030	75 a-c	20 c	22 a-b	5241 a-f
Dual Magnum 0.50 + Command 3ME 0.15	83 a-b	4 f-h	22 a-b	7024 a-d
Dual Magnum 0.50 + Command 3ME 0.30	83 a-b	6 d-h	18 b-c	8426 a-c
Barricade 0.5 +Lorox 0.10	73 b-c	54 a	11 c-d	3948 c-f
Barricade 1.0 +Lorox 0.10	75 a-c	56 a	5 d	1089 f
Vida 0.0015 +Lorox 0.10	89 a	0 h	23 a-b	6425 a-d
Vida 0.0030 +Lorox 0.10	86 a-b	9 c-h	23 a-b	5772 a-e
Handweeded check	88 a-b	3 g-h	25 a-b	5445 a-f
Weedy check	88 a-b	3 g-h	23 a-b	7228 a-d

[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. 2011 Spring Spinach weed control preemergence study, Bixby, OK.

Treatment descriptions lbs. ai/acre	% Weed Control on 5/26/2011				
	Palmer amaranth	Lambs quarter	Henbit	Carpetweed	Overall
Dual Magnum 0.50	91 a-b [z]	88 a	85 a-d	91 a-b	88 a-d
Dual Magnum 0.65	99 a	98 a	83 a-e	95 a-b	91 a-c
Lorox 0.10	89 a-c	85 a	64 e	93 a-b	74 b-d
Lorox 0.20	88 a-c	99 a	68 d-e	91 a-b	70 d-e
Bolero 1.0	80 b-d	100 a	68 d-e	90 a-b	74 b-d
Bolero 2.0	94 a-b	100 a	85 a-d	94 a-b	90 a-c
Barricade 0.5	98 a	100 a	86 a-d	99 a	89 a-c
Barricade 1.0	99 a	98 a	93 a-b	100 a	94 a
Command 3ME 0.15	90 a-c	94 a	83 a-e	90 a-b	85 a-d
Command 3ME 0.30	85 a-d	99 a	93 a-b	91 a-b	89 a-c
Vida 0.0015	84 a-d	100 a	75 b-e	90 a-b	81 a-d
Vida 0.0030	73 d	98 a	69 d-e	81 b-c	73 c-d
Dual Magnum 0.50 + Lorox 0.10	91 a-b	100 a	89 a-c	94 a-b	91 a-c
Dual Magnum 0.50 + Lorox 0.20	99 a	49 b	86 a-d	96 a-b	88 a-d
Dual Magnum 0.50 + Bolero 1.0	98 a	98 a	84 a-d	95 a-b	88 a-d
Dual Magnum 0.50 + Bolero 2.0	96 a	93 a	89 a-c	91 a-b	90 a-c
Dual Magnum 0.50 + Vida 0.0015	99 a	96 a	78 b-e	94 a-b	88 a-d
Dual Magnum 0.50 + Vida 0.0030	89 a-c	93 a	71 c-e	89 a-b	83 a-d
Dual Magnum 0.50 + Command 3ME 0.15	93 a-b	98 a	83 a-e	89 a-b	88 a-d
Dual Magnum 0.50 + Command 3ME 0.30	96 a	99 a	91 a-b	96 a-b	93 a-b
Barricade 0.5 +Lorox 0.10	95 a	98 a	84 a-d	96 a-b	88 a-d
Barricade 1.0 +Lorox 0.10	99 a	100 a	98 a	100 a	98 a
Vida 0.0015 +Lorox 0.10	85 a-d	100 a	75 b-e	83 b-c	81 a-d
Vida 0.0030 +Lorox 0.10	76 c-d	99 a	40 f	74 c	55 e
Hand weeded check	98 a	78 a	91 a-b	100 a	95 a
Weedy check	0 e	0 c	0 g	0 d	20 f

[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.

Potential Organic Herbicides for Squash Production:
Pelargonic Acid Herbicides AXXE® and Scythe®

Charles L. Webber III[1], James W. Shrefler[2], Lynn P. Brandenberger[3], and Angela R. Davis[1]

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Introduction: Organic squash (*Cucurbita pepo* L.) producers need appropriate herbicides that can effectively provide season-long weed control. Although corn gluten meal has shown promise as an early-season pre-emergent organic herbicide in squash production, any uncontrolled weeds can inflict serious yield reductions by the end of the growing season. Organic squash producers need additional organic herbicides that can affectively provide affective post-emergent weed control. Previous research with post-emergence organic contact herbicides determined that these herbicides must be applied to very young/small weeds if acceptable weed control is expected. A potential solution to increase weed control efficacy on larger weeds and decrease squash injury is the use of multiple/sequential post-directed herbicide applications (herbicides sprayed at the base of the crop rather than over-the-top).

