

Great Lakes Fruit, Vegetable & Farm Market EXPO

December 9-11, 2008

DeVo Place Convention Center, Grand Rapids, MI



Onion

Wednesday morning 9:00 am

Where: Grand Gallery (lower level) Room C

Recertification credits: 1 (PRIV OR COMM CORE)

CCA Credits: PM(1.5) CM(0.5)

Moderator: Glen Leep, 4L Farms, East Martin, MI

9:00 a.m. Sweet Onion Variety Trials

- Ron Goldy, District Vegetable Educator, MSU Extension

9:20 a.m. Improve Onion Rotation with Mustard Cover Crops

- Mathieu Ngouajio, Horticulture Dept., MSU

9:40 a.m. Managing Onion Insect Pests

- Walter Pett, Entomology Dept., MSU

10:00 a.m. Bacterial Blight and Other Onion Diseases

- Mary Hausbeck, Plant Pathology Dept., MSU

10:20 a.m. Onion Weed Control Update

- Bernard Zandstra, Horticulture Dept., MSU
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SWMREC SWEET ONION TRIALS

Dr. Ron Goldy & Dr. Darryl Warncke, MSUE
Southwest Michigan Research and Extension Center

The Michigan onion is a long day, yellow, pungent cooking onion capable of long-term storage and is grown on organic soils. The Michigan industry currently has about 3700 acres, down from 8,000 in 1992. This contrasts with a 56% increase in onion consumption over the past 25 years. This increase is primarily in sweet onions (<5 mmoles/liter pyruvic acid) used fresh or in slightly cooked, stir fry dishes. They are also served as appetizers in several restaurant chains. The best known sweet onion is Vidalia but they also come from Texas, Colorado, Washington and other states and countries. Sweet onions have a short storage life and therefore sourced from several production areas to maintain a yearly supply (Table 1). Michigan growers have not taken advantage of the increase in sweet onion popularity. Reasons include; lack of suitable varieties, short storage life, short season, lack of branding recognition and others. To determine solutions to these problems, research was initiated at the Southwest Michigan

Research and Extensions Center in 2007.

Table 1. Sweet onion availability. Michigan production is theoretical (X= available; S=available from storage).

State	J	F	M	A	M	J	J	A	S	O	N	D
Texas			X	X	X	X	X					
Georgia				X	X	X	S	S	S	S	S	
Arizona					X	X						
Washington						X	X	X	X	X		
New Mexico						X	X	X				
California				X	X	X	X	X	X			
Colorado							X	X	X			
Imports	X	X	X	X					X	X	X	X
MICHIGAN	S	S	S					X	X	X	X	S

The 2007 trial evaluated how eight easily available cultivars (Table 2) would perform under Michigan conditions. They were purchased from Jung Seed Company as transplants planted May 2, 2007, harvested August 3, and removed from the field August 7. From August 3 to 7 they were exposed to 5.5 inches of rain, 90°F and high humidity. These conditions resulted in a high incidence of bulb rot but produced good information on which entries performed best under adverse conditions. Three cultivars; ‘Sweet Spanish’, ‘Super Star’ and ‘Mars’ were found suitable for commercial consideration in Michigan. These three were

determined suitable based on high total yield (400, 379 and 369 hundred weight/acre, respectively), number of colossal and jumbo bulbs and low number of culled bulbs. The low number of culls is impressive given the weather conditions. The top three performers had round bulbs with tight, small necks. ‘Ailsa Craig’ and ‘Walla Walla’ had a significant amount of culled bulbs due to neck rot and had a “tear-shaped” bulb with a thicker neck. ‘Texas 1015Y’ did not bulb and should not be planted.

Results from 2007 showed there were varieties with commercial potential. It also showed the Michigan growing season was not too short since they were harvested with nearly two months of growing season left. From this experience it was decided to expand the number of entries to 18 for 2008 and include a direct seeded planting (Table 3 & 4).

Table 2. Yield in hundred weight/acre of eight onion cultivars at the Southwest Michigan Research and Extension Center, Benton Harbor, Michigan in 2007.

Variety	Color	Total Yield	Super Colossal	Colossal	Jumbo	Medium	Small	Cull
Ailsa Craig	Y	443	13	30	140	8	.4	251
Sw. Spanish	Y	400	0	32	218	76	27.5	45
Super Star	W	379	0	22	271	9	.6	75
Walla Walla	Y	375	3	36	38	5	.5	292
Mars	R	369	0	12	323	9	.2	25
Candy	Y	329	0	11	119	47	19.7	132
Copra	Y	327	0	0	189	102	20.4	15
Texas 1015Y	Y	52	0	0	7	26	13.5	6
lsd=0.05		110	10	31	55	19	10.5	98

In general, 2008 was not good for onion production. The planting season was cool and wet causing delays and slow growth. The direct seeded trial took 16 to 18 days to emerge. During germination soil temperature was 45°F to 61°F (51.6°F average). Cool temperatures continued through the season. The weather affect can be seen by comparing lines appearing in 2007 and 2008. There were no super colossal and colossal bulbs in 2008 (there was no direct seeded trial in 2007) while ‘Sweet Spanish’, ‘Superstar’ and ‘Mars’ all had bulbs in these categories in 2007. Total yields were lower in lines appearing both years and average size shifted downward one category in 2008 compared to 2007. Size could have been affected by a Poast application (Poast was not applied in 2007) since it came at a time of bulb growth and additional stress could have affected size. Production recommendations for Georgia indicate Poast can cause damage during hot weather. Temperatures following application reached 85°F, 88°F and 83°F on 6/11, 6/12 and 6/13, respectively.

