Asparagus

Tuesday morning 9:00 am

Where: Gallery Overlook (upper level) Room C & D
MI Recertification credits: 2 (1B, COMM CORE, PRIV CORE)
OH Recertification credits: 1 (presentations as marked)
CCA Credits: SW(0.5) PM(1.5)
Moderator: Ben Werling, West Michigan Vegetable Educator, MSU Extension, Hart, MI

9:00 am	Asparagus Research Farm Update • John Bakker, Michigan Asparagus Advisory Board, DeWitt, MI
9:30 am	Asparagus Irrigation Update -- Effects on Spear Cooling, Quality and Yield • Daniel Brainard, Horticulture Dept., MSU
10:00 am	Asparagus Insect Pest Management (OH: 2B, 0.5 hr) • Adam Ingrao, Vegetable Entomology Lab, Entomology Dept., MSU • Amanda Buchanan, Entomology Dept., MSU • Zsofia Szendrei, Entomology Dept., MSU
10:30 am	Asparagus Pathology Results -- Results of 2016 Trials (OH: 2B, 0.5 hr) • Mary Hausbeck, Plant, Soils and Microbial Sciences Dept., MSU
11:00 am	Session Ends

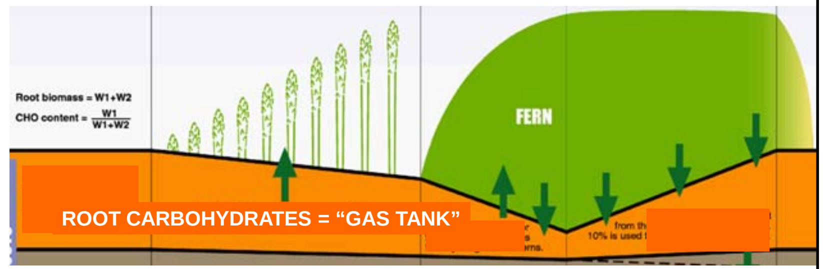
Asparagus Irrigation Update

Effects on spear cooling, quality, and yield

Dan Brainard, Ben Byl, Zack Hayden, Corey Noyes and John Bakker

MICHIGAN ASPARAGUS | Project GREEEN | MICHIGAN STATE UNIVERSITY | Department of Horticulture | Michigan Department of Agriculture

Irrigation in Asparagus: Why and When?



Harvest Season
Spear cooling
Yield & Quality

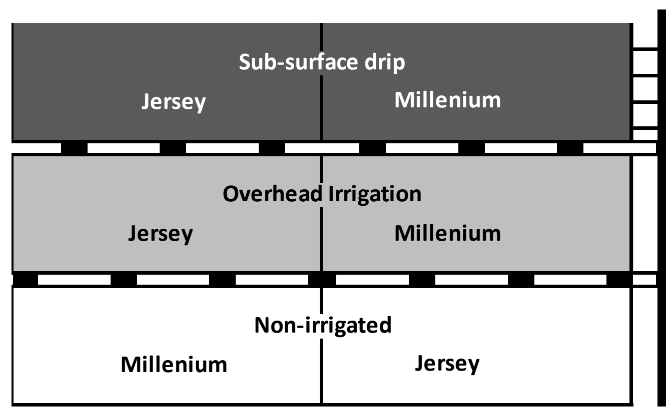
Fern Season
Avoid drought stress
Fill gas tank for next year’s yield

Adapted from Dan Drost, Utah State

Fern Season Irrigation Study Objectives

- Evaluate the impact of irrigation on yield and profitability of Jersey Supreme and Guelph Millennium under Michigan growing conditions.
- Compare effects of sub-surface drip irrigation with overhead irrigation.