Objective: Research was conducted in southeast Oklahoma (Atoka County, Lane, OK) to determine the impact of sequential post-directed applications of potential organic herbicides on weed control efficacy, crop injury, and yields.

Materials and Methods: Yellow squash, cv. 'Enterprise', was direct-seeded on June 27, 2011 into raised 91-cm centered beds. The experiment included two herbicides, AXXE® (65% pelargonic acid, BioSafe Systems LLC[1,2]) and Scythe® (57% pelargonic acid, Gowan Company, LLC[3]), applied post-directed (75 gpa, 8004, 0.40 gpm, July 14) at 4 rates (1.5, 3, 5, and 10% v/v). Eleven days after the initial herbicide treatment, a second/sequential post-directed application was applied for each herbicide for the 1.5, 3, and 5% v/v treatments (75 gpa, 8004, 0.40 gpm) on July 25). The experiment also included an untreated weedy-check and an untreated weed-free check and 4 replications.

At the time of initial applications smooth crabgrass (*Digitaria ischaemum* (Schreb.) Schreb. ex Muhl.) was 2.5 – 5 inches tall and cutleaf groundcherry (*Physalis angulata* L.) was 1 – 2.5 inches tall. Weed control and injury (phytotoxicity) ratings were collected at 1, 4, 7, 10, 12, 15, 19, 22, 27, 32 and 41 days after the initial treatment (DAIT).

Weed control ratings represent the percent weed control for a treatment compared to the weedy-check. A 0 to 100% visual rating system was used in which 0% represented no weed control, while 100% represented complete weed control. A 0 to 100% visual rating system was used in which 0% represented no crop injury, while 100% represented crop death. Weed control and crop injury data were converted using an arcsine transformation to facilitate statistical analysis and mean separation. Squash fruit was harvested from July 29, 2011 through August 22, 2011 (11 harvests). All data were subjected to ANOVA[4] and mean separation using LSD with P=0.05.

Results and Discussion: Weed control (total, broadleaf, and grass) increased as the application rates increased, producing a minimum of 99% control 1 DAIT for the 10% v/v rate for each herbicide (Table 1, 2, and 3). In general, the herbicides produced similar results for similar applications rates with some variation among treatments for the different sampling dates. The single application of each herbicide at 10% v/v performed similarly across weed control rates (12 to 41 DAIT) to the sequential application of 5% v/v. These results provide the producer with the option to apply the herbicides in a single high rate or make two judicial sequential

[1] The mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.
[2] AXXE® (65% pelargonic acid), BioSafe Systems LLC, Meadow Street, East Hartford, CT 06108, Phone: 860.290.8890, Fax: 860.290.8802, Website Address: www.biosafesystems.com
[3] Scythe®, Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268, (317) 337-3000
[4] SAS Institute Inc., 100 SAS Campus Drive, Cary, NC 27513.

applications. Squash injury increased as the application rates increased (Table 4). The 10% v/v application rates produced the greatest squash injury at 1 DAIT (Table 4) with the 5% v/v producing the greatest injury at 12 DAIT following the sequential application. Squash yields (fruit/acre and t/acre) increased as the herbicide rates increased, peaking at the 5% v/v rates and dropping off with 10% v/v (Table 5). The decrease in yields for the 10% v/v rates indicate that the greater initial injury produced season long yield reductions compare to the two 5% v/v sequential applications. In general, all the herbicide applications produced as good or greater yields than the weedy-check.

Conclusions: The 5% v/v sequential application of either herbicide produced equivalent weed control and yields with less seasonal squash injury than the one time 10% v/v application. The 5% v/v sequential applications provide additional flexibility in the timing of the weed control treatments. Additional research should focus on fine-tuning the herbicide application to control specific weeds at various maturity levels and sizes.

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Table 1. Percentage (%) total (broadleaf, grasses, and nutsedge) weed control for AXXE and Scythe applied post-directed to squash.