The 2008 direct seeded trial was planted April 7, 2008 and the transplanted trial planted April 30 and May 1 from greenhouse plants started February 25. Significant differences were found in all traits in both 2008 plantings. ‘Monterro’, ‘Desperado’, and ‘Ovation’ were among the leaders in total yield, jumbo and medium sized bulbs in both trials. Harvest for the transplanted trial began late July while harvest of the direct seeded trial began late August.

Even though the same entries appeared in both 2008 trials, the trials were not designed to make a transplanted versus direct seeded comparison. However, the transplanted trial did appear better. Average total yield was higher in the transplanted trial (337.41 hundred weight) compared to the direct seeded trial (250.77 hundred weight) (Table 3 & 4). These differences could be due to plant stand since stand in a transplanted trial is better than a direct seeded trial. The three leaders in total yield in the seeded trial, ‘Monterro’, ‘Desperado’, and ‘Ovation’ were also among the leaders in the transplanted trial and had surprisingly similar total yields in both plantings.

Average “curl” rating also differed between the two plantings with the transplanted onions appearing more effected then the direct seeded plants, 1.89 and 1.68, respectively (1 not effected; 3 severely affected). This could be due to difference in plant stage with the transplanted onions being somewhat larger when Poast was applied.

More variation for total yield was observed in the direct seeded trial than the transplanted trial indicating some cultivars may be adapted for transplanting but not seeding. This is apparent in XON 670W where it was among the leaders in the transplanted but next to last in the seeded trial (Table 3 & 4). Some direct seeded entries did not germinate well and had a poor plant stand. So even though they may be adapted for bulb production they may not be adapted to the cooler soil conditions experienced in Michigan.

Soluble solid and pyruvic acid levels were evaluated for the better performing lines (Table 3 & 4). Pyruvic acid levels fell mostly into the medium (3 – 7 micromoles) pungency level in both trials. XON 670W and ‘Sweet Spanish’ had low pyruvic acid levels (0 – 3 micromoles) in the transplanted trial and ‘Ovation’ had low levels in the direct seeded trial. ‘Copra’ had the highest soluble solid levels in both trials. Ideally sweet onions should be high in soluble solids and low in pyruvic acid. With these criteria, ‘Sweet Spanish’ had the best soluble solids to pyruvic acid levels in either trial. Michigan could potentially fill the demand for sweet onions from August to December, or longer, when onions are being shipped into the state from the western US or Central and South America.

Table 3. Yield in hundred weight per acre of 18 **transplanted** onions at the Southwest Michigan Research and Extension Center, Benton Harbor, Michigan in 2008. Plant population was approximately 95,000 plants per acre.

Variety	Color	Source	Total Yield	Yield Jumbo ¹	Yield Medium ²	Yield Small ³	Yield Cull	Soluble Solids	Pyruvic Acid ⁴	Curl Rating
Expression	Y	BE	502.38	291.97	131.87	0.00	78.54	5.4	3.08	1.75
Montero	Y	NH	447.03	279.73	157.68	1.26	8.36	5.4	4.83	2.50
XON 670W	W	SK	392.21	211.98	152.48	11.23	16.51	5.6	2.98	2.50
Desperado	Y	BE	385.22	193.97	154.71	12.82	23.72	6.5	5.08	2.75
Red Defender	R	RI	378.81	264.04	106.55	1.28	6.94	9.9	6.67	2.00
Ovation	Y	SK	375.97	226.81	100.22	0.89	48.05	4.2	3.99	2.50
Rosita	P	BE	374.34	168.61	190.06	3.06	12.61	7.3	3.75	1.00
Red Fortress	R	RI	363.27	203.57	110.32	3.05	46.33	8.6	5.71	1.75
Western Giant	Y	SK	350.19	110.59	148.90	9.28	81.42	--	--	2.00
Spanish Medallion	Y	SK	301.47	151.19	118.21	9.68	22.39	--	--	1.50
Mt. Whitney	W	SK	299.58	81.83	156.32	4.31	57.13	--	--	2.75
Sweet Spanish	Y	JU	290.58	58.42	192.89	2.17	37.10	6.0	2.96	1.50
Rumba	R	NH	289.11	56.99	199.47	3.82	28.83	--	--	1.25
Sequoia	Y	NH	283.92	33.29	214.68	21.08	14.88	--	--	2.00
Superstar	W	JU	280.55	65.27	121.51	9.38	84.39	--	--	1.75
Mars	R	JU	266.53	49.74	188.51	18.12	10.17	--	--	1.00
XON 550Y	Y	SK	246.31	79.16	117.93	25.61	23.62	--	--	1.75
Copra	Y	JU	245.83	3.98	225.44	16.41	0.00	10.4	5.48	1.75
Lsd=0.05			176.86	144.3	98.13	24.19	50.99			0.75

¹Three to four inches in diameter

²Two to three inches in diameter.

³One to two inches in diameter.

⁴Micromoles/liter.

