Update on Irrigation and fertilization management in watermelon production in Southern Indiana

Wenjing Guan (guan40@purdue.edu)
Vegetable specialist
Clinical & Engagement Associate Professor
Southwest Purdue Agricultural Center
Vincennes, IN 47591
812-886-0198

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Watermelon Production Overview in the U.S.

Planted acres in the past three years

	2020	2019	2018
Florida	26,300	25,500	22,600
Texas	20,000	22,000	24,000
Georgia	19,000	22,000	23,000
California	9,600	9,300	12,000
North Carolina	9,000	7,800	7,700
Indiana	6,700	6,500	6,600
Arizona	4,700	5,000	NA
South Carolina	4,700	5,000	4,500

Value (1,000 dollars) of utilized production

	2020	2019	2018
Indiana	46,898	35,294	27,915

Watermelon is the top specialty crop in Indiana

2020 Indiana Agriculture Overview

Crops - Planted, Harvested, Yield, Production, Price (MYA), Value of Production †
Sorted by Value of Production in Dollars

Commodity	Planted All Purpose Acres	Harvested Acres	Yield	Production	Price per Unit	Value of Production in Dollars
CORN						
CORN, GRAIN		5,250,000	187 BU / ACRE	981,750,000 BU	4.65 $ / BU	4,368,788,000
CORN	5,400,000					
CORN, SILAGE		130,000	21 TONS / ACRE	2,730,000 TONS		
SOYBEANS						
SOYBEANS	5,750,000	5,730,000	59 BU / ACRE	338,070,000 BU	11.1 $ / BU	3,755,616,000
HAY & HAYLAGE						
HAY & HAYLAGE						230,580,000
HAY & HAYLAGE, ALFALFA	40,000					133,980,000
HAY & HAYLAGE, (EXCL ALFALFA)						96,600,000
HAY						
HAY		500,000	2.56 TONS / ACRE	1,282,000 TONS	180 $ / TON	230,580,000
HAY, ALFALFA		220,000	2.9 TONS / ACRE	638,000 TONS	210 $ / TON	133,980,000
HAY, (EXCL ALFALFA)		280,000	2.3 TONS / ACRE	644,000 TONS	150 $ / TON	96,600,000
WHEAT						
WHEAT	300,000	250,000	70 BU / ACRE	17,500,000 BU	5.28 $ / BU	92,750,000
WHEAT, WINTER	300,000	250,000	70 BU / ACRE	17,500,000 BU	5.28 $ / BU	92,750,000
MELONS						
MELONS, WATERMELON, FRESH MARKET					19.5 $ / CWT	46,898,000
MELONS, WATERMELON	6,700	6,500	370 CWT / ACRE	2,405,000 CWT	19.5 $ / CWT	46,898,000
MELONS, WATERMELON, UTILIZED				2,405,000 CWT		
PUMPKINS						
PUMPKINS	6,200	6,000	160 CWT / ACRE	960,000 CWT	17.9 $ / CWT	16,397,000
PUMPKINS, UTILIZED				916,800 CWT		
PUMPKINS, FRESH MARKET					(D) $ / CWT	(D)
PUMPKINS, PROCESSING					(D) $ / TON	(D)
MINT						
MINT, SPEARMINT, OIL		4,200	69 LB / ACRE	290,000 LB	15.8 $ / LB	4,582,000
MINT, PEPPERMINT, OIL		5,600	44 LB / ACRE	246,000 LB	(D) $ / LB	(D)

(NA) Not Available
(D) Withheld to avoid disclosing data for individual operations
(S) Insufficient number of reports to establish an estimate
(X) Not Applicable
(Z) Less than half the rounding unit

Watermelons are primarily grown in southern Indiana

Counties	Farms	Acres
Knox	34	4,346
Gibson	7	435
Sullivan	8	380
Jackson	6	156

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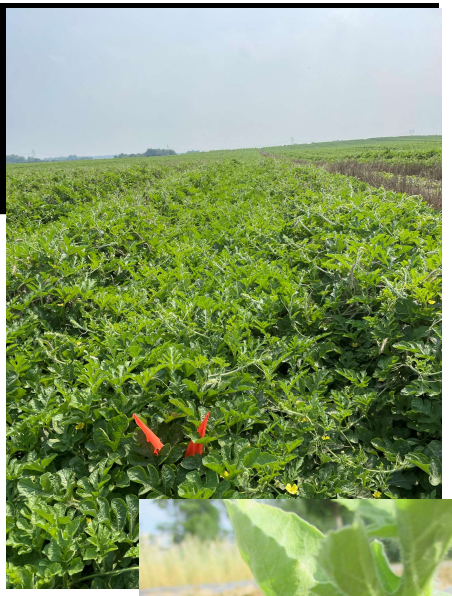
Overview of watermelon production

- Watermelons are primarily grown on sandy, sandy loam soils
- Seedless watermelons
- Use transplants
- Black plastic covered beds
- Wind break
- Timeline: transplanting from end April to middle June; Harvesting from middle July to Sep.



Watermelon Irrigation and Fertilization Management

- Estimate about half the watermelon field has irrigation capability (drip irrigation or overhead irrigation)