Weed Control Treatment (v/v%)	Days After Initial Treatment (DAIT)							
	1	4	10	12	19	22	27	41
	Percentage Total Weed Control (%)							
AXXE 1.5	43 g*	34 f	23 f	19 e	11 e	10 f	11 d	6 e
AXXE 3	80 e	80 d	73 d	84 cd	71 cd	69 de	66 c	44 d
AXXE 5	95 c	93 c	87 c	94 b	90 b	89 b	91 b	76 c
AXXE 10	99 b	97 b	96 b	91 bc	89 b	78 cd	86 b	81 bc
Scythe 1.5	33 h	23 g	14 g	24 e	10 e	8 f	5 d	3 e
Scythe 3	72 f	61 e	53 e	80 d	64 d	59 e	65 c	49 d
Scythe 5	88 d	81 d	78 d	94 b	76 c	79 cd	89 b	74 c
Scythe 10	99 b	98 b	94 b	91 bc	86 b	81 bc	86 b	86 b
Weedy-Check	0 i	0 h	0 h	0 f	0 f	0 g	0 e	0 f
Weed-Free	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a

*Values in columns followed by the same lower case letter are not significantly different at P≤0.05, ANOVA (using transformed data).

Table 2. Percentage (%) broadleaf weed control for AXXE and Scythe applied post-directed to squash.

Weed Control Treatment (v/v%)	Days After Initial Treatment (DAIT)							
	1	4	10	12	19	22	27	41
	Percentage Broadleaf Weed Control (%)							
AXXE 1.5	38 e*	33 f	21 f	21 d	11 e	10 e	11 d	6 e
AXXE 3	80 cd	78 d	73 d	84 b	71 cd	68 d	66 c	46 d
AXXE 5	94 b	91 c	83 c	94 ab	90 b	89 b	89 b	76 c
AXXE 10	99 a	96 b	94 b	90 b	88 b	85 bc	86 b	81 bc
Scythe 1.5	29 e	21 g	13 g	24 d	9 e	8 e	5 d	4 e
Scythe 3	71 d	60 e	53 e	60 c	64 d	60 d	70 c	49 d
Scythe 5	87 cd	79 d	73 d	94 ab	75 c	79 c	89 b	74 c
Scythe 10	99 a	96 b	93 b	93 b	87 b	81 c	86 b	86 b
Weedy-Check	0 f	0 h	0 h	0 e	0 f	0 f	0 e	0 f
Weed-Free	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a

*Values in columns followed by the same lower case letter are not significantly different at P≤0.05, ANOVA (using transformed data).

Table 3. Percentage (%) grass weed control for AXXE and Scythe applied post-directed to squash.

Weed Control Treatment (v/v%)	Days After Initial Treatment (DAIT) 1	4	10	12	19	22	27	41
	Percentage Grass Weed Control (%)							
AXXE 1.5	45 e*	31 e	24 f	15 f	11 f	10 g	30 d	7 d
AXXE 3	85 c	85 c	75 d	88 d	78 d	73 e	69 c	39 c
AXXE 5	98 a	98 b	90 c	98 abc	95 b	91 b	95 b	80 b
AXXE 10	99 a	100 a	99 a	99 ab	91 bc	89 bc	90 b	84 b
Scythe 1.5	33 f	23 e	13 g	28 e	10 f	8 g	4 e	2 de
Scythe 3	74 d	64 d	54 e	84 d	69 e	65 f	73 c	53 c
Scythe 5	93 b	86 c	80 d	97 bc	80 d	80 d	90 b	79 b
Scythe 10	100 a	99 ab	98 b	96 c	90 c	85 cd	91 b	86 b
Weedy-Check	0 g	0 f	0 h	0 g	0 g	0 h	0 e	0 e
Weed-Free	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a

*Values in columns followed by the same lower case letter are not significantly different at P≤0.05, ANOVA (using transformed data).

Table 4. Percentage (%) crop injury for AXXE and Scythe applied post-directed to squash.