Table 4. Yield in hundred weight per acre of 18 **direct seeded** onions at the Southwest Michigan Research and Extension Center, Benton Harbor, Michigan in 2008. Plant population was approximately 95,000 plants per acre.

Variety	Color	Source	Total Yield	Yield Colossal ¹	Yield Jumbo ²	Yield Medium ³	Yield Small ⁴	Yield Cull	Soluble Solids	Pyruvic Acid ⁵	Curl Rating
Montero	Y	NH	481.75	8.51	324.85	106.58	13.50	28.33	7.1	5.25	1.75
Desperado	Y	BE	396.45	0	181.61	118.24	44.18	52.42	7.2	5.49	2.00
Ovation	Y	SK	372.25	0	175.78	146.37	21.53	28.57	5.4	2.78	1.75
Red Fortress	R	RI	360.42	0	149.74	148.00	25.56	37.13	9.1	4.29	1.75
Sweet Spanish	Y	JU	324.65	0	136.22	150.20	16.03	22.19	6.7	3.07	1.75
Expression	Y	BE	321.18	0	155.96	115.27	20.74	29.21	5.6	3.65	1.25
Red Defender	R	RI	308.88	0	224.69	55.24	1.35	27.61	8.5	5.81	2.25
Spanish Medallion	Y	SK	289.73	0	89.11	92.44	72.62	35.56	--	--	1.75
Rosita	P	BE	278.79	0	89.36	148.74	40.07	0.62	6.7	4.48	1.25
Rumba	R	NH	256.92	0	17.11	146.03	75.85	17.93	--	--	1.25
Copra	Y	JU	223.97	0	18.87	165.57	34.37	5.16	10.6	6.12	1.50
Western Giant	Y	SK	223.83	0	73.72	90.92	11.93	47.27	--	--	1.50
Mars	R	JU	197.26	0	54.58	115.67	23.64	3.37	--	--	1.00
Superstar	W	JU	177.97	0	47.97	69.29	32.81	37.48	--	--	1.75
XON 550Y	Y	SK	156.74	5.11	38.40	29.09	17.61	18.70	--	--	1.75
Mt. Whitney	W	SK	58.05	0	16.30	23.89	9.83	8.02	--	--	2.00
XON 670W	W	SK	58.05	0	47.97	10.07	0.00	0.00	7.6	4.83	2.00
Sequoia	Y	NH	27.05	0	2.47	14.46	5.54	4.58	--	--	2.00
Lsd=0.05			117.95	6.69	104.20	85.33	37.87	30.07			0.96

¹Four to 4.5 inches in diameter.

²Three to four inches in diameter

³Two to three inches in diameter.

⁴One to two inches in diameter.

⁵Micromoles/liter.

HARNESSING BRASSICA COVER CROPS AND ONION PLANT POPULATION TO IMPROVE ONION PRODUCTION ON MUCK SOILS

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SUMMARY

Onion stand establishment and yield responded positively to brassica cover crops (yellow mustard and oilseed radish) under muck soil condition. Overall, onion stand was about 40% greater in the cover crop plots compared with the control without cover crop. The excellent onion stand in the cover crop plot allowed reducing onion seeding rate by 25-40% with no reduction in total yield. Savings in onion seed cost could help offset some of the cost associated with the use of cover crops. Both total yield and bulb size distribution were affected by the cover crops and onion plant populations. Therefore, an economic analysis of the systems would help growers select the optimum plant population for their specific system.

METHODOLOGY

Field studies were established at the MSU Muck Research Farm (Houghton muck) in 2008 to test the effects of two *Brassica* cover crops on onion growth and yield. Yellow mustard 'Tilney' and oilseed radish 'Defender' were sown on 17 August 2007 in preparation for the 2008 onion season. A control treatment without a cover crop was also included.

Onion ('Nebula'; Nunhems) was seeded on 42 inch raised beds (5.5 feet centers) on 5 April 2008 using a Stanhay vacuum seeder. Three double rows were seeded per bed with 16 to 17 inches center to center between consecutive double rows. The two lines on a double row were 5 inches apart.

Plant densities were:

- 259,000 Plants/A
- 225,000 Plants/A
- 205,000 Plants/A
- 172,000 Plants/A
- 140,000 Plants/A

To achieve those densities, the seeding density was increased by 20% to account for mortality and non germination. Weeds were controlled following commercial production recommendations supplemented with hand weeding. Diseases and insects were controlled following commercial production recommendations. Ratings consisted of biomass for the cover crop (24 Oct) and onion (8 July), stand counts (6 June and 1 July), and harvested yield (27 Oct). Stand count and yield were performed in the middle 10-foot section of each bed. Onion bulbs were stored in a shed for two weeks and then sorted into 4 grades.

RESULTS

Onion stand and growth

Growing oilseed radish and yellow mustard cover crops prior to the onion season improved onion stand by up to 40%. This is in agreement with results of previous studies conducted between 2004 and 2007 where yellow mustard and oilseed radish have consistently helped improve onion stand establishment.

Table 1. The effects of cover crops on onion stand count and biomass (dry weight).

