Evaluation of Composted Poultry Manure & Potassium as Plant Nutrient Supplements to Improve Tomato Plant Health

BEN LEACOX, AGRICULTURAL TECHNICIAN, UCCE, YOLO, SOLANO, SAC
MIKE DAVIS, PLANT PATHOLOGY DEPT, UC DAVIS (RETIRED)
GENE MIYAO, FARM ADVISOR, UCCE, YOLO, SOLANO & SACRAMENTO COUNTIES

University of California Cooperative Extension

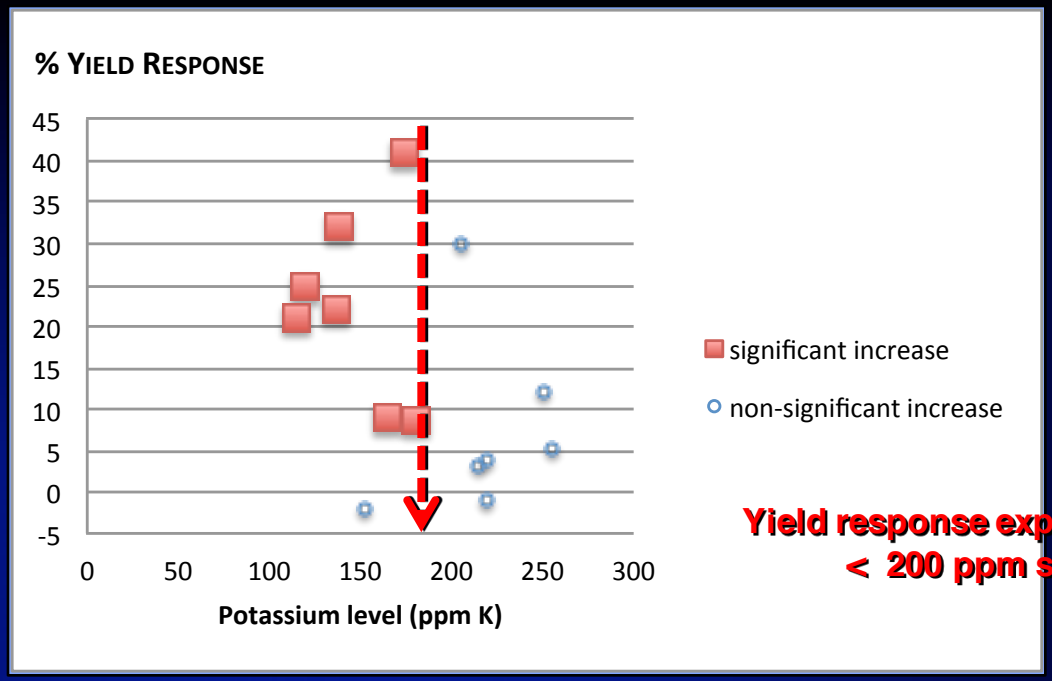
ANR UNIVERSITY of CALIFORNIA

California Tomato Research Institute

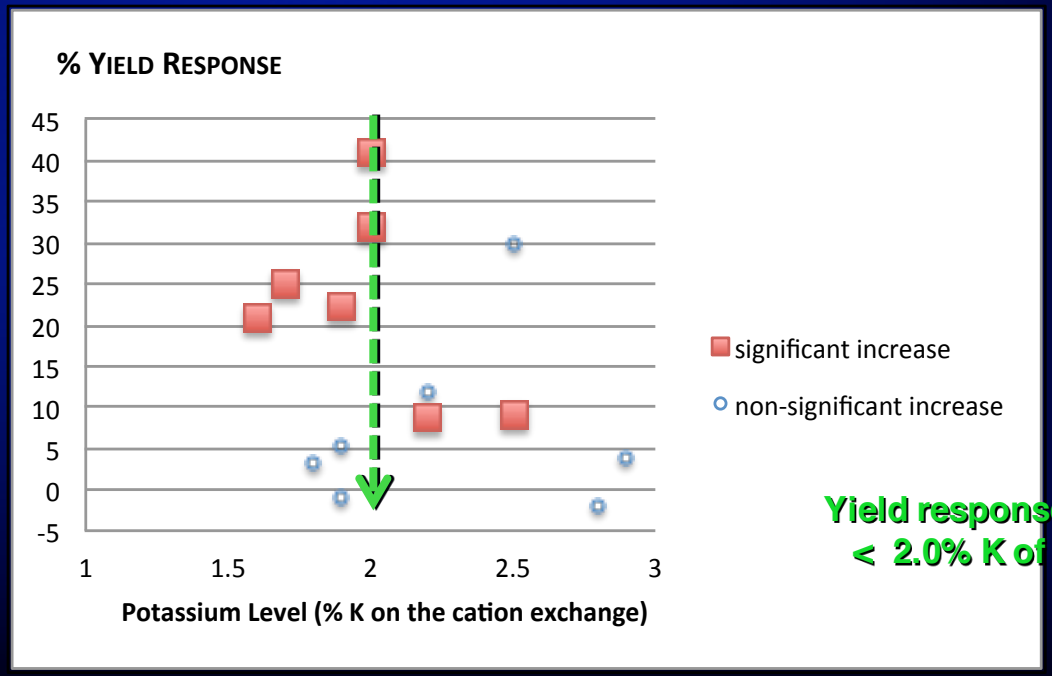
Composted poultry manure applications (supplemental) 2011-2014

soil lab determinations as:

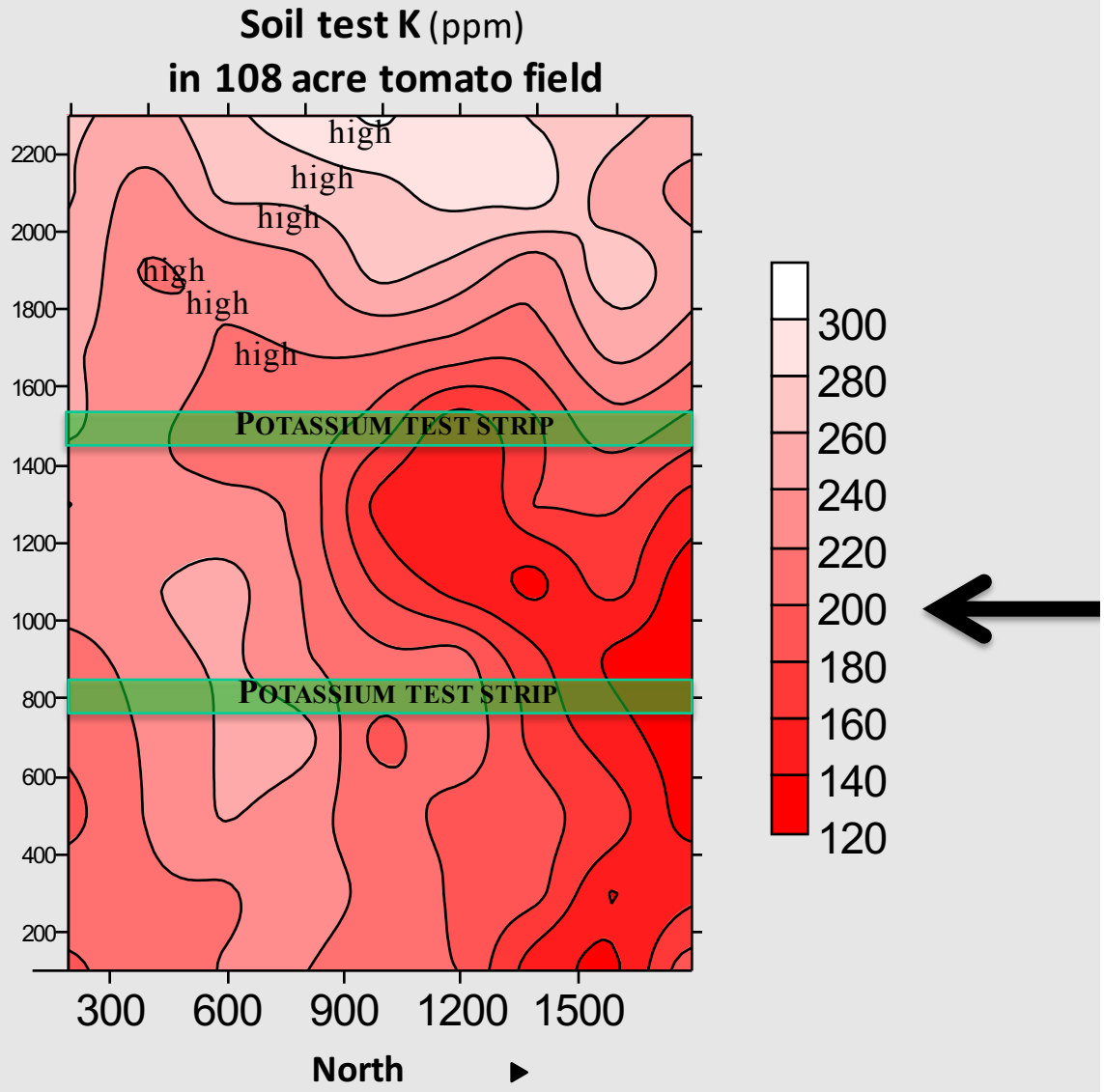
ppm K



% K of cations



Potassium variability (in a Yolo field)



derived from 200 x 200 ft grid samples

Unpublished data, S. Pettygrove, R. Plant, et al. 1997

Premature vine senescence

66 days before harvest

fruit sizing

18 days before harvest

fruit ripening

8 days before harvest

approaching harvest

Year 2011

	Treatment
1	Control
2	Vapam 15 gpa
3	Tenet
4	Vapam + Tenet
5	Quadris + Ridomil
6	Vapam + Quad + Ridomil
7	Serenade Soil
8	Serenade + Quad + Rid
9	Vapam + Serenade
10	Chicken manure
11	Tenet + Serenade
12	SoilGard

Year 2011

	Treatment
1	Control
2	Vapam 15 gpa
3	Tenet
4	Vapam + Tenet
5	Quadris + Ridomil
6	Vapam + Quad + Ridomil
7	Serenade Soil
8	Serenade + Quad + Rid
9	Vapam + Serenade
10	Chicken manure
11	Tenet + Serenade
12	SoilGard

Treatments included:

Chemigations

Metham (biocide)

Fungicides

Biologicals

Trichoderma sp.