- Estimate about half of the field that installed drip tapes use fertigation

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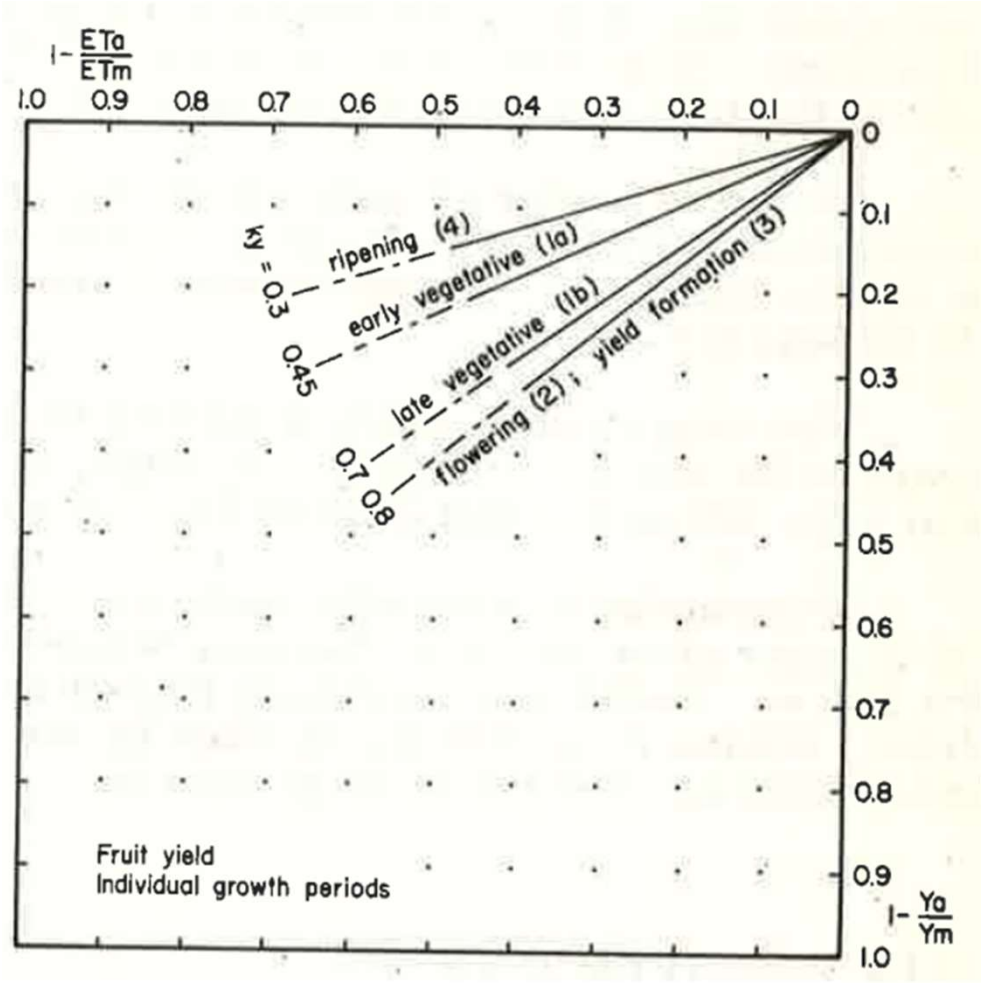
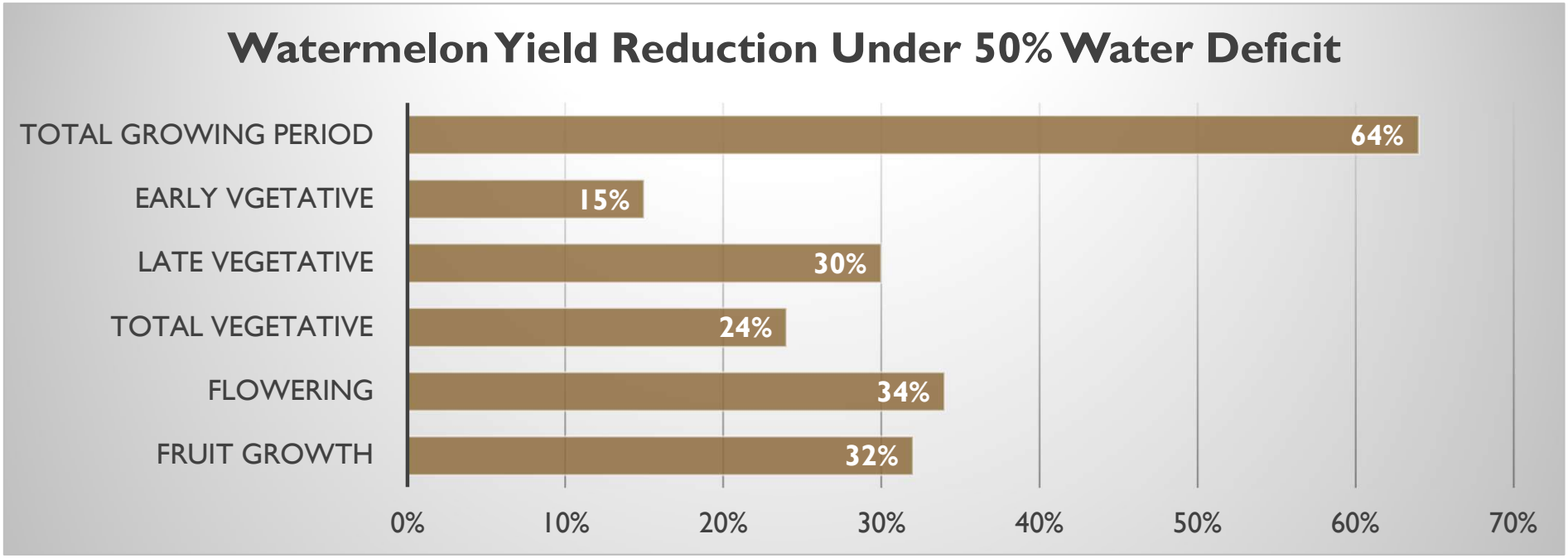
Irrigation