Cover Crop	Stand count*		Biomass evaluation**	
	6 Jun	1 Jul	Plant count	Plant weight (g)
Control	166.1	156.8	11.1	11.6
Oilseed radish	235.2	223.1	14.2	19.9
Yellow mustard	230.0	225.0	13.9	18.8
LSD	10.3	11.9	1.0	4.2

*Stand count on 10-foot section of the bed

** Biomass evaluation was conducted by destructively sampling a 50-cm section of the middle double row outside the area used for yield.

Onion yield

The cover crops increase onion yield by an overall average of 6 to 8.5%. However, the impact of the cover crops varied with plant density. At high onion density, the impact of the cover crops was either negative or minimal because the good stand establishment in the cover crop plots resulted in too many small bulbs. However, as onion plant density decreased, the benefit of using the cover crops became more evident. This clearly indicates that after the cover crops growers should reduce their onion seeding rate.

The largest benefit of using the cover crops was found at onion density of 172,000 plant/A. At that density the impact of the cover crops was a 15% yield increase. Given the fact that many growers are currently using densities close to 220,000 plants/A it is evident that the cover crops could help reduce onion seed cost.

Table 2. Effects of cover crops on bulb count and weight for 4 grades of onions*.

Cover Crop	Marketable								Nonmarketable	
	Total		>3 inch		2.5-3 inch		2-2.5 inch		<2 inch	
	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight
Control	155.4	31.7	44.6	13.2	49.7	10.3	61.1	8.2	7.1	0.3
Oilseed Radish	209.3	33.6	15.7	4.3	61.9	12.4	131.8	17.0	17.7	0.9
Yellow Mustard	206.5	34.4	18.7	5.0	64.0	12.6	123.9	16.7	16.9	0.8
LSD	11.8	1.3	5.6	1.6	6.0	1.3	15.6	1.8	3.6	0.2

* Yield and bulb count for a 10-foot section of a bed.

Table 3. Yield change as a result of the use of cover crops

Cover crop	Yield increase (% of control)*
Control	0.0%
Oilseed Radish	6.0%
Yellow Mustard	8.5%

* Yield change indicates the impact of a cover crop at a given onion density based on total marketable yield.

Table 4. Effects of planting densities on bulb count and weight for 4 grades of onions*.

Plant Density	Marketable								Nonmarketable	
	Total		>3 inch		2.5-3 inch		2-2.5 inch		<2 inch	
	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight
259,000	248.8	35.5	6.3	1.8	52.3	10.1	190.2	23.7	24.3	1.2
225,000	205.6	33.4	18.6	5.2	56.1	10.9	130.9	17.3	17.9	0.9
205,000	182.3	33.3	24.8	7.2	64.3	13.0	93.2	13.0	10.0	0.5
172,000	165.3	32.2	34.7	9.9	61.8	12.8	68.8	9.5	5.8	0.3
140,000	149.8	31.7	47.1	13.5	57.9	11.9	44.8	6.3	11.3	0.5
LSD	15.2	1.6	7.2	2.1	7.7	1.6	20.2	2.3	4.6	0.2

* Yield and bulb count for a 10-foot section of a bed.

Table 5. The interaction between the cover crop and plant density for onion bulb count, weight, and grade distribution*.

Cover Crop	Target Plant Density	Marketable								Nonmarketable	
		Total		>3 inch		2.5-3 inch		2-2.5 inch		<2 inch	
		Bulbs	Weight	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight	Bulbs	Weight
Control	259,000	223.2	35.6	13.0	3.5	66.2	13.3	144.0	18.8	11.0	0.6
	225,000	171.7	33.3	43.0	12.7	54.5	11.0	74.2	9.7	8.2	0.4
	205,000	138.5	30.7	47.2	14.4	51.0	10.7	40.2	5.6	6.0	0.3
	172,000	124.7	29.2	52.5	15.8	43.7	9.4	28.5	4.0	2.2	0.1
	140,000	118.5	29.5	67.0	19.8	33.0	6.9	18.5	2.8	8.0	0.3
Oilseed Radish	259,000	256.5	34.7	3.0	0.8	42.0	8.1	211.5	25.7	30.2	1.5
	225,000	226.2	32.3	2.7	0.7	53.0	10.2	170.5	21.4	25.2	1.3
	205,000	206.2	34.6	13.7	3.8	70.7	14.3	121.7	16.5	10.2	0.5
	172,000	190.5	33.7	21.7	5.8	73.0	14.9	95.7	12.9	7.5	0.4
	140,000	167.0	32.9	37.0	10.2	70.5	14.4	59.5	8.2	15.0	0.6
Yellow Mustard	259,000	266.7	36.4	3.0	1.0	48.7	8.9	215.0	26.5	31.7	1.5
	225,000	218.7	34.7	10.0	2.4	60.7	11.5	148.0	20.8	20.2	1.0
	205,000	202.2	34.4	13.5	3.4	71.2	14.1	117.5	17.0	13.7	0.7
	172,000	180.7	33.7	29.7	8.0	68.7	14.1	82.2	11.6	7.7	0.4
	140,000	164.0	32.6	37.2	10.4	70.2	14.4	56.5	7.9	11.0	0.5

* Yield and bulb count for a 10-foot section of a bed.

Table 6. Yield change (%) resulting from the effects of cover crops at various onion plant densities.