Weed Control Treatment (v/v%)	Days After Initial Treatment (DAIT) 1	4	10	12	19	27	41
	Percentage Crop Injury (%)						
AXXE 1.5	2.50 cde*	1.25 cd	0.75 de	2.25 cd	0.50 ab	0 a	0 a
AXXE 3	3.75 cd	2.50 bc	1.50 cd	4.50 c	1.00 ab	0 a	0 a
AXXE 5	7.00 b	4.50 b	2.50 bc	11.25 a	1.50 a	0 a	0 a
AXXE 10	13.70 a	7.25 a	3.50 ab	3.50 c	1.50 a	0 a	0 a
Scythe 1.5	2.00 de	3.25 bc	1.00 de	4.50 c	0.75 ab	0 a	0 a
Scythe 3	7.00 b	2.50 bc	2.50 bc	7.50 b	1.75 a	0 a	0 a
Scythe 5	5.00 bc	3.00 bc	1.75 cd	12.00 a	1.75 a	0 a	0 a
Scythe 10	11.25 a	7.00 a	4.50 a	4.50 c	1.50 a	0 a	0 a
Weedy-Check	0.00 e	0.00 d	0.00 e	0.00 d	0.00 b	0 a	0 a
Weed-Free	0.00 e	0.00 d	0.00 e	0.00 d	0.00 b	0 a	0 a

*Values in columns followed by the same lower case letter are not significantly different at P≤0.05, ANOVA (using transformed data).

Table 5. Impact of sequential post-directed applications of AXXE® and Scythe® applied at 1.5, 3, 5, and 10% v/v on marketable squash fruit number (#/acre), % marketable fruit, and yield (tons/acre).

Weed Control Treatment (v/v%)	Marketable Fruit Production fruit/acre		%		tons/acre	
AXXE 1.5	32,820	bcd*	98	ab	7.6	abc
AXXE 3	42,980	abc	93	c	9.2	ab
AXXE 5	50,240	a	97	abc	10.6	a
AXXE 10	43,700	abc	95	bc	9.2	ab
Scythe 1.5	28,900	cd	97	ab	6.2	bc
Scythe 3	38,480	abc	98	a	8.2	ab
Scythe 5	44,140	abc	98	ab	9.8	ab
Scythe 10	42,690	abc	96	abc	9.2	ab
Weedy-Check	19,020	cd	98	ab	4.1	c
Weed-Free	47,780	ab	96	abc	11.3	a

*Values in columns followed by the same lower case letter are not significantly different at P≤0.05, ANOVA.

Preemergence Weed Control in Watermelon

Vegetable Research Station, Bixby, OK
Summer, 2011
Lynn Brandenberger and Lynda Carrier,
Oklahoma State University

Introduction and Objectives: Watermelon is a major vegetable crop grown in the state of Oklahoma. Weed control on this crop is crucial for commercial growers particularly as labor costs increase and availability of hoeing crews becomes less. Weed infested fields can be a source of pest problems including insect and disease in addition to the obvious loss of yield and additional harvest cost. The objectives of this study were to determine the crop safety and effectiveness of herbicides that have not previously been labeled for use in watermelon for transplanted watermelon production.

Materials and Methods: Treatments in this study included Reflex (fomesafen), Sandea (halosulfuron), and Lorox (linuron) alone and in combination for a total of eight treatments plus weeded and unweeded checks. The study was a randomized block design with four replications. Plots consisted of one plant row 18 feet wide and 30 feet long. The herbicide treatment area of each plot was treated with a CO_2 hand-boom sprayer with a six foot width, areas between treatments (plot alleys) were treated with a tankmix of 0.048 lbs. ai/acre of Sandea + 1.7 lbs ai/acre of ethalfluralin. All treatments were applied on 6/16/11 as preplant treatments and transplants of the watermelon cultivar Delta were transplanted on 6/21/11. The study area received a total of 105 lbs. of nitrogen per acre total from three applications of urea (46-0-0) on 7/8/11, 7/13/11, and 7/25/11. Water needs of the study were met with overhead irrigation of the plots. Data including number of plants/plot, vine length, vigor ratings, and number of Palmer amaranth/plot were recorded on 7/13/11. Data including percent injury, and percent control of Palmer amaranth (*Amaranthus palmeri*), goosegrass (*Eleusine indica*), morningglory (*Ipomoea* species), and all weeds were recorded on 7/25/11. Plots were harvested on 9/6/11 with individual fruit weights recorded.

Results and Discussion: No differences were recorded between treatments on 7/13/11 for plant number per plot, vine length, or vigor (Table 1). Number of Palmer amaranth counted per plot on 7/13/11 ranged from a high of 63 and 61 for the weeded and unweeded checks, respectively, to less than 10 for all herbicide treated plots.