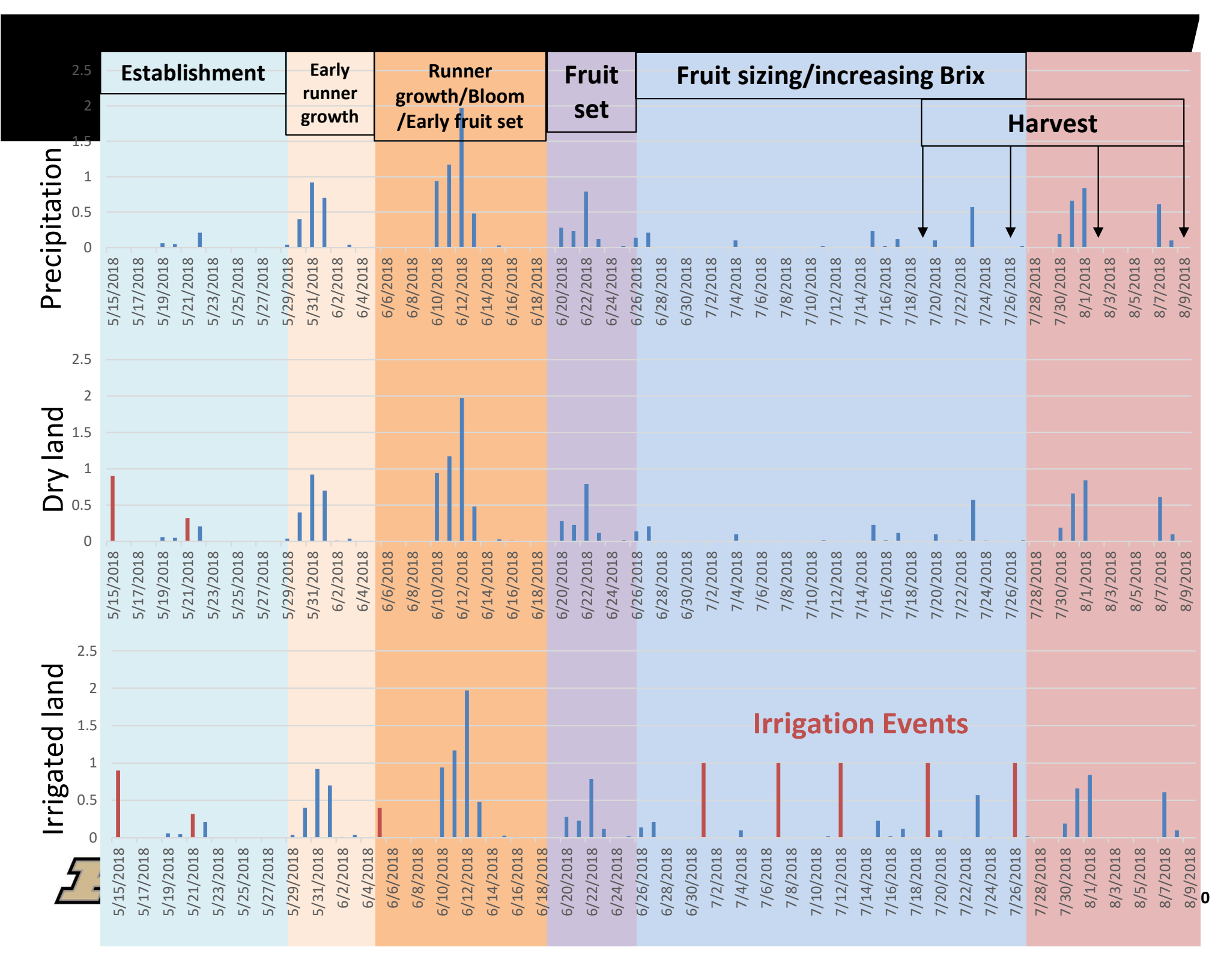


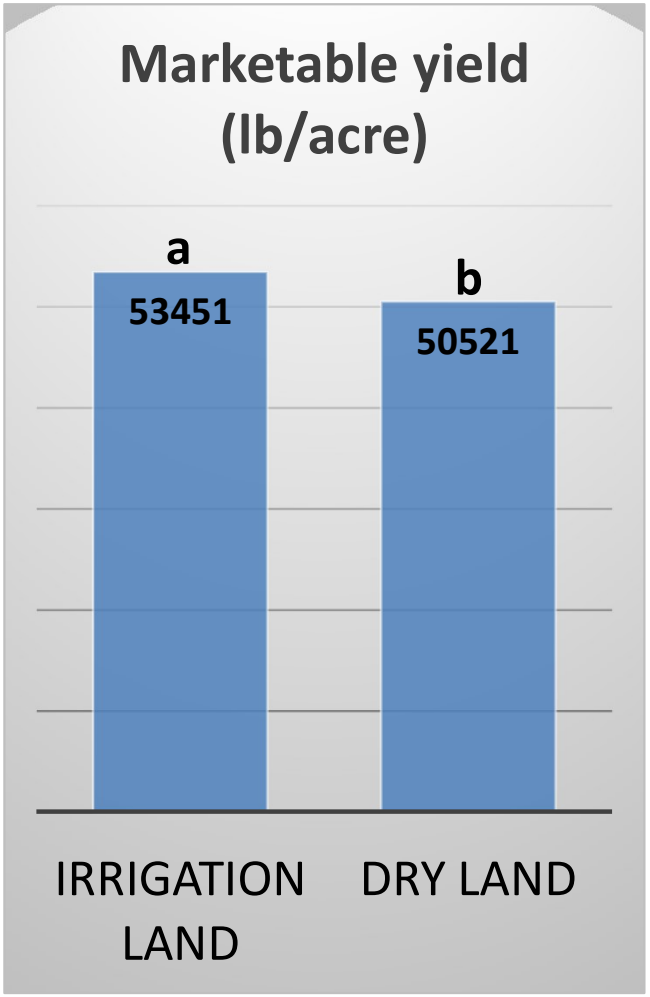
- Vegetative period:
  early vegetative growth (week1-2)
  late vegetative growth (vine development week 3-4)
- Flowering period (week5-6)
- Fruit filling (week7-10)
- Ripening (week10-13)

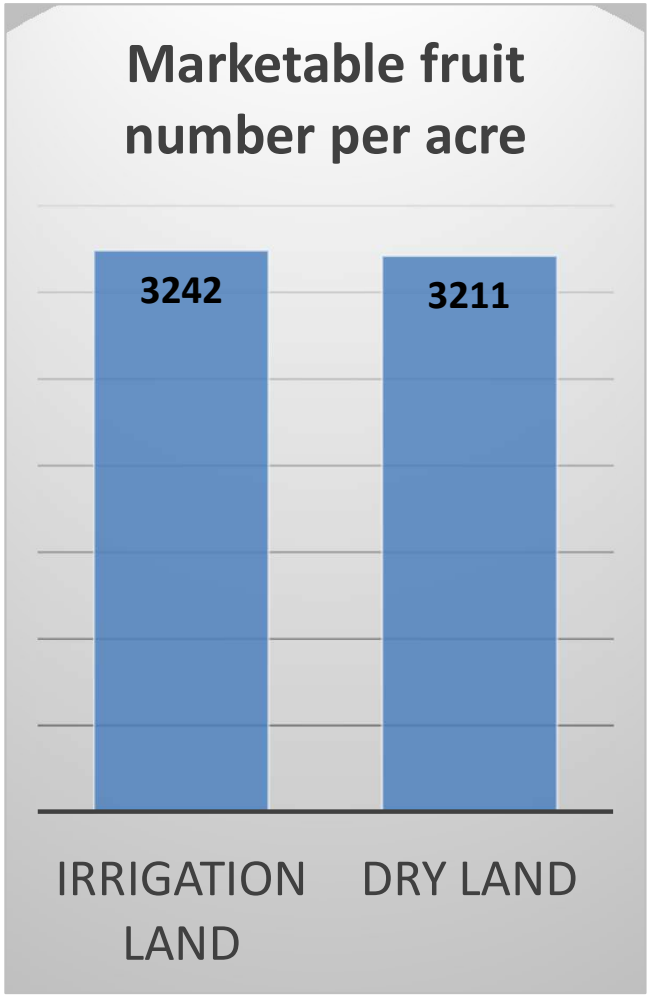
(1979. Yield response to water. Irrigation and Drainage Paper No. 33. FAO)

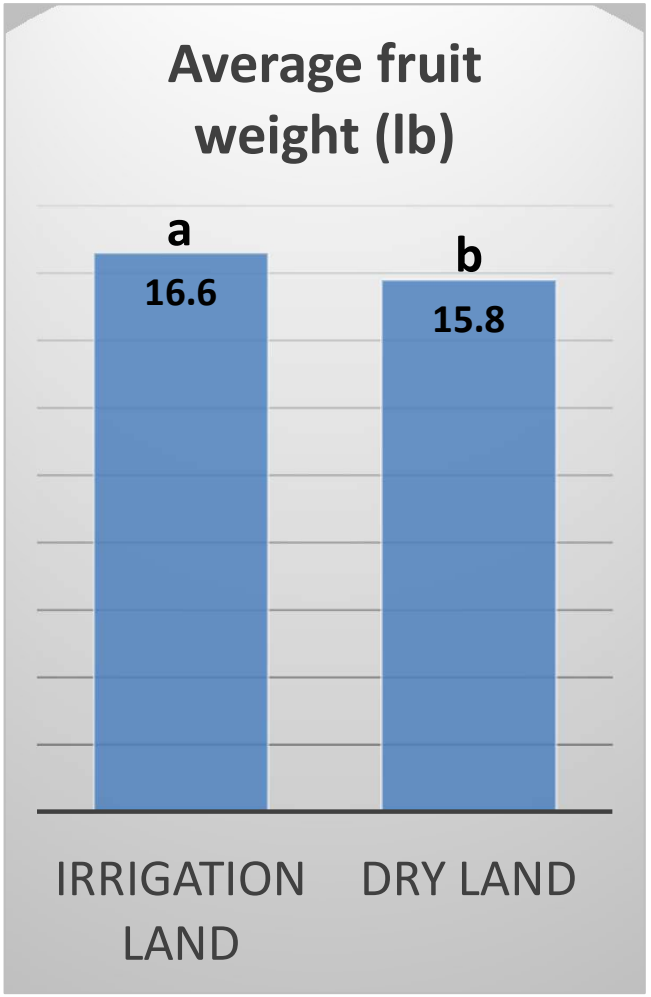


(2003. Yield response of watermelon to irrigation shortage. Scientia Horticulturae V. 98)


Establishment
Early runner growth
Runner growth/Bloom /Early fruit set
Fruit set
Fruit sizing/increasing Brix
Harvest
Precipitation
Dry land
Irrigated land
Irrigation Events







Dry land had smaller fruit, less yield by weight, but similar fruit number compared to the irrigated land.

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Sensor-based irrigation

Table 3. Fruit yield (kg·ha^{-1}) for plants from three irrigation treatments in 2008, 2009, and 2010.[z]

Treatment	Fruit yield (kg·ha^{-1})		
	2008	2009	2010
WI	138,653 a[y]	100,759 a	83,862 a
MI	113,090 a	90,121 a	50,726 b
NI	77,197 b	86,578 a	46,145 b

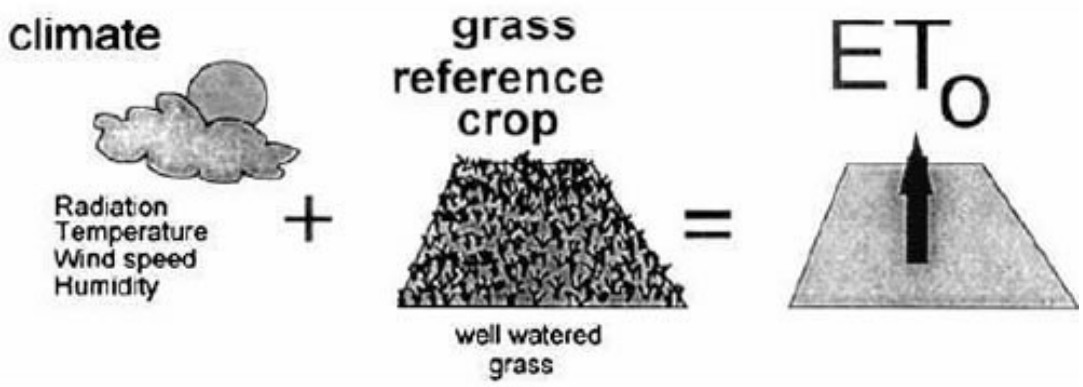
[z]Experiments were conducted at the Edisto Research and Education Center, Blackville, SC.
[y]Within a column, different letters denote a significant difference ($P < 0.05$).
NI = not irrigated; MI = minimally irrigated; WI = well irrigated (see "Methods").