Methods: Plot layout

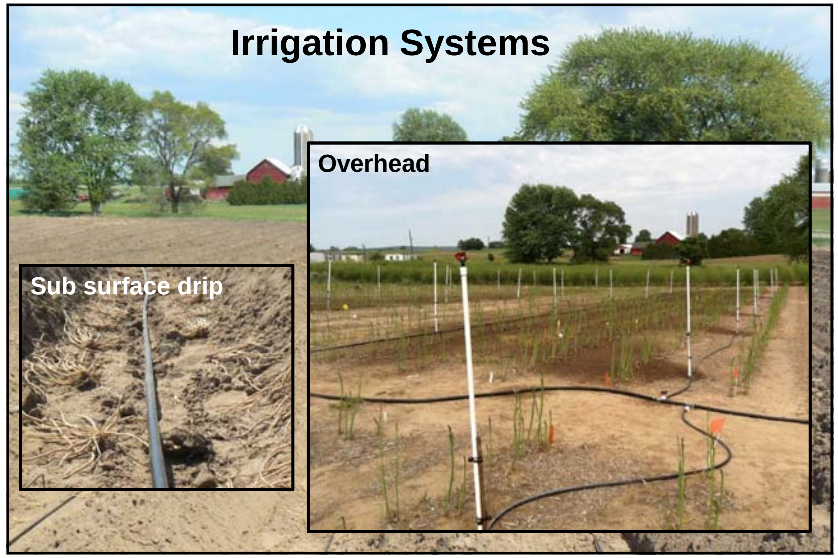


Planting 2010

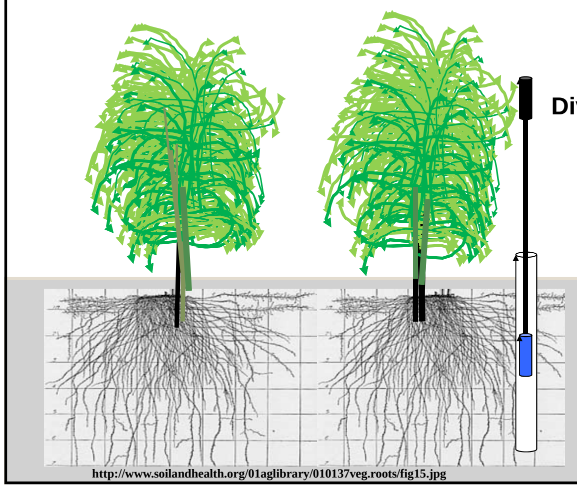
Spinks sandy soil

16,600 crowns/acre

5' between rows



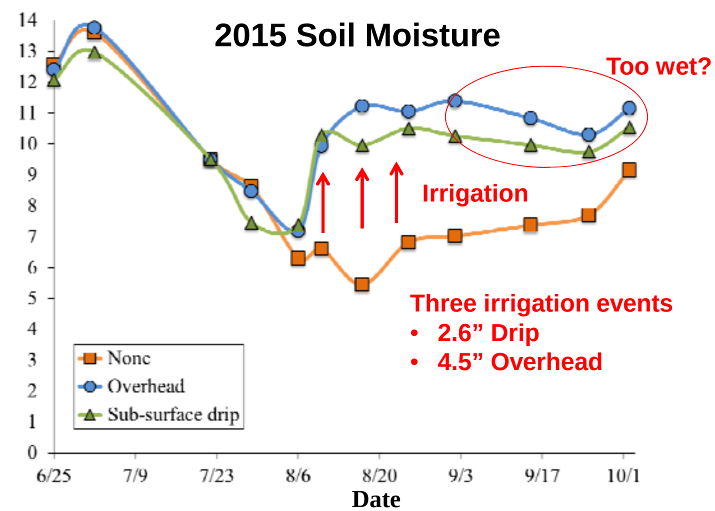
Soil Moisture Monitoring

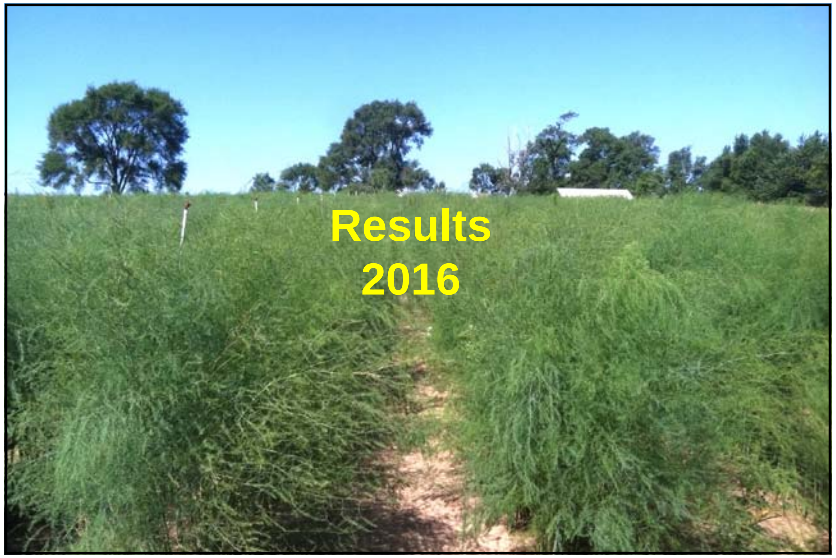


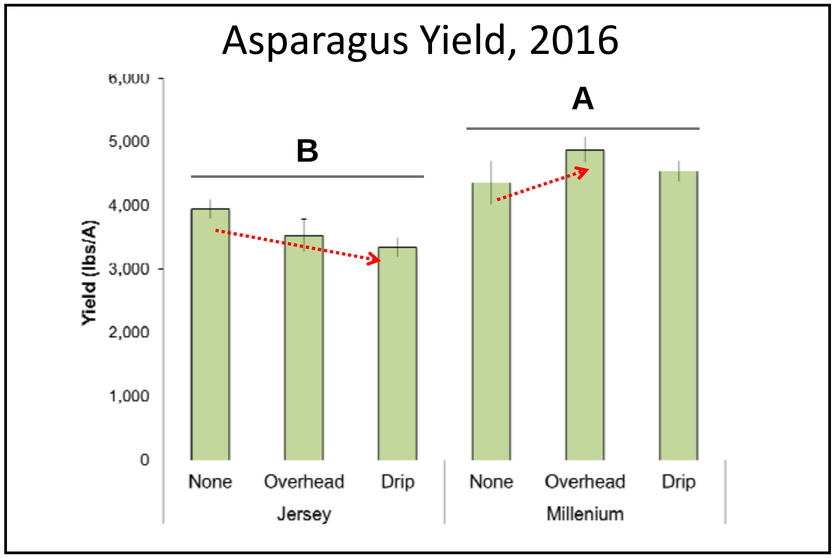
Diviner 2000

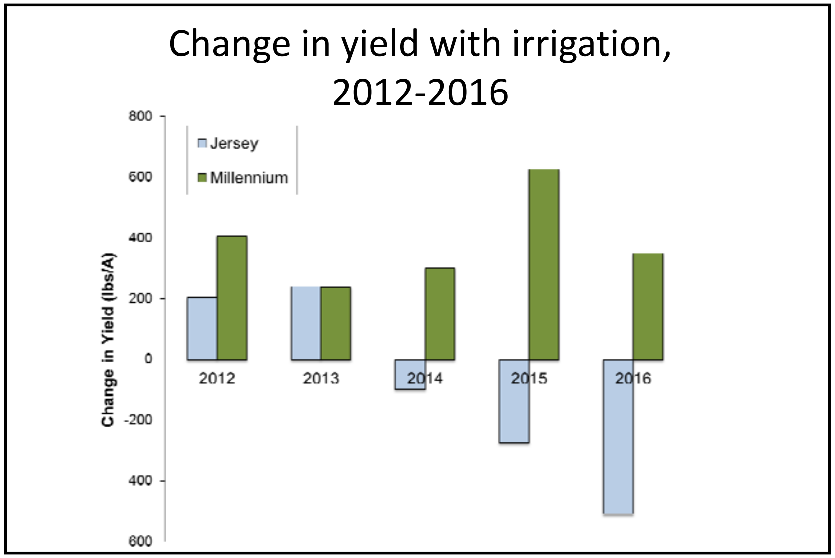
Used to Guide Irrigation During the Summer:

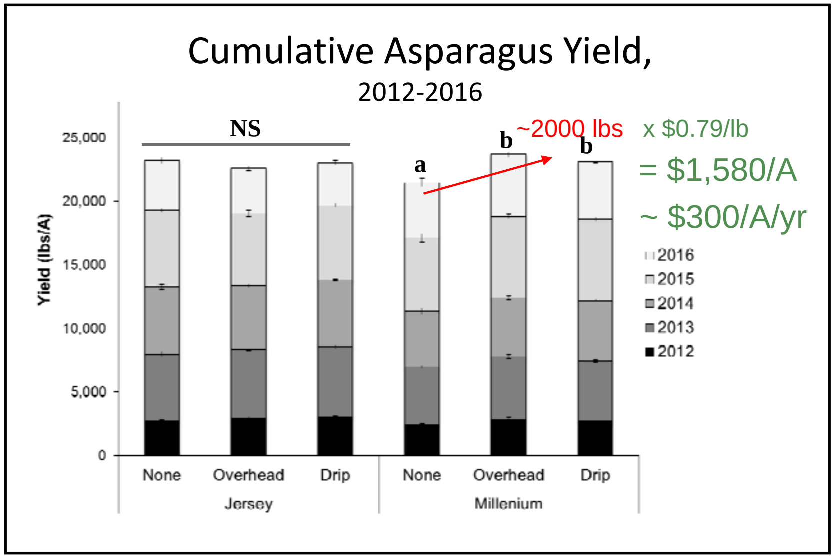
- **When average soil moisture drops below 50% available**
- **~0.5-1" water applied**
- **3-7x per summer, depending on conditions**

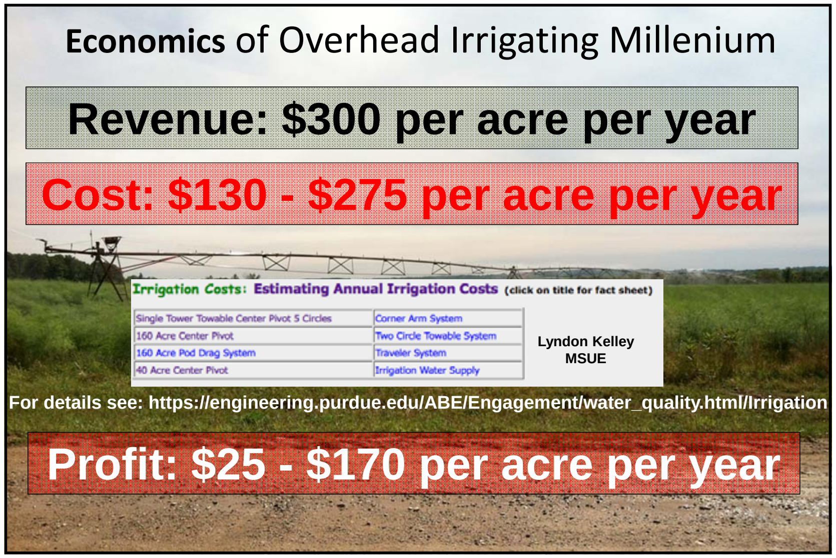


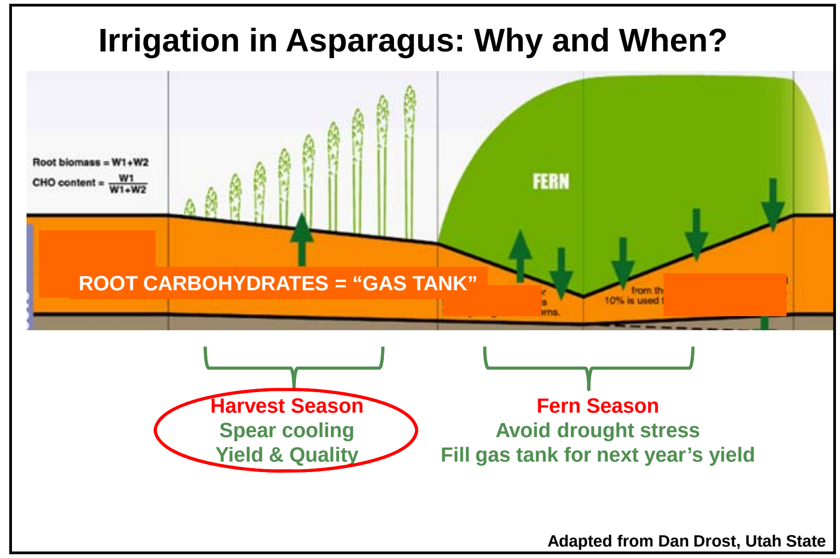

Results
2016


Asparagus Yield, 2016
Yield (lbs/A)
6,000
5,000
4,000
3,000
2,000
1,000
0
A
B
None
Overhead
Drip
Jersey
None
Overhead
Drip
Millenium

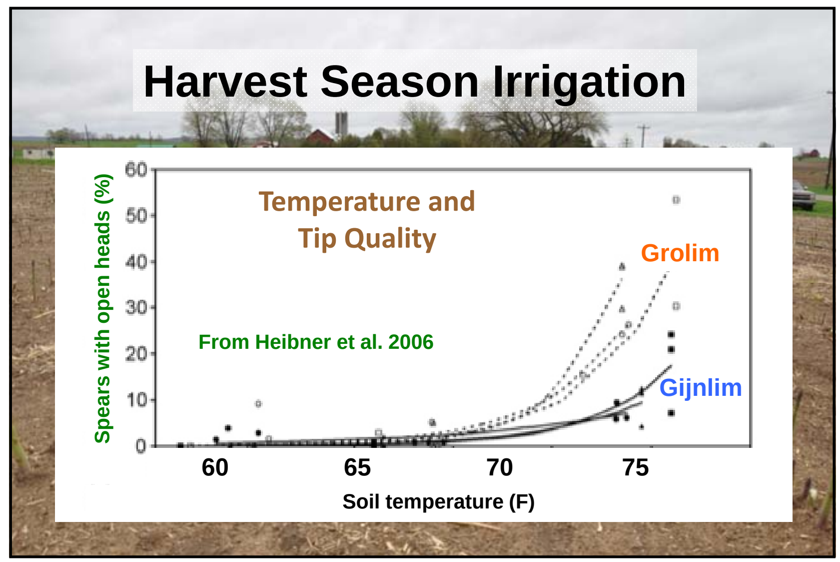

Change in yield with irrigation, 2012-2016
Change in Yield (lbs/A)
800
600
400
200
0
-200
400
600
Jersey
Millennium
2012
2013
2014
2015
2016