Cover crop	Onion plant density		Yield change (% of control)*
	Plant/A	% normal rate	
	Oilseed Radish	259,000	
225,000		100%	-3.0%
205,000		90%	+12.7%
172,000		75%	+15.4%
140,000		60%	+11.5%
Yellow Mustard	259,000	115%	+2.2%
	225,000	100%	+4.2%
	205,000	90%	+12.1%
	172,000	75%	+15.4%
	140,000	60%	+10.5%

* Yield change indicates the impact of a cover crop at a given onion density based on total marketable yield.

CONCLUSION

This study confirms results from the 2007 season and shows that it is possible to improve onion stand establishment, yield and grade distribution by integrating appropriate cover crops and by selecting an adequate plant population for the production system.

ACKNOWLEDGEMENT

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BACTERIAL BLIGHT AND OTHER ONION DISEASES

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Bacterial diseases occur each year and can be minor or major problems. Bacterial soft rot symptoms include water-soaking and discoloration of scale tissues to a pale yellow to light brown. As the disease progresses, tissues become soft, and break down into a watery, foul-smelling viscous liquid. Leaves wilt and whiten. The bacteria can occur in soil and crop debris, and are spread by rain, irrigation water and insects (Schwartz and Mohan, 1995). *Erwinia* enters the bulb through the neck tissue of maturing plants and through wounds. The bacteria can survive on infested crop residues in the soil, and be spread by rain and irrigation or by direct contact with the infested soil (Howard et al., 1994). The onion maggot can harbor the bacteria in the guts of the larvae, and adult flies can spread the pathogen. Optimum weather for infection is 68-86°F (20-30°C) and high humidity. Infection can continue in storage or transit if the temperature is >37°F (3°C) (Schwartz and Mohan, 1995).

Center rot is caused by the bacterium, *Pantoea ananatis*. Symptoms of center rot include the rapid death of the two center leaves followed by a soft rot of the heart of the bulb. Little is known about the epidemiology and control of this disease.

Slippery skin is caused by the bacterium, *Burkholderia gladioli* pv. *alliicola*. The disease first occurs as softening of the neck tissue, with 1-2 inner bulb scales that are water-soaked. The rot progresses down along the scales, and does not affect adjacent scales; however, the bacteria can invade other scales. Plants may have 1-2 wilted leaves in the middle of the leaf cluster, which turn pale yellow to off-white and die back (Howard et al., 1994). Eventually, all internal tissue may rot, then dry out and shrivel the bulb. The center core of the infected bulb may slip out the top if the base is pressed. The bacterium enters leaves and maturing bulbs through wounds, probably before or at harvest. Young leaves are only slightly susceptible. The disease is usually more severe if onion tops are damaged by hail or high winds, or subjected to wet or rainy conditions prior to harvest. Mature bulbs are very susceptible and can rot completely within 10 days at room temperature (Schwartz and Mohan, 1995).

Sour skin, another bacterial disease (caused by *Burkholderia cepacia*) first appears on onion bulbs as slimy, pale yellow to light brown decay and breakdown of one to several inner bulb scales. The bulb may appear normal, but the neck region may soften after leaves have collapsed (Schwartz and Mohan, 1995). One to two leaves may turn light brown, and young leaves may die back. Affected leaves can easily be pulled out of the bulb. Healthy scales may slip off during handling of bulbs with advanced disease. The bacterium, *B. cepacia*, has been found in organic soils and irrigation water (Howard et al., 1994). Infection generally occurs through a wound in the presence of water from rain, irrigation or flooding, or can occur when water with bacteria strike young leaves and flow down them into the neck area. Young leaves are much more susceptible than older leaves, and infection can remain latent until the plant begins to form a bulb. Infection into the bulb occurs along the infected leaf, and does not move between scales. Temperatures >86°F (30°C) favor rapid disease progression (Schwartz and Mohan, 1995).

Bactericide products such as copper fungicides (Kocide, Champ, copper sulfate) are the only products that are currently both registered and effective in limiting bacterial populations that are responsible for these onion diseases. These copper fungicides are most effective if applied before bacterial populations become established at a level high enough to cause disease. Coppers also should be applied prior to and after heavy rains to help limit the spread of bacteria to other onion plants in the field. Copper fungicides can be safely tank-mixed with other products used to control fungal pathogens.