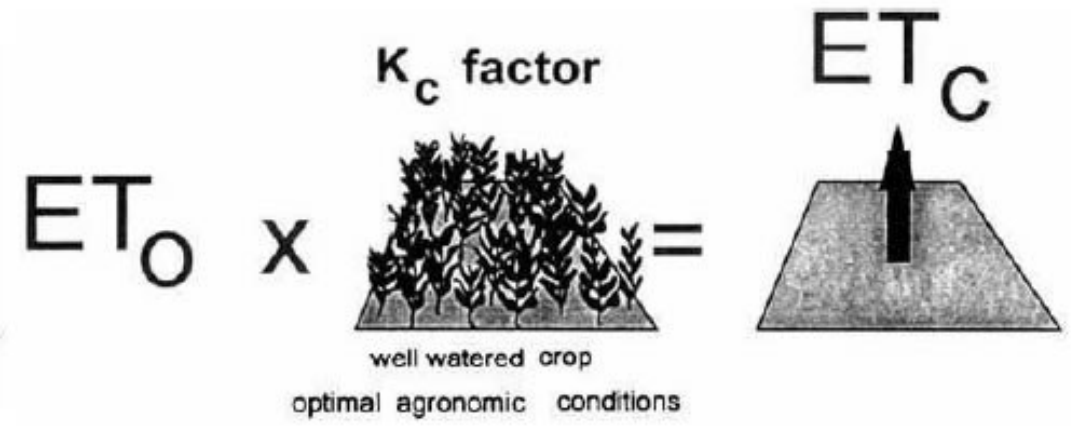
WI: soil moisture fell below 15% available water depletion
MI: soil moisture fell below 50% available water depletion
NI: only irrigate for early season plant establishment and fertigation
Based on sensors at 12" depth

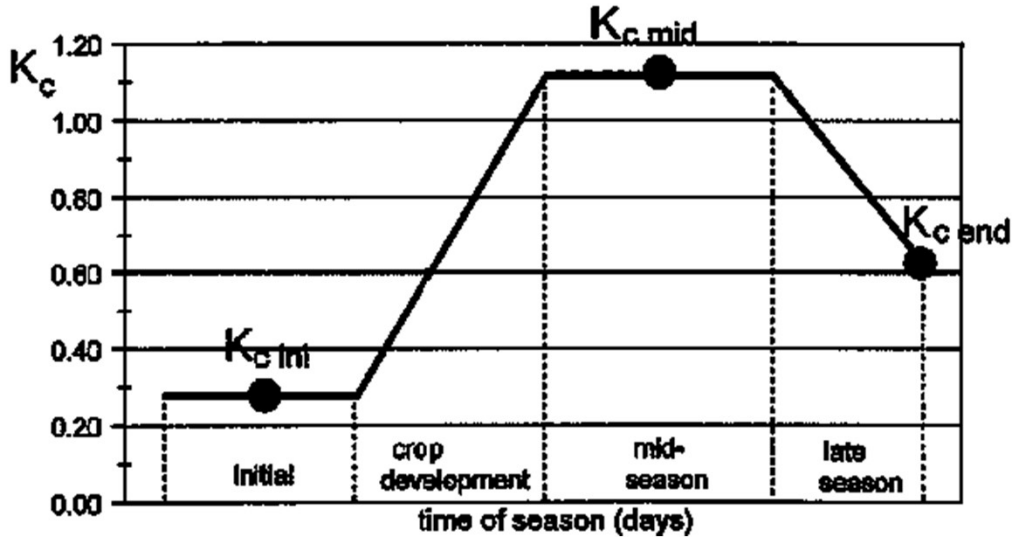
88-136 irrigation triggers in well irrigated treatment in the season. Each event was 60 min in 2008, 30 min in 2009 and 2010

(2013. Miller G. et al., Grafted watermelon root length density and distribution under different soil moisture treatments. HortScience)

ET-based irrigation scheduling







$$I_{100} = \mathrm{ET}_0 \times K_c \times \mathrm{CF} \times W_m \times 100\,\mathrm{m}$$

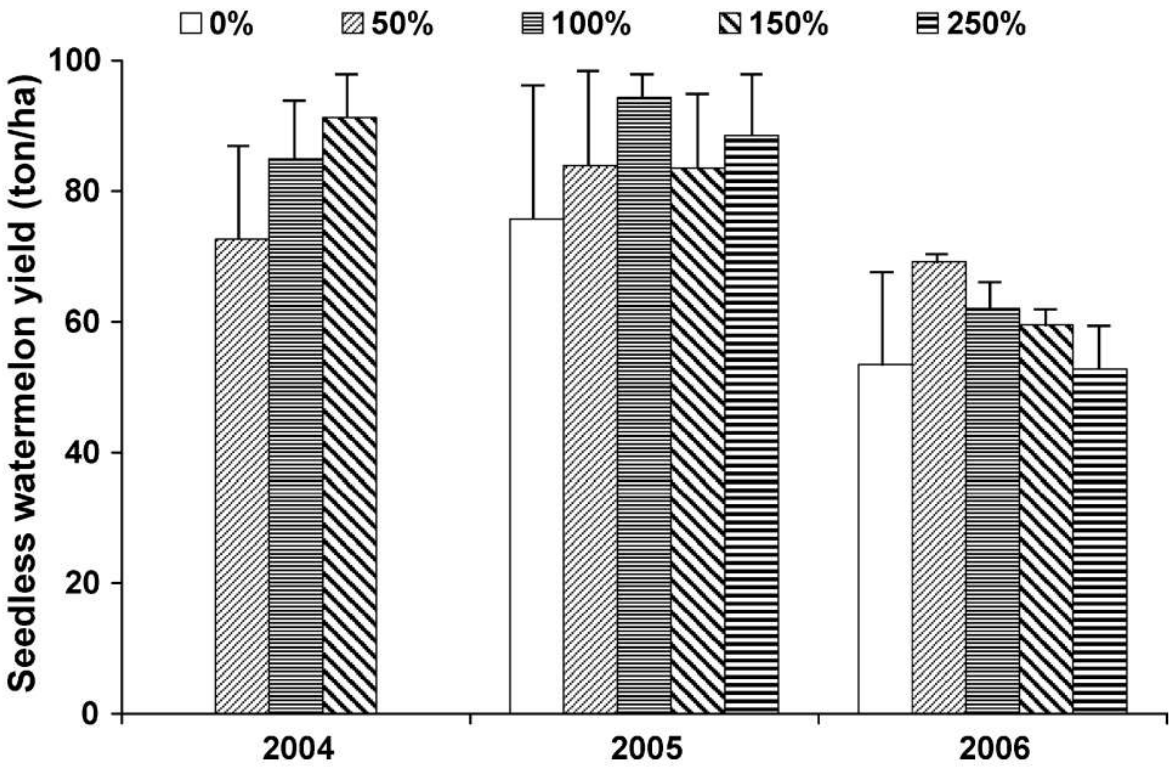


Fig. 6. Total yield of seedless watermelon in 2004, 2005 and 2006 as a function of relative irrigation rate. Error bars show standard deviation of yield.

24 irrigations in 2004 and 2005, 21 irrigations in 2006. Average irrigation duration for the 100% irrigation treatment in 2004, 2005, 2006 were 4.18 h, 1.87 h, and 2.44 h.