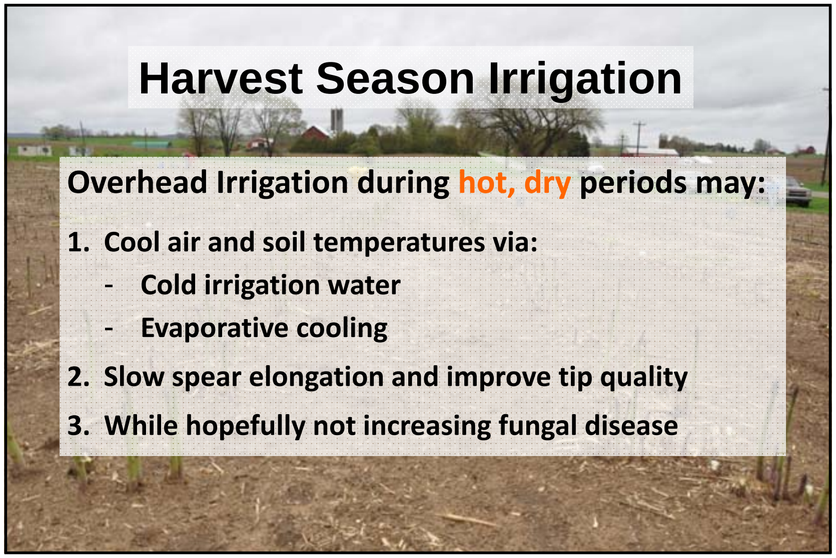

Cumulative Asparagus Yield,
2012-2016
Yield (lbs/A)
25,000
20,000
15,000
10,000
5,000
0
NS
a
b
b
~2000 lbs
x $0.79/lb
= $1,580/A
~ $300/A/yr
2016
2015
2014
2013
2012
None
Overhead
Drip
Jersey
None
Overhead
Drip
Millenium


Economics of Overhead Irrigating Millenium
Revenue: $300 per acre per year
Cost: $130 - $275 per acre per year
Irrigation Costs: Estimating Annual Irrigation Costs (click on title for fact sheet)
Single Tower Towable Center Pivot 5 Circles
Corner Arm System
160 Acre Center Pivot
Two Circle Towable System
160 Acre Pod Drag System
Traveler System
40 Acre Center Pivot
Irrigation Water Supply
Lyndon Kelley
MSUE
For details see: https://engineering.purdue.edu/ABE/Engagement/water_quality.html/Irrigation
Profit: $25 - $170 per acre per year

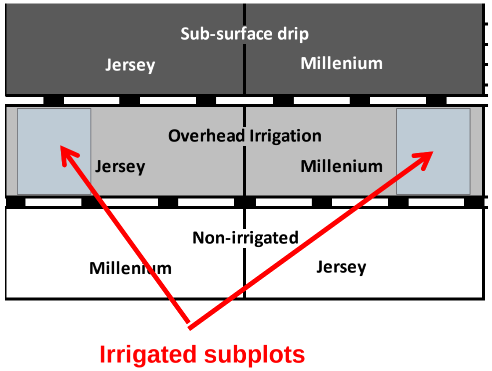

Irrigation in Asparagus: Why and When?
Root biomass = W1+W2
FERN
ROOT CARBOHYDRATES = "GAS TANK"
Harvest Season
Spear cooling
Yield & Quality
Fern Season
Avoid drought stress
Fill gas tank for next year's yield
Adapted from Dan Drost, Utah State


Study 2: Harvest Season Irrigation


Harvest Season Irrigation
Temperature and
Tip Quality
From Heibner et al. 2006
Grolim
Gijnlim
Spears with open heads (%)
0
10
20
30
40
50
60
60
65
70
75
Soil temperature (F)

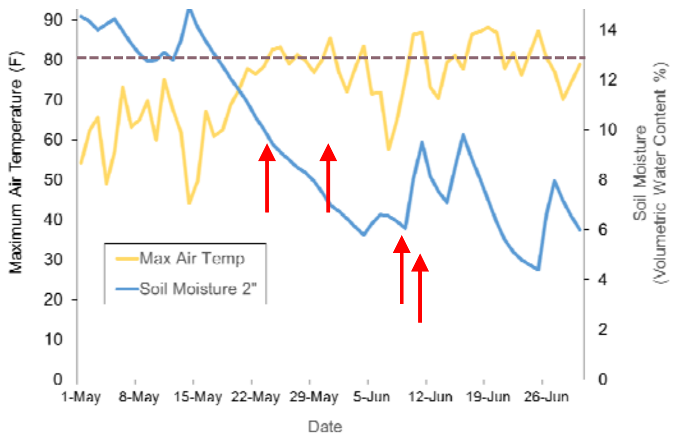


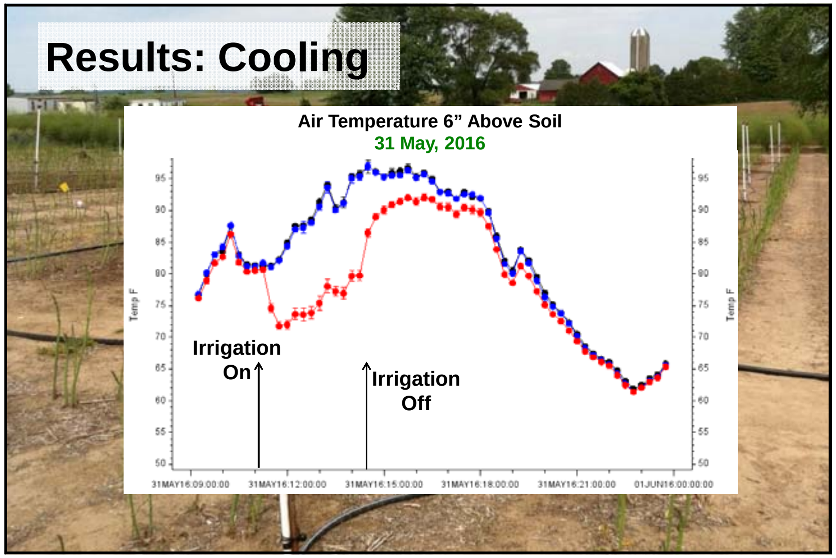
Methods: Irrigation during harvest



Irrigation:
- When hot and dry
  - 80 °F
  - Dry Soil (VWC<50%)
- 2014: 3 times
- 2015: Once
- **2016: 4 times**
- 2-3 hr, ~0.25" per event