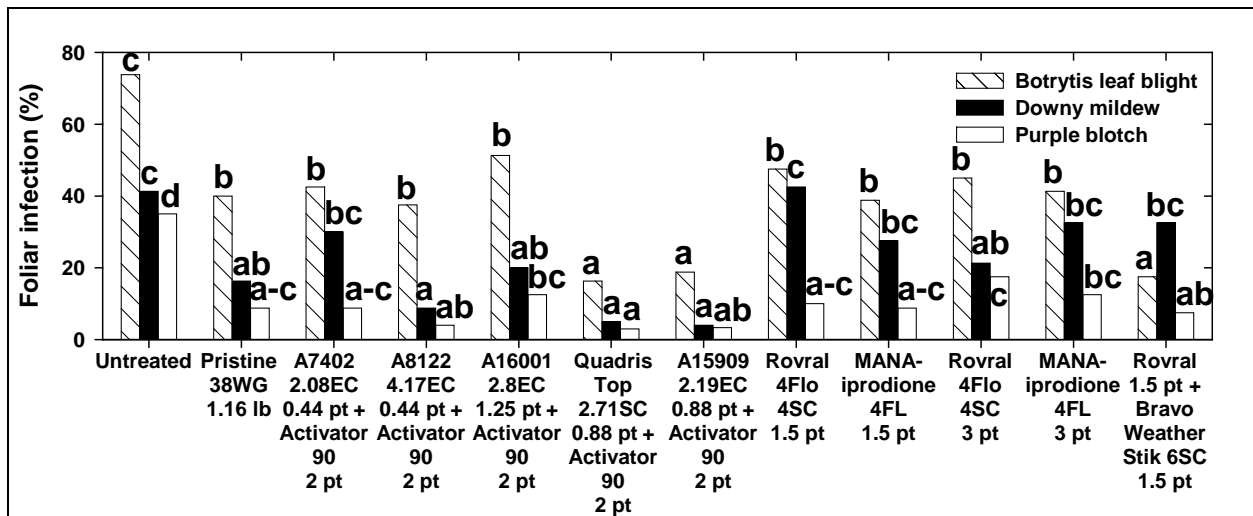
Onion Fungicide Trials 2008

Historically chlorothalonil (Bravo) and iprodione (Rovral) fungicides have been very effective in controlling both onion leaf blight and purple blotch. The newer classes of strobilurin fungicides (Quadris, Pristine) are also very effective and should be used in rotation with the established products for season long control of both onion foliar blights. When onion downy mildew appears in the state, growers should also include mefenoxam products (Ridomil Gold MZ or Ridomil Gold Bravo) and mancozeb (Dithane, Manzate) in their spray program.

Michigan State University conducts yearly fungicide screens to evaluate existing and new fungicides for their control of all three fungal pathogens. During the 2008 experiments, all three diseases developed in both trials held at the MSU Muck Soils Research Farm.

A twelve treatment trial was conducted to evaluate fungicides for control of the foliar diseases, *Botrytis* leaf blight (*Botrytis squamosa*), downy mildew (*Peronospora destructor*), and purple blotch (*Alternaria porri*), of onion. *Botrytis* symptoms first developed in mid-Jul and steadily increased in severity until harvest. Both downy mildew and purple blotch also became a factor in the trial at the middle of Aug, and when combined with the existing *Botrytis* infections, resulted in rapid defoliation of the plot. All of the treatments were effective in limiting both *Botrytis* and purple blotch infections compared to the untreated control on 8 Aug (Fig. 1). The treatments of Quadris Top 2.71SC and A15909 2.19EC, both tankmixed with Acivator 90, were especially effective in limiting all three foliar pathogens. Starting in mid-Jul, leaf yellowing and tip burn was apparent on all treatments that had Activator 90 in the tank mix. This symptom was very noticeable several days after treatment applications and seemed to increase in severity with more applications.

Figure 1. Twelve treatment trial at MSU Muck Farm that included fungicides for the control of onion foliar blights.



The heavy disease pressure on the foliage and the damage caused by the phytotoxicity resulted in yield differences in the plot. Treatments without the Activator 90 product had significantly higher yields than the untreated control. Treatments 2 (Pristine 38WG 1.16 lb), 8 (Rovral 4Flo 4SC 1.5 pt), and 12 (Rovral 4Flo 4SC 1.5 pt + Bravo WeatherStik 6SC 1.5 pt) had the highest total yield for all treatments.

A second trial was conducted evaluating sixteen treatments for the control of onion foliar diseases at the Muck Soils Research Farm. Botrytis symptoms first developed in mid Jul and steadily increased in severity until harvest, and as with the first trial, the additional pressure from purple blotch and downy mildew infections resulted in defoliation of the ineffective treatments. All of the treatments were effective in limiting Botrytis infection compared to the untreated control on 8 Aug (Table 1).

Table 1. Onion foliar blight trial conducted at MSU Muck Farm, 2008.