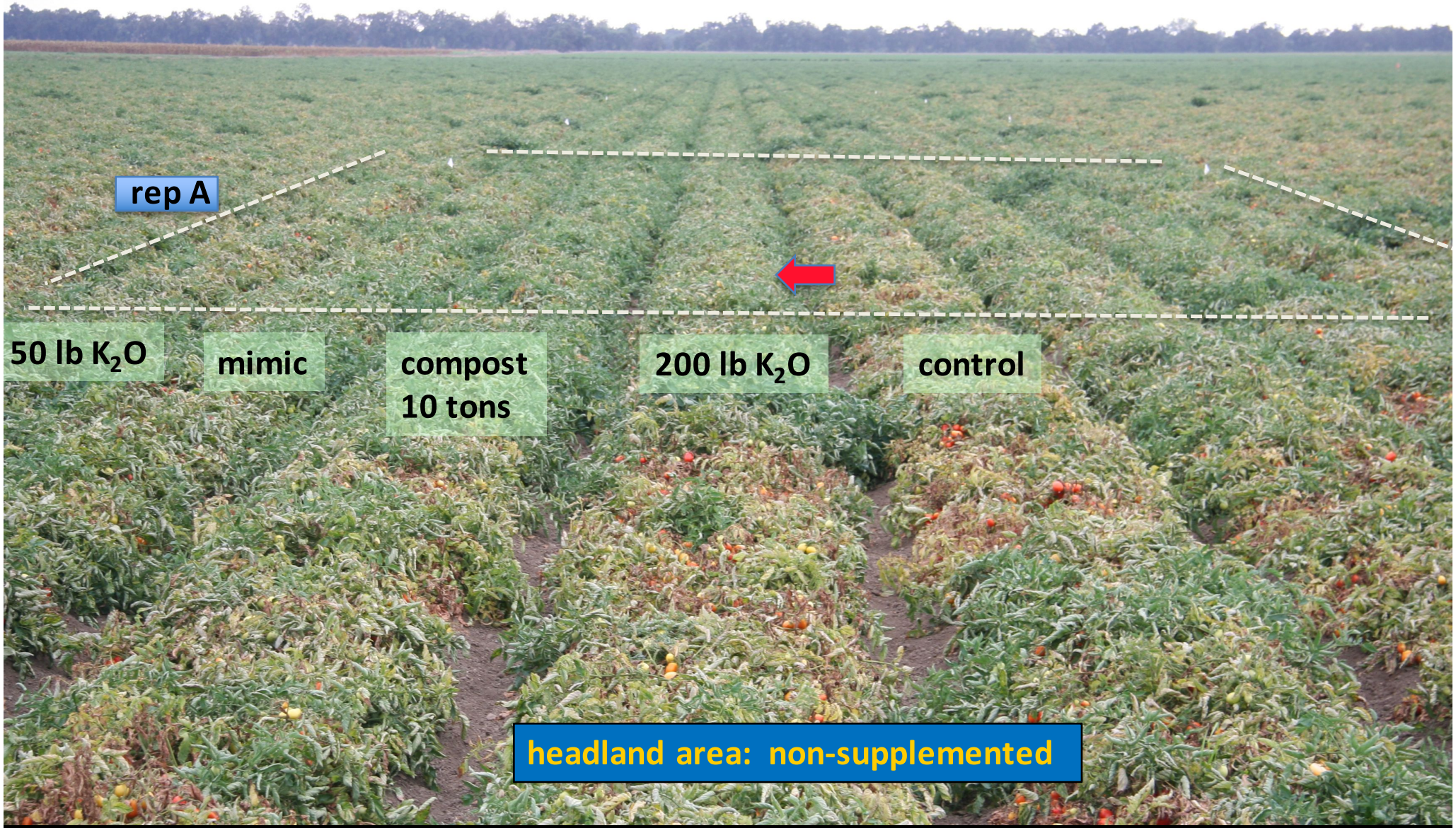
Bacillus subtilis

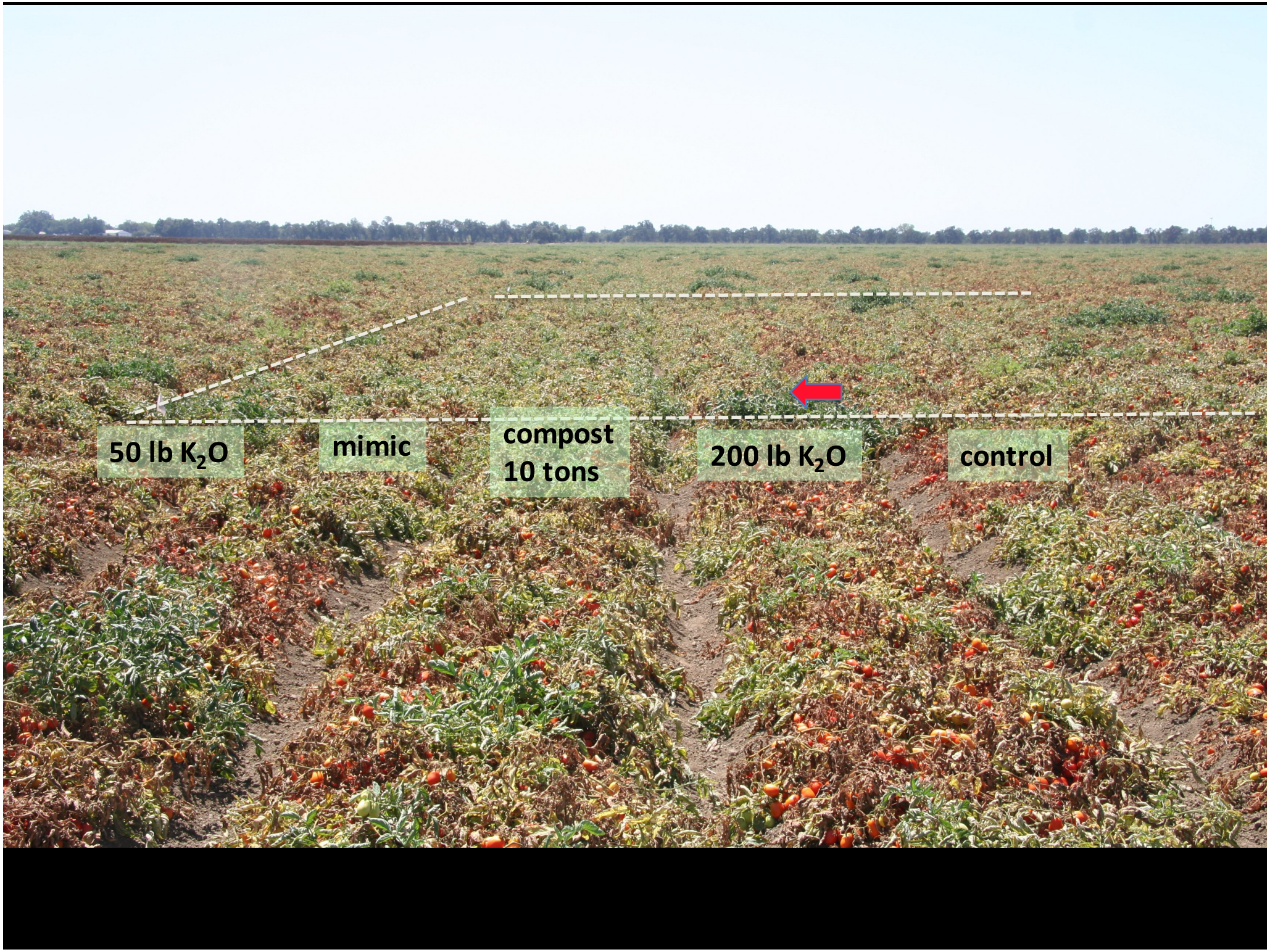
Gliocladium virens

Composted manure- surface applied

J.H. Meek and Sons,

Woodland, 2014




50 lb K_2O
mimic
compost
10 tons
200 lb K_2O
control

J.H. Meek and Sons,
Woodland, 2014

Composted Manure
Poultry

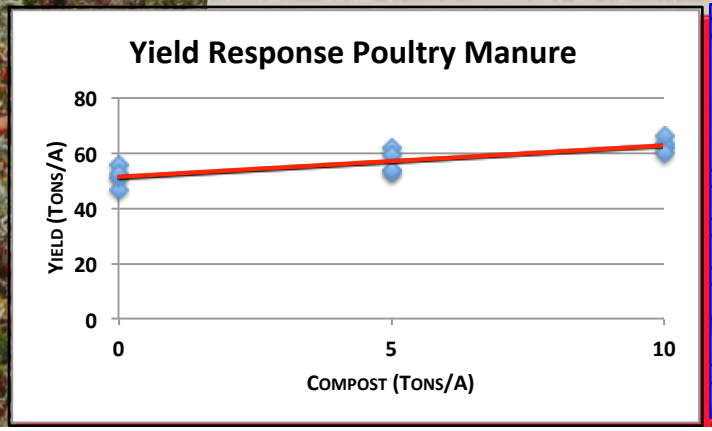
Potassium
Sidedressed KCl

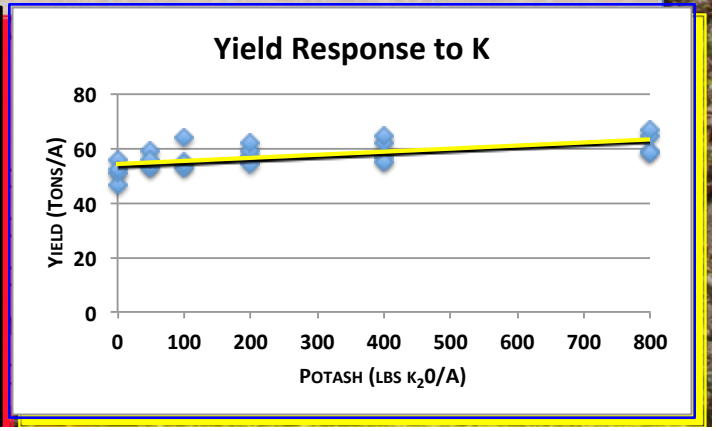
136 ppm K with 1.9% on the cation exchange

	treatment	Yield tons/A		°Brix	% N	full bloom % P	% K
1	control	51.3	e	4.35	4.6	0.38	1.7
2	compost 5 tons	56.8	cd	4.40	4.8	0.40	2.0
3	compost 10 tons	62.6	a	4.63	4.9	0.43	2.3