Temperature & Moisture During Harvest



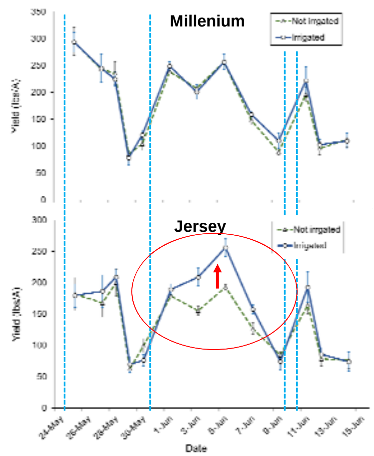


Results: Cooling

	Maximum Temperature Reduction[z]				Average Temperature Reduction[y]				Duration of Cooling[x]			
	24 May	31 May	10 June	11 June	24 May	31 May	10 June	11 June	24 May	31 May	10 June	11 June
	°F				°F				h:m			
Air Temperature												
6" above soil	9.0	15.6	11.7	11.2	6.2	7.5	7.8	6.0	10:45	8:00	5:30	8:15
2" above soil	11.6	18.3	14.5	13.0	7.7	6.2	8.5	6.6	22:15	44:15	7:15	39:30
Soil Temperature												
2" below surface	7.6	9.7	7.7	7.3	4.9	6.9	5.8	4.8	41:30	79:00	11:00	75:15
6" below surface	4.0	5.2	4.0	3.7	3.4	4.5	3.4	2.9	38:45	64:45	8:15	72:45

[z] Maximum difference in temperature recorded between irrigated and unirrigated treatments following an irrigation event.
[y] Average of recorded temperature differences over the period when cooling due to irrigation was observed.
[x] Defined as the time following an irrigation event that the temperature difference between irrigated and unirrigated treatments

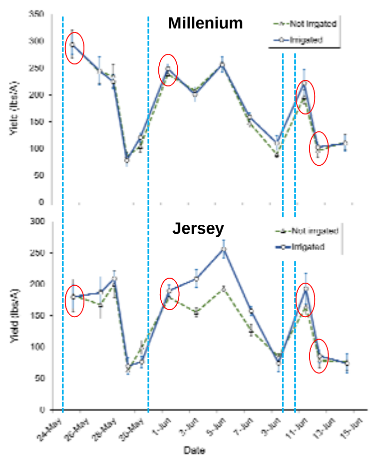
Results: Yield benefit from In-Season Irrigation, 2016



+192 lbs/A x $0.79/lb

= $151/A

Spear Quality Evaluation



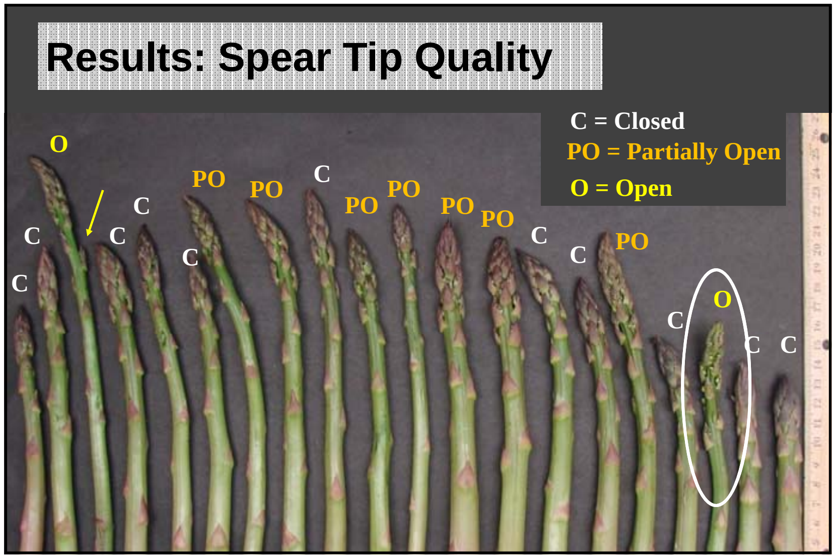
- First harvest after each irrigation event
- Spear characteristics evaluated:
  - Spear diameter
  - Spear length
  - Spear moisture content
  - Tip quality
  - Purple spot

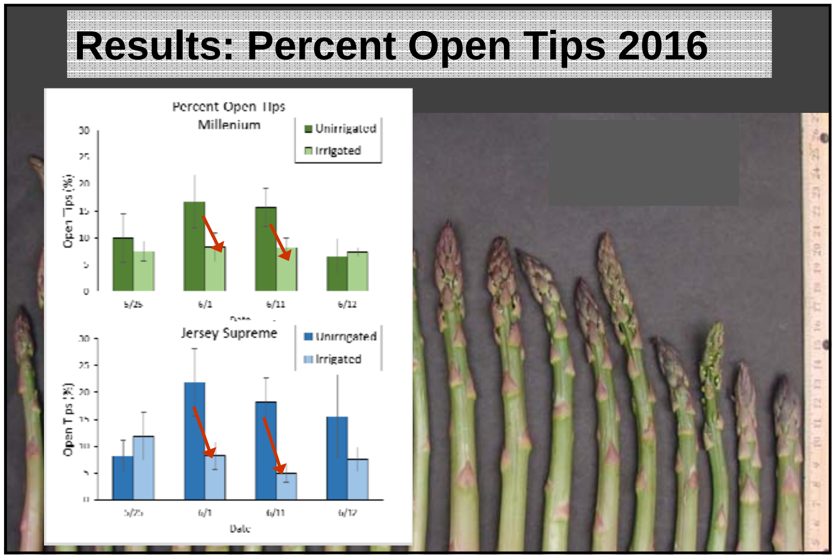
Results: Spear Quality

- Spear characteristics one day after irrigation event:

	Moisture content					Diameter				
	2014		2015	2016		2014		2015	2016	
	6/10	6/16	6/11	6/1	6/12	6/10	6/16	6/11	6/1	6/12
	%					mm				
Jersey Supreme	A	A					A			A
None	94.0	94.4	94.8	91.6	93.9	10.1 ab	8.1	14.2	11.4	9.9
Irrigated	94.0	94.4	NS	92.7	93.7	9.8 b	8.3	NS	10.8	9.4
Guelph Millennium	B	B					B			B
None	93.8	93.9	[illegible]	94.3	93.9	10.0 b	9.2	[illegible]	11.5	10.5
Irrigated	93.9	93.9	94.8	92.8	93.9	10.8 a	9.3	14.6	11.8	10.2
Variety	0.019	0.002	NS	NS	NS	0.069	0.005	NS	NS	0.0255
Irrigation	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Variety X Irrigation	NS	NS	NS	NS	NS	0.048	NS	NS	NS	NS

Irrigation events occurred on 6/7, 6/9 and 6/15 in 2014; on 6/10 in 2015; and on 5/31 and 6/11 in 2016





Summary

➢ Fern Irrigation

- Irrigation **increased yield of Guelph Millennium by 10%** on average during 2012 – 2016 seasons, with added gross revenue of over $1,500/A (or about **$300/A per year**).
- Irrigation has not improved yields for Jersey Supreme variety.
- Little difference in effects between overhead and drip irrigation

➢ Harvest Season Irrigation

- Reduced air temperatures by 5-15° F
- No observed yield benefits in 2014 or 2015, but **improved yield of Jersey Supreme in 2016,** with added revenue of about **$150/A**
- On hot days during harvest, irrigation **reduced the percentage of spears with open tips by 50%** or more in 2016.

Asparagus Pathology Research − Results of 2016 Trials

Dr. Mary K. Hausbeck, 517-355-4534 and Katie Goldenhar
Michigan State University, Department of Plant, Soil & Microbial Sciences

Asparagus is a perennial crop that should be in production for many years with proper horticultural and pest management. Michigan is ranked second nationally in asparagus production. With an average of 8,900 acres harvested, Michigan asparagus growers produced approximately 228,000 cwt of spears at a value of $19.8 million in 2015 (USDA NASS, 2016). These totals are similar to previous years. Major asparagus-producing counties in Michigan include Mason and Oceana in the northwest. Asparagus is also produced in Cass and Van Buren counties in the southwest.

Unlike annual crops where an epidemic in one year will not necessarily influence yields in subsequent years, premature defoliation of the asparagus fern from a plant pathogen may reduce plant vigor. Consecutive years of premature defoliation have been shown to critically reduce subsequent yields. The primary pests of asparagus include both foliar and soilborne pathogens that are currently managed in seedbed and production sites through the use of fungicides. The goal of our 2016 field research was to test new tools and strategies for managing diseases in asparagus.

Foliar Diseases

Fungicides are applied to asparagus fern that develop following spear harvest to manage rust and purple spot, which are the most important foliar fungal diseases of asparagus in Michigan. Purple spot (caused by *Stemphylium vesicarium*) occurs on both fern and the edible spears. Purple spot lesions may result in spears being rejected for the fresh market. Rust (caused by *Puccinia asparagi*) only affects the fern. Both rust and purple spot can develop on the main stem, secondary branches, and cladophylls and can be present together exacerbating defoliation. Premature defoliation decreases carbohydrate stores in the crown, which can limit yield in subsequent years and cause plant stress that may increase susceptibility to soilborne pathogens such as *Fusarium*.