Treatment and rate/A, applied at 7-day intervals	Botrytis infection			Foliar infection (%) ^y		
	# leaves 8 Aug	Severity ^y 8 Aug	Foliar (%) ^y 5 Sep	Downy mildew	Purple blotch	Plot health ^z
1 Untreated	23.8 cde	2.5 bc	62.5 ef	17.5	27.5 f	3.5 h ^w
2 LEM 17 1.67SC 1.05 pt.....	21.3 bcde	2.5 bc	50.0 cde	17.5	20.0 def	4.3 fgh
3 LEM 17 1.67SC 1.5 pt.....	28.3 e	3.0 c	73.8 f	11.3	23.8 ef	3.3 h
4 LEM 17 1.67SC 1.05 pt + MSO 8.33SC 4 pt	26.3 de	3.0 c	56.3 de	20.0	22.5 ef	3.5 h
5 LEM 17 1.67SC 1.5 pt + MSO 8.33SC 4 pt	19.8 bcde	2.5 bc	56.3 de	15.0	22.5 ef	4.0 gh
6 Pristine 38WG 0.75 lb	16.5 abc	2.0 ab	35.0 abc	23.8	16.3 cd	6.5 cde
7 Pristine 38WG 0.75 lb + MSO 8.33SC 4 pt	11.0 a	1.8 ab	28.8 a	16.3	3.8 abc	8.5 ab
8 Pristine 38WG 1.15 lb	20.5 bcde	2.5 bc	33.8 abc	21.3	11.3 bcd	6.0 def
9 A7402 2.08EC 0.44 pt + Activator 90 8.33EC 2 pt....	14.5 ab	1.8 ab	48.8 bcde	26.3	10.0 abc	6.5 cde
10 A8122 4.17EC 0.44 pt + Activator 90 8.33EC 2 pt....	20.8 bcde	2.3 abc	42.5 abcd	10.0	7.5 abc	7.5 abcd
11 A16001 2.8EC 0.88 pt + Activator 90 8.33EC 2 pt....	15.8 abc	2.0 ab	41.3 abcd	7.5	7.5 abc	7.0 bcde
12 A16001 2.8EC 1.25 pt + Activator 90 8.33EC 2 pt....	11.0 a	1.5 a	47.5 bcde	11.3	12.5 cd	5.5 efg
13 Quadris Top 2.71SC 0.63 pt + Activator 90 8.33EC 2 pt....	13.8 ab	2.0 ab	32.5 ab	5.0	1.5 a	8.8 ab
14 Quadris Top 2.71SC 0.88 pt + Activator 90 8.33EC 2 pt....	13.3 ab	1.8 ab	26.3 a	2.5	2.8 ab	9.0 a
15 A15909 2.19EC 0.66 pt + Activator 90 8.33EC 2 pt....	18.3 abcd	2.0 ab	33.8 abc	8.8	7.5 abc	8.0 abc
16 A15909 2.19EC 0.88 pt + Activator 90 8.33EC 2 pt....	15.3 abc	2.0 ab	26.3 a	7.5	3.8 abc	8.3 abc

^zPlot health rated on a scale of 1=10 where 1=dead and 10=no disease.

^yBased on an estimation of percentage of foliage infected.

^yBotrytis infection severity rated on a scale of 1 to 5, where 1=no lesions per plant, 2=trace-10 lesions, 3=10-25, 4=25-50, 5=>50 lesions.

^wColumn means with a letter in common or with no letter are not significantly different (Fisher LSD Method; P=0.05).

Treatment 6 was especially effective in limiting both number of *Botrytis*-infected leaves as well as infection severity. On the last evaluation date treatments 6, 7, and 12 were very effective in limiting the amount of foliage infected by *Botrytis*. Treatments 4, 6, and 7 were very effective in limiting both downy mildew and purple blotch compared to the untreated control. Treatments 6 and 7 had the best plot health ratings compared to all other treatments and the untreated control. Starting in mid-Jul, leaf yellowing and tip burn was apparent on all treatments that had Activator 90 in the tank mix. This symptom was very noticeable several days after treatment applications and seemed to increase in severity as more treatments were applied. The heavy disease pressure on the foliage and the damage caused by the phytotoxicity resulted in yield differences in the plot. Treatments without the Activator 90 product had significantly higher yields than the untreated control. Treatments 2, 8, and 12 had the highest total yield for all treatments.

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Onion Weed Control for 2009

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Onion Research Objectives for 2008

- 1. Improve PRE weed control (after seeding, before emergence).
- 2. Develop methods for effective use of **CHATEAU** on onion.
- 3. Determine recommendations for use of **GOALTENDER** on onion.
- 4. Evaluate recently registered herbicides on onion.
- 5. Study potential for **BASAGRAN** on onion.

2008 Onion Research

- 1. Six weed control trials at MSU Muck Farm.
- 2. One trial each at Grant, Hudsonville, and Momence, Illinois.

Onion Preemergence Herbicides Evaluated

Prowl 3.3 EC	Ramrod 4 F
Prowl H20 3.8 SC	Surpass 6.4 EC
Dual Magnum 7.62E	Nortron 4 SC
Outlook 6 EC	Chateau 51 WDG

Onion Results - Preemergence

- 1. **PROWL EC** and **PROWL H20** performed similarly when applied PRE.
- 2. **PROWL H20** was safe on onion @ 4 lb/ai/acre (2x rate); weed control was slightly improved.
- 3. **DUAL MAGNUM** caused slight stunting PRE and resulted in slight yield reduction. However, weed control was less with **DUAL MAGNUM** than with **PROWL**.
- 4. **OUTLOOK** caused stunting PRE, with slight yield reduction.

- 5. **RAMROD** (propachlor) was safe on onion but a little weak on weeds.
- 6. **SURPASS** (acetachlor) stunted some onions but gave good weed control.
- 7. **NORTRON** was weak on most weeds, and yields were slightly decreased.
- 8. **CHEATAU** was safe PRE and gave good yield.

Onion Results - Postemergence

- 1. **GOAL 2XL** consistently caused slightly more onion foliar injury than **GOALTENDER** but had similar yield.
- 2. **GOAL XL** had slightly better weed control than **GOALTENDER**.
- 3. **CHATEAU**, 1 or 2 oz, was safe on onions and gave similar yield.
- 4. **STARANE**, **BASAGRAN**, and **BUCTRIL** applied alone lowered onion yield. None gave sufficient weed control alone.

Postemergence Combinations

- 1. **GOALTENDER** 2 fl. oz. + **CHATEAU** 1 oz. gave good weed control and good yield.
- 2. **GT** + **NORTRON** and **GT** + **STARANE** gave good weed control and onion yield. **STARANE** caused some crop visual injury.
- 3. **GT** + **BUCTRIL** caused slight crop injury but no yield reduction.
- 4. The combos had better weed control than any single product alone.