(2007. McCann, I. et al., Effect of irrigation rate on yield of drip-irrigated seedless watermelon in a humid region. Scientia Horticulturae)

Watermelon vine decline

Photo credit: Dr. Dan Egel

Fertilization

Watermelon generally accumulate in the vegetation and fruit ---

145-160 lbs nitrogen (N) per acre
30-45 lbs phosphate (P_2O_5) per acre
160-180 lbs potassium (K_2O) per acre

(Warncke, D.D. 2007. Nutrient management for cucurbits: melons, pumpkin, cucumber, and squash. 2007 Indiana CCA Conference Proceedings)

Adjustments in nitrogen

Situation	N Rate adjustment
Legume cover crop	Subtract 40 to 60
Compost, 2 ton/acre	Subtract 20 to 25
Cereal Grain cover crop, < 8 inches	No change
Cereal Gain cover crop, > 8 inches	Add 20
Corn grain as previous crop	Add 20-30
Wheat grain as previous crop	Add 30-40
Soil Organic matter, <2 %	Add 20
SOM, 2-4%	No change
Soil Organic Matter, >4 %	Subtract 20

(Warncke, D.D. 2007. Nutrient management for cucurbits: melons, pumpkin, cucumber, and squash. 2007 Indiana CCA Conference Proceedings)

Watermelon N experiment in 2021 at SWPAC

- Soil and field history:
  OM 0.7%;
  Planted wheat in 2020
- Treatment (N: Urea)
  Trt 1: 75 lbs/acre N (preplant broadcast) + 75 lbs/acre N (in-season topdressing)
  Trt 2: 100 lbs/acre N (preplant broadcast)
  Trt 3: 150 lbs/acre N (preplant broadcast)
  Trt 4: 200 lbs/acre N (preplant broadcast)
  Trt 5: 250 lbs/acre N (preplant broadcast)
- 6' bed spacing, 4' in-row spacing

Each experiment plot comprised two rows, 6 plants per row, 12 plants per experimental plot

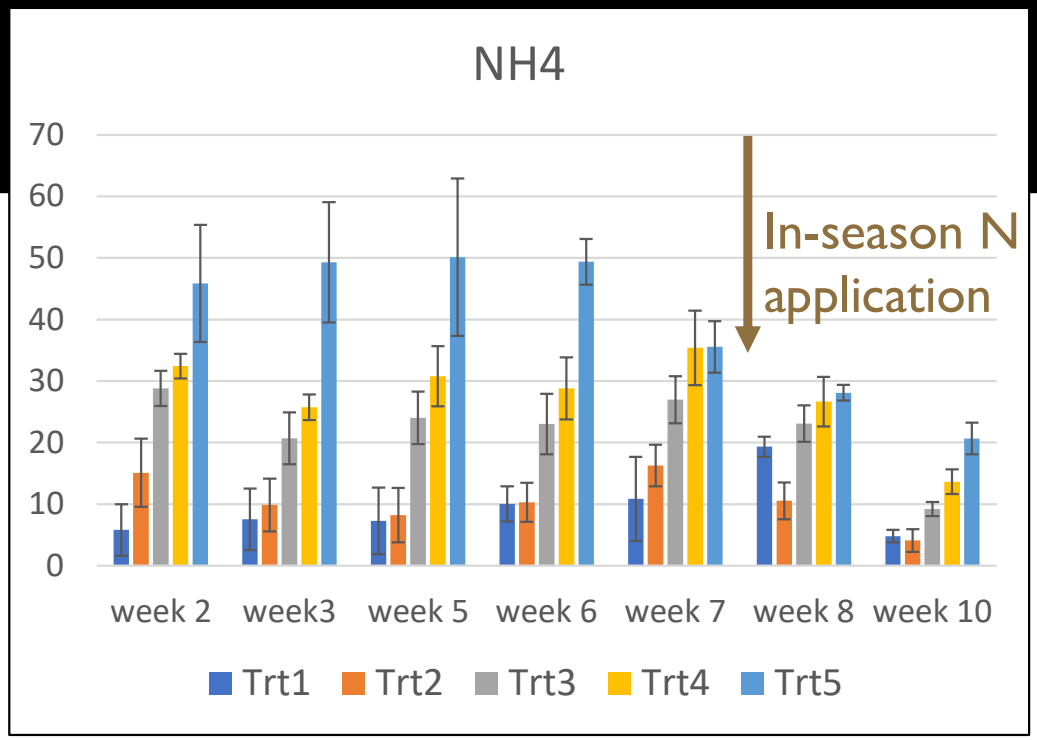
20 (W) x 28 (L) area

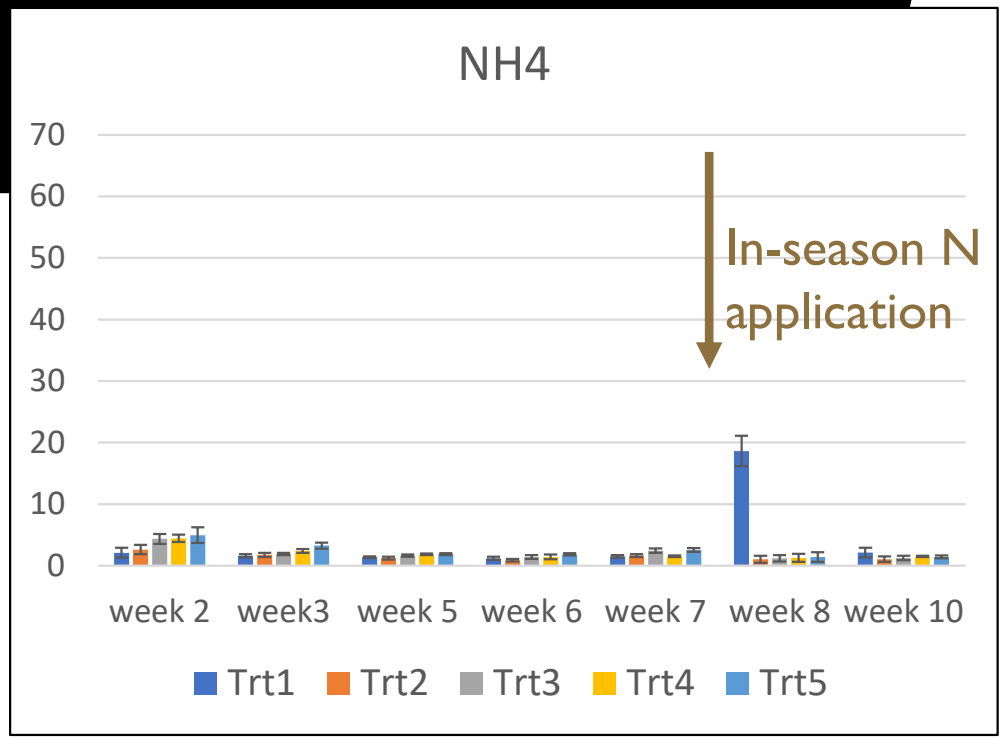
Randomized complete block design, four blocks