Crop injury ratings recorded on 7/25/11were not different between either of the untreated checks or treatments in the study (Table 2). Injury ranged from 3 to 13%, but again no significant differences were recorded. Control of Palmer amaranth ranged from 50 to 99% for Sandea alone and Reflex alone at 0.375 lbs. ai/acre, respectively. The weeded and unweeded checks had 90 and 0% control, respectively. Goosegrass control was highest for Sandea + Reflex at 0.25 lbs. ai/acre and Reflex alone at 0.375 and 0.5 lbs. ai/acre. These treatments ranged from 95 to 96% control of goosegrass. Morningglory control ranged from a low of 25% for the unweeded check to a high of 100% for Reflex at 0.1875, Sandea alone, and Sandea + Reflex at 0.1875 and 0.25 lbs. ai/acre. Overall weed control was only different for the unweeded check and Sandea alone which were 6 and 26%, respectively, while the rest of the treatments and weeded check ranged from 56-86% control.

Fruit counted on the vine were recorded on 8/30/11. Counts ranged from a low of 444 and 726 for the unweeded check and Sandea alone to a high of 2440 and 2541/acre for Reflex alone at 0.375 and Sandea + Reflex at 0.25 lbs. ai/acre (Table 3). The number of fruit that were harvested reflected the on the vine fruit counts. The highest number of harvested fruit was 1896 fruit per acre for Sandea + Reflex at 0.25 lbs. ai/acre. Overall yields per acre were lowest for the unweeded check and Sandea alone. The highest yields came from Reflex alone at 0.1875, 0.25, 0.50 lbs. ai/acre and for Sandea + Reflex at 0.25 lbs. ai/acre. These treatments yielded 13,924, 14,760, 15,799 and 21,492 lbs. of watermelon per acre, respectively. Average fruit weight did not vary between treatments or the weeded check (9.4-11.7 lbs.), but the unweeded check had considerably lower weight per fruit with an average fruit weight of 3.8 lbs.

Conclusions: In this study, our highest level of overall weed control was with Reflex alone at the 0.375 lbs. ai/acre rate, although Palmer amaranth control was highest with the tankmix of Sandea + Reflex at 0.25 lbs. ai/acre. Tankmixing combinations of herbicides are one approach to obtaining higher levels of weed control in many crops. That said the real test of any type of treatment is how it affects the yield of a crop. Highest yielding treatments in this study included several rates of Reflex alone and the combination of Sandea + Reflex at 0.25

lbs. ai/acre. Based upon these results, the authors would conclude that Reflex appears to be safe for use in transplanted watermelon as a pre-transplanting treatment.

Table 1. 2011 Preemergence weed control in watermelon, Bixby, OK. Ratings on 7/13/2011

Treatment description lbs. ai/acre	Plants/plot (number)	Vine length (inches)	Vigor (1-10) 10=best	Palmer amaranth (number per plot)
Weeded check	9.5 a	73.0 a	7.5 a	63 a
Unweeded check	10.0 a	85.8 a	7.8 a	61 a
Reflex 0.1875	10.0 a	65.5 a	6.5 a	0 b
Reflex 0.25	10.3 a	77.0 a	6.5 a	2 b
Reflex 0.375	10.3 a	60.5 a	6.0 a	0 b
Reflex 0.50	11.5 a	52.5 a	5.3 a	1 b
Sandea 0.024	10.8 a	66.0 a	7.0 a	9 b
Sandea 0.024 + Reflex 0.1875	9.3 a	62.8 a	6.5 a	0 b
Sandea 0.024 + Reflex 0.25	10.3 a	65.0 a	7.0 a	0 b
Lorox 0.50	10.5 a	61.0 a	6.5 a	2 b

[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. 2011 Preemergence weed control in watermelon, Bixby, OK. Ratings on 7/25/2011

	Injury	Palmer amaranth	Goosegrass	Morning Glory	Total weed 8/30/2011
Treatment description lbs. ai/acre	-------%-------	----------------------------% control			--------------------------------
Weeded check	11 a	90 a-b	91 a-b	88 a-b	65 a
Unweeded check	5 a	0 d	0 d	25 b	6 b
Reflex 0.1875	5 a	90 a-b	83 a-b	100 a	65 a
Reflex 0.25	10 a	94 a-b	89 a-b	75 a-b	66 a
Reflex 0.375	13 a	99 a	95 a	85 a-b	86 a
Reflex 0.50	11 a	91 a-b	95 a	80 a-b	69 a
Sandea 0.024	8 a	50 c	50 c	100 a	26 b
Sandea 0.024 + Reflex 0.1875	5 a	96 a	94 a-b	100 a	66 a
Sandea 0.024 + Reflex 0.25	10 a	98 a	96 a	100 a	80 a
Lorox 0.50	3 a	73 b	73 b	73 a-b	56 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.