Postemergence Weed Control in Production Fields

- 1. **GOALTENDER** 2-8 fl. oz. + **POAST** 1 pt. + **NIS** .25% gave good weed control and no crop injury; good yield.
- 2. **GOAL 2 XL** caused slightly more visual injury in combo with **POAST** and **NIS**.
- 3. **BASAGRAN** 1 qt. + **POAST** reduced yield.
- 4. **NORTRON** 1 qt, **STARANE** 5 oz, or **BUCTRIL** 4 fl. oz. plus **POAST** 1 pt. gave good weed control and good yield.

New Label for 2009

- 1. **STARANE ULTRA** 2.8 L
- 2. Apply 0.35 pt. (5.6 fl. oz.)/acre.
- 3. Onions 2-6 leaves.
- 4. Controls volunteer potato, chickweed, composites, nightshade, mustards.
- 5. Use in combo with **GOALTENDER**.

Goal XL and Goaltender (GT) Summary

- 1. **GOALTENDER** applied 1,2,3 LS at 0.031-0.188 lb ai (1-6 fl. oz. **GT**) caused minimal foliar injury and no yield reduction.
- 2. **GOAL XL** applied at 1,2,3 LS caused slightly more foliar injury; onion yield was reduced @ 0.188 lb ai (12 fl. oz.).
- 3. **GT** applied @ 2-4 LS was safe on onions @ 0.25 lb/a (8 fl. oz.). No yield reduction at that rate.

Goal and Goaltender Applied to Onion at 1, 2 and 3 LS

	Rate (1 fl. oz.)	Onion Rating 6/4	Onion Rating 6/12	Onion Kg/Plot
GT	0.031	1.0	1.3	27
	0.063	1.0	1.3	28
	0.125	2.0	1.8	24
	0.188	2.3	2.8	29
Goal XL	0.031	1.3	2.0	25
	0.063	2.0	3.0	29
	0.125	3.8	3.0	25
LSD	0.188	4.3	5.8	23
	1.0	0.7	0.9	10

Chateau Combinations on Onion After 2 LS - 2008

<u>Treatment</u>	<u>Onion Rating 6/12</u>	<u>Onion Rating 7/3</u>	<u>Onion Yield Kg/Plot</u>
Chateau 2oz. + Prowl H2O 2lb	1.8	3.5	29
Chateau 2oz. + Prowl EC 2lb	6.8	7.3	18
Chateau 2oz. + Outlook 0.98lb	7.3	7.3	15
Chateau 2oz. + Dual Mag. 1.3lb	8.3	8.3	9
Chateau 2oz.	2.3	3.5	26
Untreated	1.0	1.0	24

Chateau on Onion – Summary 2008

- 1. Combination of **CHATEAU** with **PROWL EC**, **DUAL MAGNUM**, or **OUTLOOK** caused serious crop injury and yield reduction.
- 2. Combination with **PROWL H2O** caused slight onion stunting but no yield reduction
- 3. In most cases, 1 oz. (0.032 lb ai) **CHATEAU** was as effective as 2 oz. on weeds.

PRE Onion Weed Control Recs For 2009

- 1. After Seeding: **PROWL H2O** 2 qt.
- 2. 2 LS: **PROWL H2O** , **DUAL MAGNUM**, or **OUTLOOK**.
- 3. 3-4 LS: **CHATEAU** 1 oz.
- 4. 4 LS: **PROWL H2O** or **DUAL MAGNUM**.
- 5. 6-7 LS: **CHATEAU** 2 oz.
- 6. 8-9 LS: **PROWL H2O** (45 day PHI).

POST Onion Weed Control Recs for 2009

- 1. After seeding, before emergence: **BUCTRIL** 0.25-0.5 pt.
- 2. Loop-1LS: Kill barley with **POAST**, **FUSILADE**, or **SELECT**.
- 3. 2 LS: **GOALTENDER** 1-2 fl. oz; plus **STARANE** for chickweed, potato, marsh yellowcress.
- 4. 3-4 LS: **NORTRON** 1 pt. for nightshade.
- 5. 4 LS: **GT** 2-4 fl. oz. plus **FUSILADE**, **POAST**, or **SELECT MAX**.
- 6. 6-8 LS: **GT** 2-4 fl. oz. plus **POAST** (45 day PHI).

Ok Herbicide Tank Mixes on Onion

- **Prowl H2O + Goaltender + Poast**
- **Prowl H2O + Chateau**
- **Goaltender + (Starane or Nortron) + Poast**

Do Not Tank Mix With Chateau

- **Dual Magnum**
- **Outlook**
- **Prowl EC**
- **Goal XL**
- **Buctril**
- **COC or NIS**

Onion Weed Control for 2009 - Summary

- 1. Use **PROWL H20** in place of **PROWL EC**.
- 2. Use **GOALTENDER** in place of **GOAL XL**.
Exception: Large Weeds (>3 inches).
- 3. **CHATEAU** will improve weed control in most situations.
- 4. Stay ahead of weeds. Kill when small.
- 5. No safe POST treatment for yellow nutsedge. Use **OUTLOOK** and **DUAL MAGNUM PRE** (before nutsedge emerges).