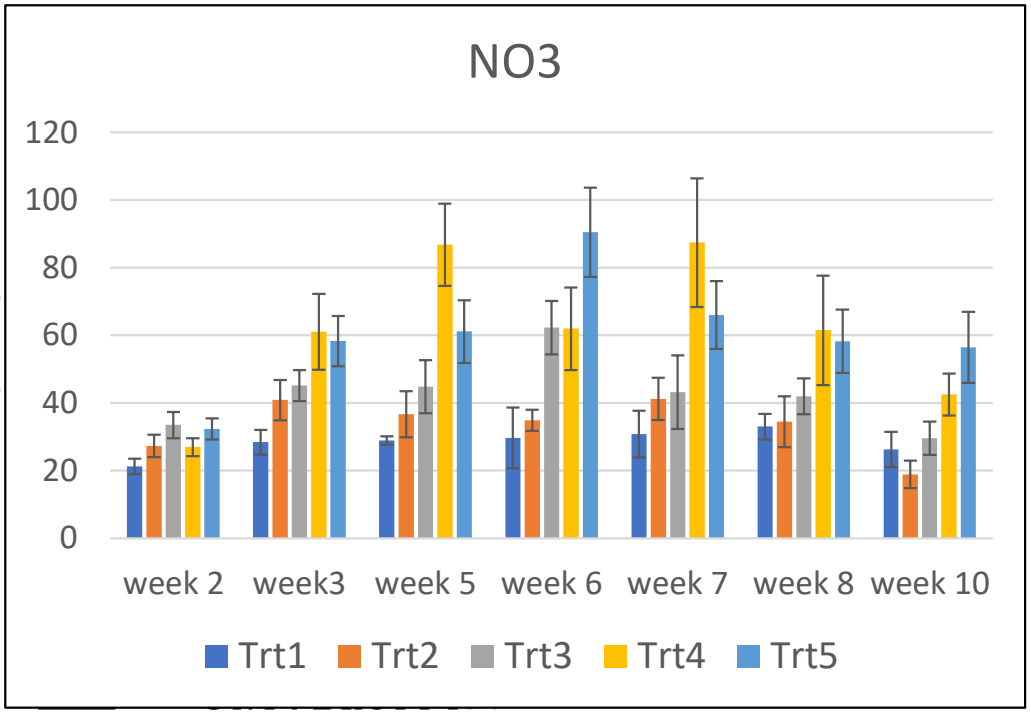
Fertilizers were applied by hand

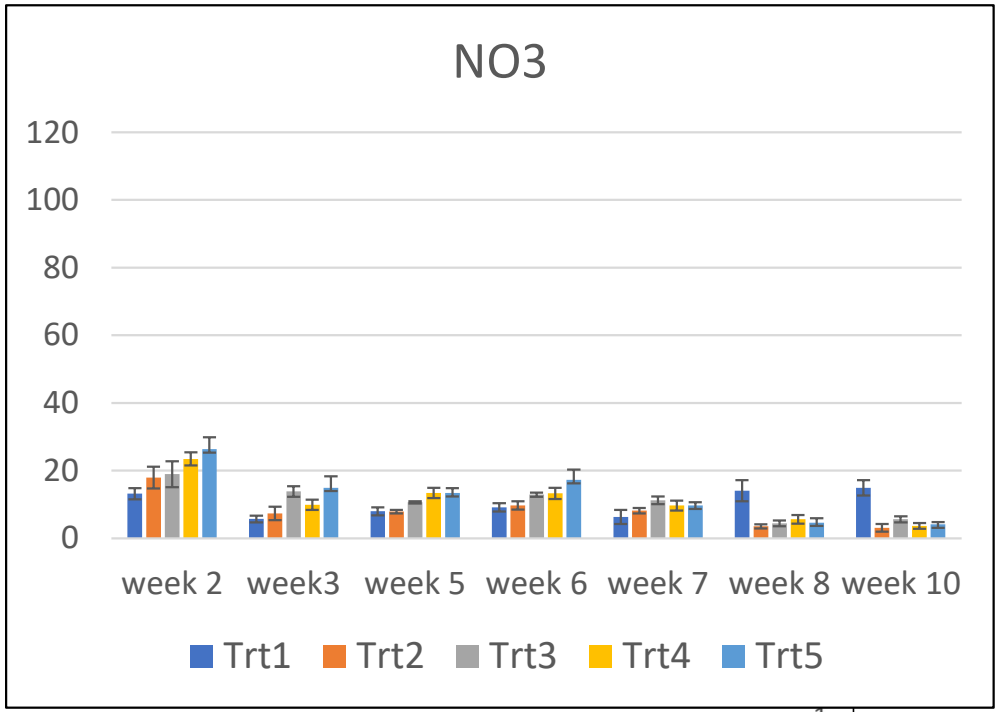
Soil NO_3-N and NH_4-N were measured in soils taken from mulch-covered beds and row middles (bare soil)

Plant tissue samples were collected for nutrient content measurement during the season