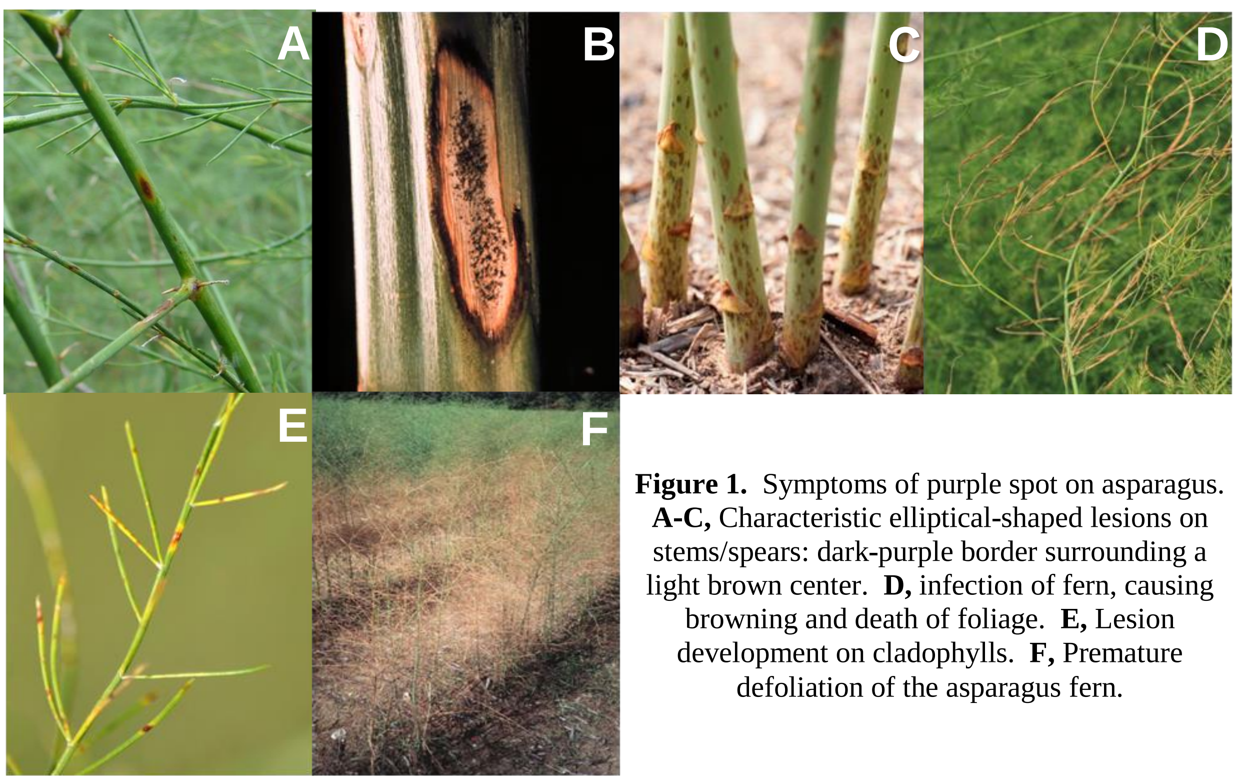


Figure 1. Symptoms of purple spot on asparagus. **A-C,** Characteristic elliptical-shaped lesions on stems/spears: dark-purple border surrounding a light brown center. **D,** infection of fern, causing browning and death of foliage. **E,** Lesion development on cladophylls. **F,** Premature defoliation of the asparagus fern.

Evaluation of registered and unregistered fungicides for control of purple spot in asparagus.

A field trial was established in Oceana County, MI to examine the effects of registered and unregistered fungicides for control of purple spot and/or rust disease. The asparagus crowns were established on sandy loam soil. Overhead irrigation was set up to encourage disease pressure. There were four replications in a randomized complete block design, with one 35-foot row representing a plot. Sprays were made with a CO_2 backpack sprayer with a three-nozzle boom equipped with XR8003 flat fan nozzles, operated at 35 PSI, delivering 50 gallons per acre. Applications were made every 14 days (21 June; 6 and 20 July; 3, 16, and 30 August). Fern were rated on 26 August, 13 and 20 September based on the severity of infection using the Horsfall-Barratt scale.

Rating #1: The first rating was on 26 August when disease pressure from purple spot was high. Bravo WeatherStik SC, KFD-271-01 SC alternated with Manzate Max SC, Manzate Max SC alone and Folicur SC were similar to the untreated control (rating=7.3; 7=50-70% disease). Quadris Top SC, Luna Tranquility SC, KFD-271-01 SC alternated with Bravo WeatherStik SC resulted in a rating <5.0 (5=12-25% disease).

Rating #2: On 13 September, Manzate Max SC, Bravo WeatherStik SC, Folicur SC and Luna Tranquility SC were comparable to the untreated control (7.8; 8=75-87% disease) and did not limit disease. Quadris Top SC had the lowest disease rating (5.3; 5=12-25% disease), while KFD-271-01 SC alone or in alternation with Manzate Max SC, and Aprovia EC also controlled disease.

Rating #3: On 20 September, Bravo WeatherStik SC was severely diseased and was similar to the untreated control (9.3; 9=87-94% disease). Quadris Top had the lowest disease rating (5.8; 6=25-50% disease) and provided better control than all other fungicides included in this study. Overall Quadris Top showed good control of purple spot throughout the study, and will be registered for use on asparagus in the future.

Table 1. Fungicides applied to control foliar diseases of asparagus.

Treatment and rate/A, applied at 14-day intervals	Foliar ratings*		
	8/26/2016	9/13/2016	9/20/2016
Untreated control	7.3 a**	7.8 a	9.3 a
KFD-271-01 SC 2 qt	5.0 de	5.8 d-f	7.3 bc
Bravo WeatherStik SC 2 pt	6.3 a-c	7.0 a-c	8.3 ab
KFD-271-01 SC 2 qt -*alt*- Bravo Weatherstik SC 2 pt	4.8 e	6.5 b-e	7.3 bc
KFD-271-01 SC 2 qt -*alt*- Manzate Max SC 1.6 qt	6.3 a-c	5.8 d-f	7.0 cd
Manzate Max SC 1.6 qt	7.0 ab	7.3 ab	8.0 bc
Folicur SC 6 fl oz	7.0 ab	6.5 b-e	7.8 bc
Quadris Top SC 14 fl oz	4.3 e	5.3 f	5.8 e
Luna Tranquility SC 1 pt	4.5 e	6.8 a-d	8.0 bc
Aprovia EC 10 fl oz	5.3 c-e	6.0 c-f	7.8 bc

*Rated on the Horsfall-Barratt scale of 1 to 12, where 1=0% plant area diseased, 2=>0 to 3%, 3=>3 to 6%, 4=>6 to 12%, 5=>12 to 25%, 6=>25 to 50%, 7=>50 to 75%, 8=>75 to 87%, 9=>87 to 94%, 10=>94 to 97%, 11=>97 to <100%, 12=100% plant area diseased.

**Column means with a letter in common are not significantly different (LSD t Test; P=0.05).

Soilborne Diseases

Fusarium spp. cause stem, crown, and root rot of asparagus and *Phytophthora asparagi* causes spear, crown, and root rot. While both pathogens may infect asparagus seedlings in the nursery and crowns after establishment in production fields, *Phytophthora* is especially devastating. Since asparagus is a perennial crop, crown rot may progress unnoticed initially. Heavy rainfall tends to favor *Phytophthora* whereas high heat and drought stress may favor *Fusarium*. Control of *Fusarium* and

Phytophthora rot is challenging as the pathogens persist in the soil and cultural and chemical control options are limited. Treating crowns with fungicides before planting and fumigating crown nurseries and production fields have been used in recent years to improve crown health and enhance the longevity and productivity of the asparagus planting. Fungicide soil applications for direct-seeded crown nurseries may improve crown health and vigor by reducing soilborne diseases and has been the focus of our recent research.

Evaluation of fungicides for control of asparagus soilborne seedling diseases in a crown nursery.