Table 3. 2011 Preemergence weed control in watermelon, Bixby, OK. Yield results

Treatment description lbs. ai/acre	**8/30/11 Vine fruit cnts. (#/acre)**	**9/6/11 Fruit harvested (#/acre)**	**9/6/11 Fruit yield (lbs./acre)**	**Average fruit wt (lbs.)**
Weeded check	1795 a	1008 b	10745 b-c	10.3 a
Unweeded check	444 b	182 c	1500 d	3.8 b
Reflex 0.1875	2017 a	1311 a-b	13924 a-b	10.6 a
Reflex 0.25	2117 a	1291 a-b	14760 a-b	11.1 a
Reflex 0.375	2440 a	1049 b	10509 b-c	9.4 a
Reflex 0.50	1775 a	1512 a-b	15799 a-b	10.0 a
Sandea 0.024	726 b	323 c	3612 c-d	11.5 a
Sandea 0.024 + Reflex 0.1875	1956 a	1069 b	10943 b-c	10.1 a
Sandea 0.024 + Reflex 0.25	2541 a	1896 a	21492 a	11.7 a
Lorox 0.50	1714 a	1170 b	13445 a-b	11.3 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.

Weeded check (Photos from 7/19/11)

Unweeded check

Reflex at 0.1875 lbs. ai/acre

Reflex at 0.25 lbs. ai/acre

Reflex at 0.375 lbs. ai/acre

Reflex at 0.50 lbs. ai/acre

Sandea at 0.024 lbs. ai/acre

Sandea + Reflex at 0.1875 lbs. ai/acre

Sandea + Reflex at 0.25 lbs. ai/acre

Lorox at 0.50 lbs. ai/acre

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
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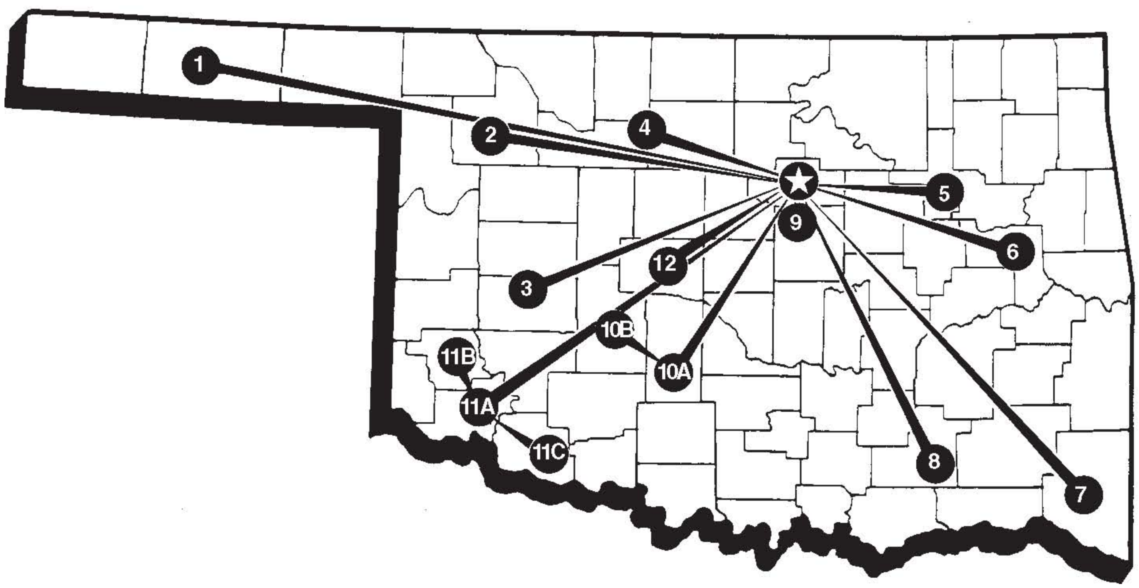
SYSTEM COVERS THE STATE



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

1. **Oklahoma Panhandle Research and Extension Center—*Goodwell***
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3. **Marvin Klemme Range Research Station—*Bessie***
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5. **Oklahoma Vegetable Research Station—*Bixby***
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