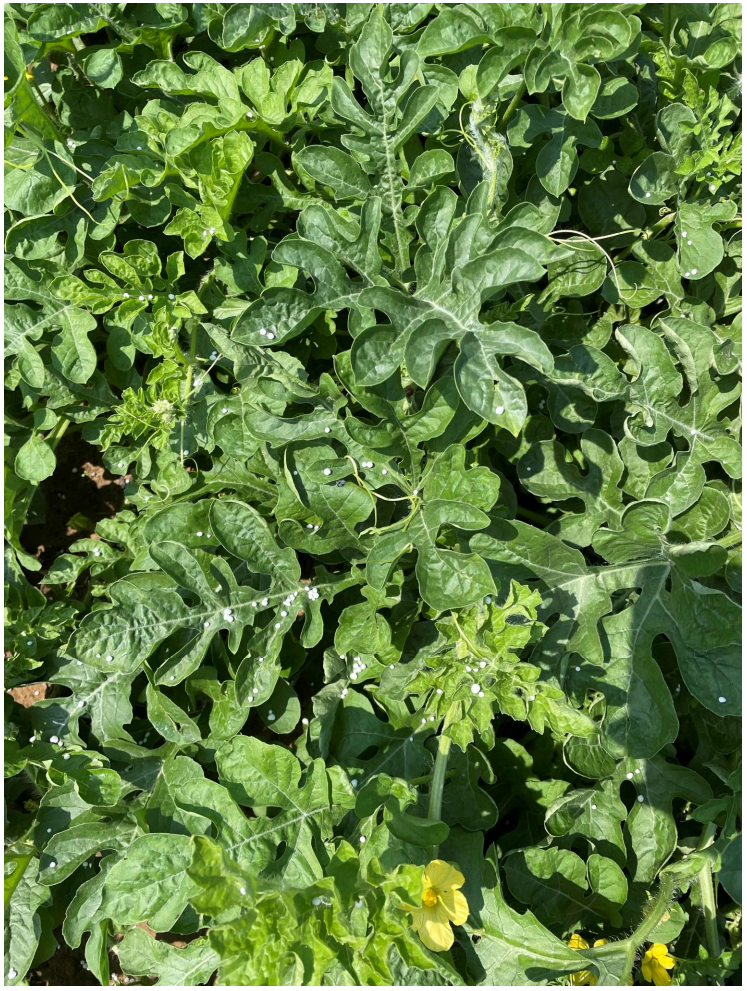


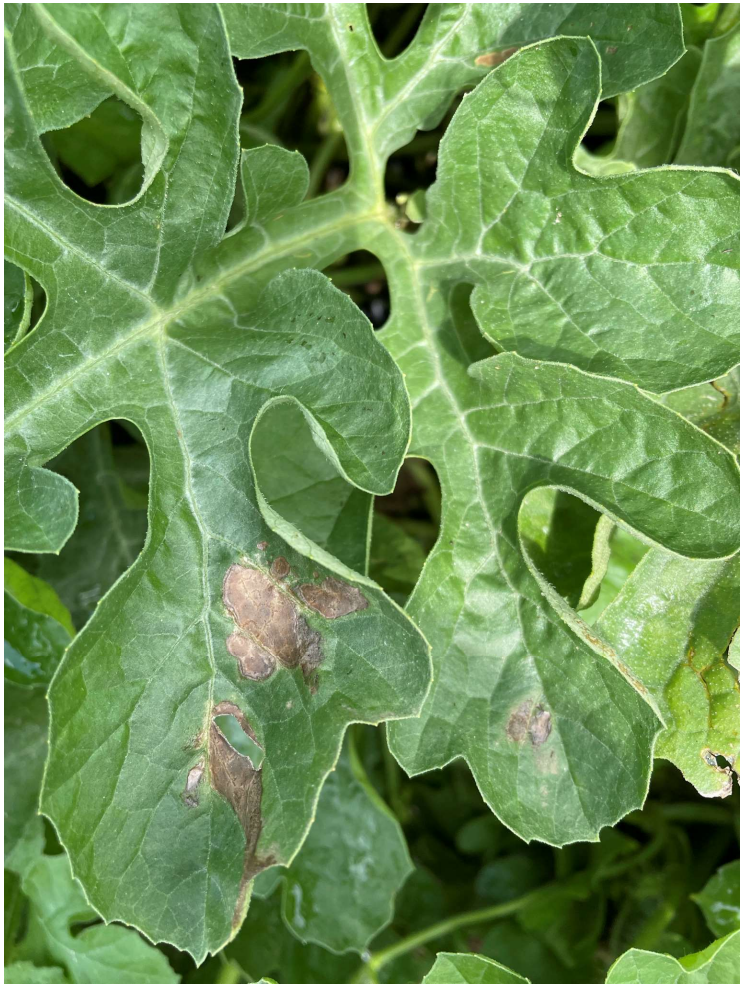


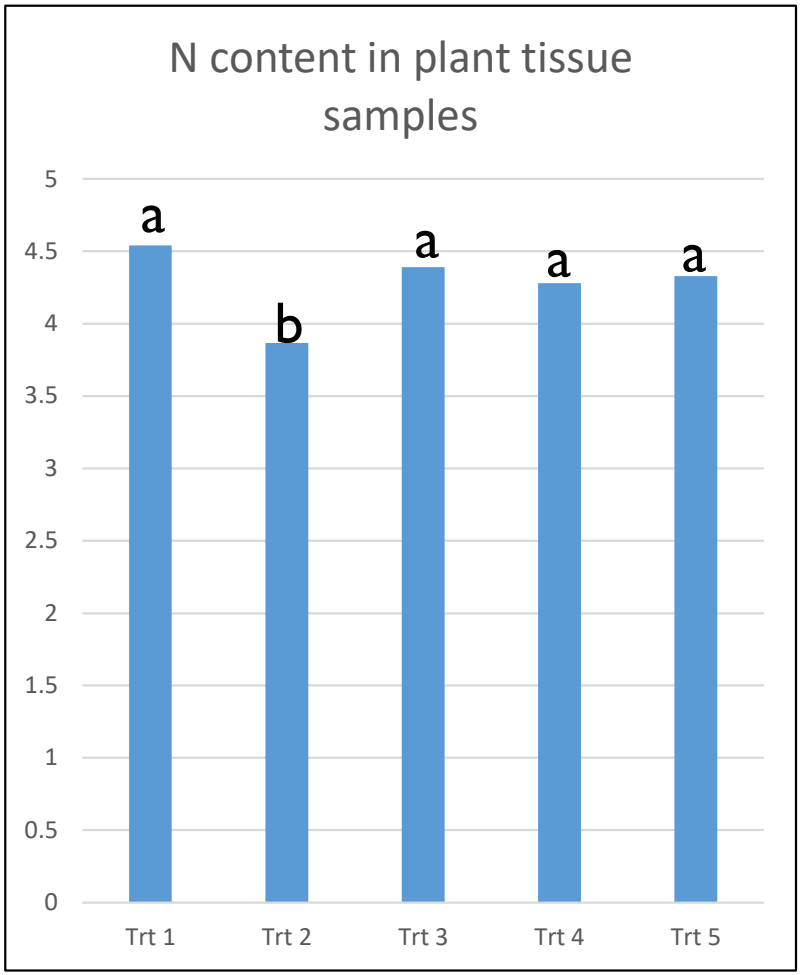
Soil samples from mulch-covered beds

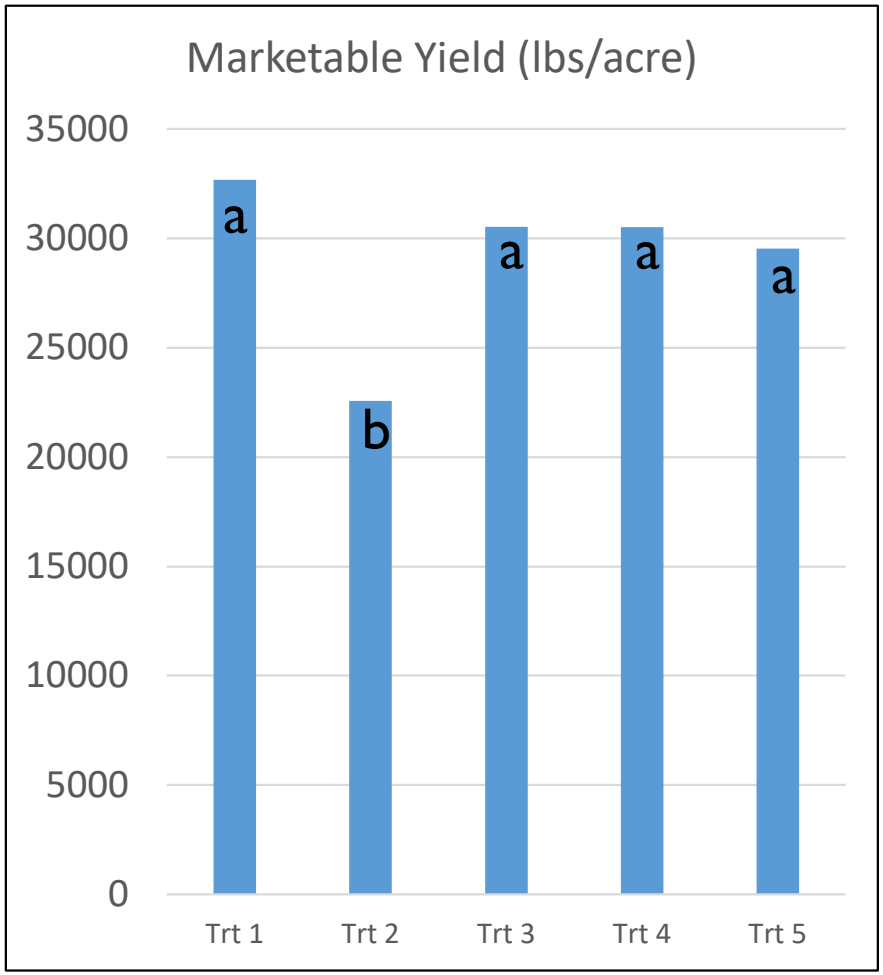
Soil samples from row middles

Leaf damage was observed after in-season Urea application on Trt 1









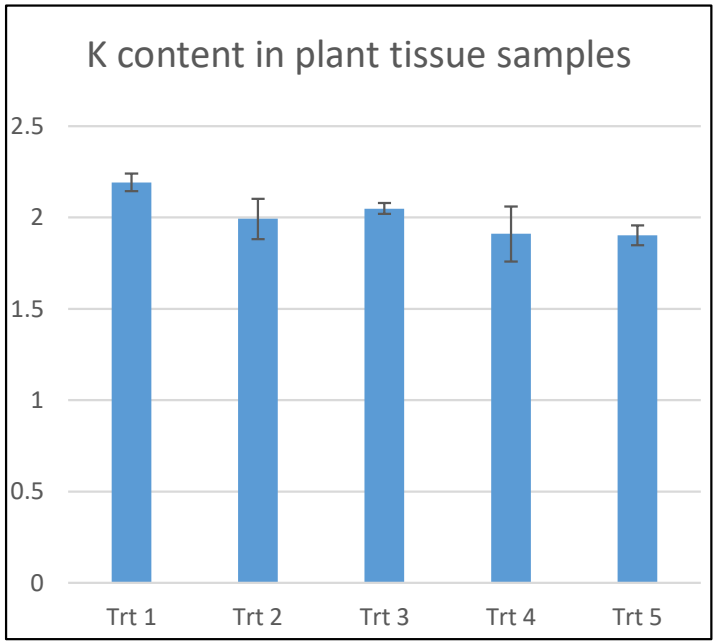
Tissue samples were collected in week 13 (harvest)