Two studies were conducted in a crown nursery in collaboration with a commercial farm in Oceana County, MI. The trial was replicated four times with treatments arranged in a randomized complete block design. Each plot consisted of three rows, and was 25 feet long with a five-foot buffer between each replicate. Treatments were applied with a handheld, CO_2 pressurized backpack sprayer, operated at 35 psi to deliver 33 gallons per acre. A three-nozzle boom was used with XR8002 flat-fan nozzles. Treatments were at three week intervals on 26 June, 17 July, 10 August, 1 and 22 September. Twenty crowns were dug from each plot on 12 April 2016, washed and assessed for size using a 1 to 4 scale (Figure 2) and weighed on April 29, 2016.

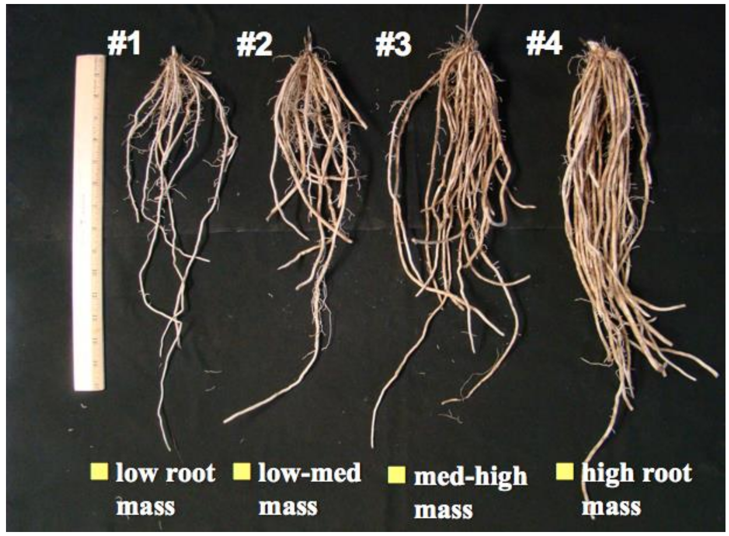


Figure 2: Crown rating visual scale

There were no significant differences among the crowns treated with various fungicides and those crowns that received no treatment (untreated) based on the weight per crown. For the large root mass category (#4), the crowns (%) of the Presidio SC alternated with Topsin M WP treatment were significantly greater than the untreated control. For the #3 category (medium-high mass) the greatest percentage of the crowns occurred for the untreated control and Viathon LC treatments. There were no differences among the treatments for the #2 category (low-medium mass). For the low root mass category (#1), the untreated control was similar to several fungicide treatments. Treatments including Presidio SC, Ridomil Gold SL and Presidio SC alternated with Cannonball WP had a greater percentage of crowns in the low root mass category than the untreated plots.

Table 2. Fungicides applied as a soil drench to control soilborne pathogens of asparagus.

Treatment and rate/A, applied at 21-day intervals	Crown ratings (%)				Yield (oz/crown)
	#1: low root mass	#2: low-medium	#3: medium-high	#4: high root mass	
Untreated control	11.3 d*	27.5	51.9 a	9.4 b	1.7
Presidio SC 4 fl oz	22.5 a-c	30.0	36.9 bc	10.6 ab	1.4
Ridomil Gold SL 2 pt	28.8 a	34.4	31.9 c	5.0 b	1.4
Orondis OD 9.6 fl oz	20.6 a-d	34.4	34.4 bc	10.6 ab	1.5
Cannonball WP 7 oz	21.3 a-d	29.4	40.0 bc	9.4 b	1.6
Topsin M WP 1.5 lb	17.5 b-d	30.6	40.6 a-c	11.3 ab	1.5
Fontelis SC 24 fl oz	17.5 b-d	33.1	39.4 bc	10.0 ab	1.6

Treatment and rate/A, applied at 21-day intervals	Crown ratings (%)				Yield (oz/crown)
	#1: low root mass	#2: low-medium	#3: medium-high	#4: high root mass	
Presidio SC 4 fl oz -*alt*- Cannonball WP 7 oz	26.3 ab	30.0	35.6 bc	8.1 b	1.5
Presidio SC 4 fl oz -*alt*- Topsin M WP 1.5 lb	16.3 b-d	31.3	34.4 bc	18.1 a	1.7
Ridomil Gold SL 2 pt -*alt*- Cannonball WP 7 oz	17.9 b-d	35.7	39.3 bc	7.1 b	1.5
Ridomil Gold SL 2 pt -*alt*- Topsin M WP 1.5 lb	18.8 a-d	34.4	39.4 bc	7.5 b	1.5
Viathon LC 2 pt	13.8 cd	32.5	43.8 ab	10.0 ab	1.6

[*]Column means with a letter in common or with no letters are not significantly different (LSD t Test; *P*=0.05).

Table 3. List of fungicides used in Michigan 2016 trials.

Product name	Active ingredient	FRAC[1]	Registered?	
			Foliar	Drench
	Foliar Trial Fungicides			
Bravo WeatherStik......	chlorothalonil	M5	yes	no
Manzate Max	mancozeb	M3	yes	yes (crown soak)
Folicur.........................	tebuconazole	3	no	no
Quadris Top	azoxystrobin/difenoconazole	11/3	In progress	no
Luna Tranquility	fluopyram/pyrimethanil	7/9	no	no
Aprovia	benzovindiflupyr	3	no	no
	Soil Treatment Trial Fungicides			
Presidio	fluopicolide	43	no	no
Ridomil Gold	mefenoxam	4	no	yes
Orondis........................	oxathiapiprolin	U15	no	no
Cannonball	fludioxonil	12	no	no
Topsin M.....................	thiophanate-methyl	1	no	no
Fontelis........................	penthiopyrad	7	no	no
Viathon........................	potassium phosphite/tebuconazole	33/3	no	no

[1]Numbers and letters are used to define the fungicide groups by their cross resistance potential. Numbers are primarily based on when the product enters the market. P = host plant defense inducers, M = multi-site inhibitors, and U = unknown mode of action and unknown resistance risk. Visit www.frac.info for more information about FRAC codes.

Acknowledgement. This research was partially funded by the United Phosphorus Inc. company and the Michigan Asparagus Advisory Board.