Other factors may have limited yield

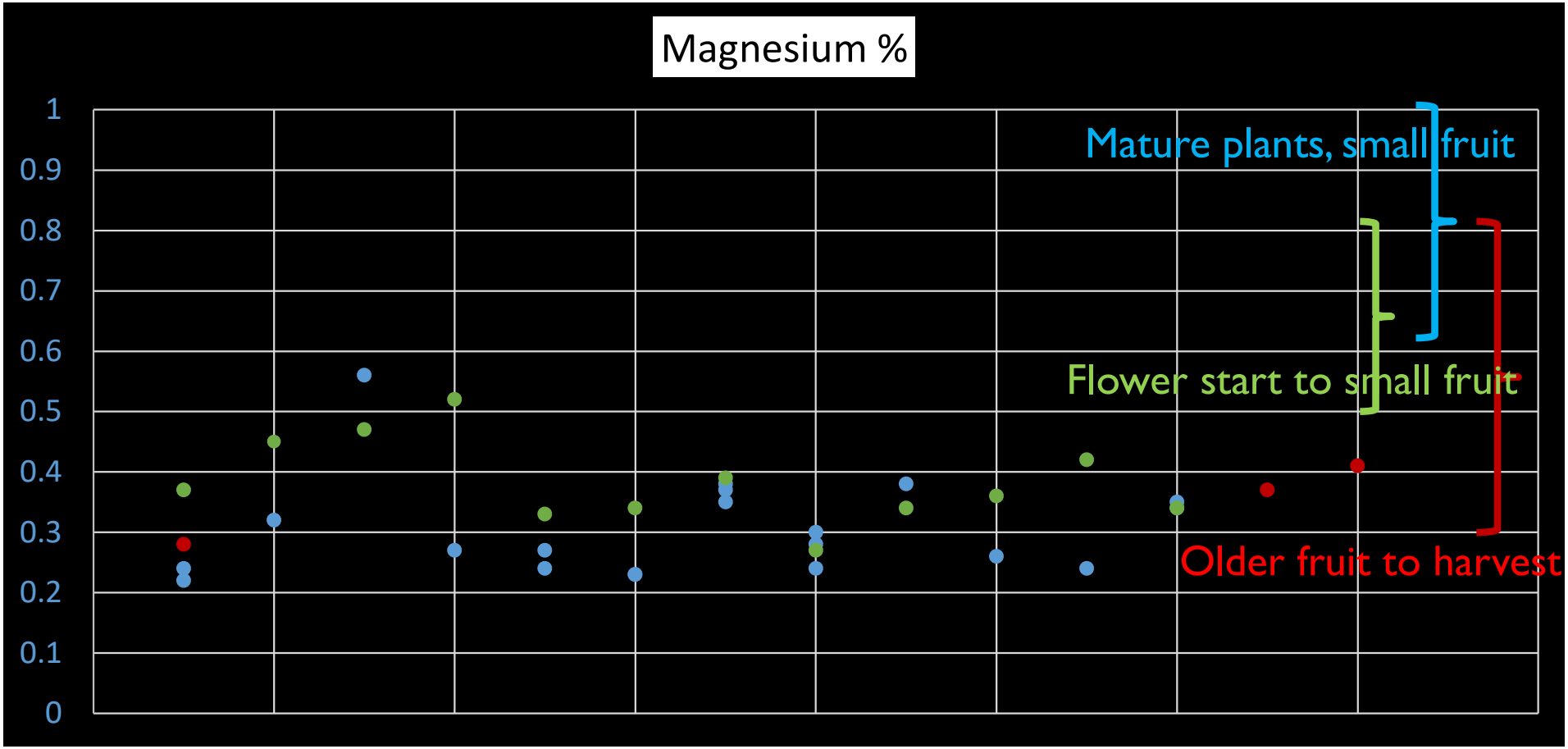
- Average pH from experimental plots dropped from 6.6 at the beginning of the season to 5.5 at the end of the season

- Plant tissue test found K, Mg and S were generally at low or deficient levels across the treatments

All the treatments received100 lbs K/acre and 30 lbs Mg/acre in the forms of potash and K-Mag



Magnesium levels were generally low or deficient in watermelons in southern Indiana



Reference: Bryson et al., Plant Analysis Handbook III

Watermelon Mg and S experiment in 2021 at SWPAC

- 150 lbs N/acre with urea, 100 lbs K/acre with potash or K-Mag
- Treatment:

Trt 1: K-Mag (Mg 30 lbs/acre; S 65 lbs/acre)

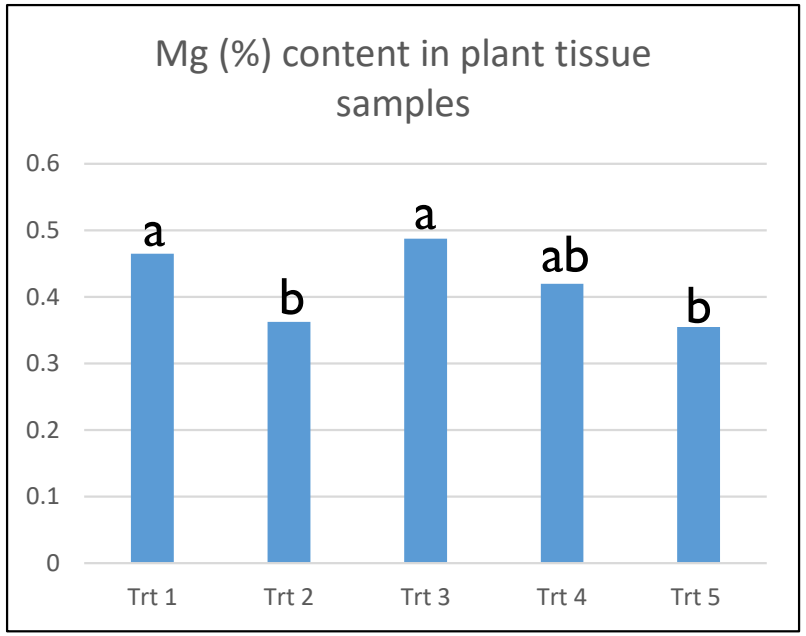
Trt 2: no K-Mag

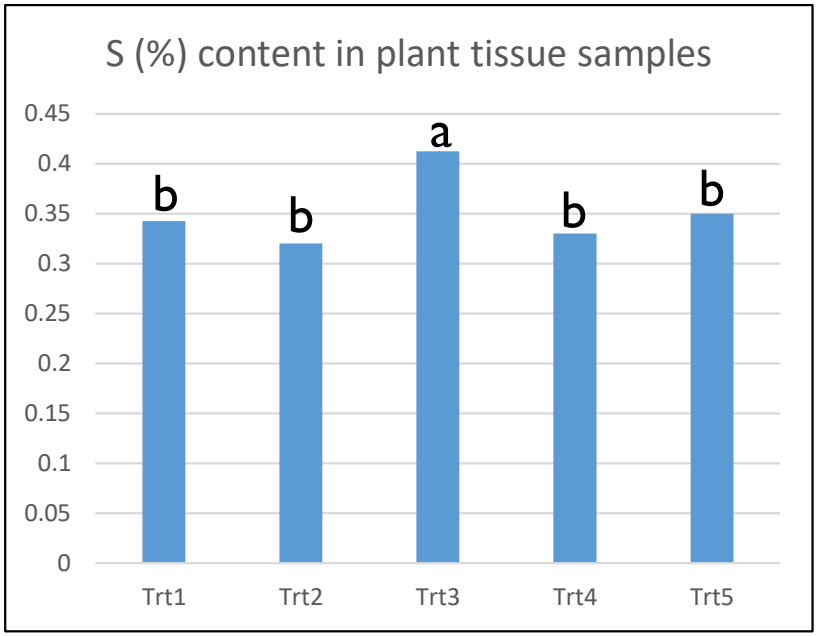
Trt 3: no K-Mag, foliar spray epsom salt

Trt 4: no K-Mag, foliar spray Max-IN ®Magnesium (6% N, 5% Mg)

Trt 5: no K-Mag, S 65 lbs/acre using gypsum

Tissue samples were collected in week 13 (harvest)





- Foliar sprays were conducted five times during the season (week 9, 10,11,12,13)

Application rate-

Empson salt (9%Mg,13%S): 1 lb Mg/acre

Max IN Magnesium: 3 quarts per acre (label)

- Yields were similar among treatments

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Acknowledgement

Dr. James Camberato, Purdue University
Superior Ag
Syngenta
Dean Haseman, Technician
Silas Buchanan, Summer help
Staff at Southwest Purdue Agricultural Center

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