4	NPK compost mimic	61.7	ab	4.53	4.7	0.49	2.3
5	K20 800 lbs	62.3	a	4.57	4.7	0.36	2.2
6	K20 400 lbs	59.4	abc	4.55	4.7	0.36	2.2
7	K20 200 lbs	57.9	bcd	4.53	4.5	0.37	2.0
8	K20 100 lbs	56.5	cd	4.53	4.5	0.36	1.9
9	K20 50 lbs sidedress	55.1	de	4.35	4.6	0.39	1.9
	LSD @ 5%	3.9		0.2	0.19	0.04	0.20
	% CV	5		3	3	6	7

Class Comparisons:

compost rate (probability):	✔		✔		
linear response	0.01		0.01	0.00	0.01	0.00
quadratic	NS		NS	NS	NS	NS
Potassium rate:	✔		✔		
linear response	0.00		0.02	0.06	NS	0.00





From small-scale, test plot results ...

... to grower adoption

Challenges:

High Cost$ (w/ short supply)

Slow operation (high volume)

Specialized equipment

- Compost superior beyond NPK value
- KCl alone similar results to NPK compost 'mimic'
- Tissue K levels raised

Processing tomato yield (tons/acre)

	Treatment	# sites all 7 sites		only significant 4 sites		remove 1 3 sites	LSD 1%	LSD 5%
1	Compost	**56.9**	a	**67.9**	a	**67.3**	a	a
2	compost 'mimic'	54.1	b	64.3	b	64.6	ab	b
3	Potassium KCl	53.8	b	63.5	b	62.0	b	b
4	Control	50.2	c	58.6	c	57.0	c	c
	LSD 1%	1.99		2.75		3.46		
	CV	5		5		5		
	interaction prob	0.000		0.001		0.017		

Tissue K levels from whole leaves (% K) @ full bloom

	Treatment	# sites all 7 sites		only significant 4 sites		remove 1 3 sites	LSD 1%
1	Compost	2.470	a	2.547	a	2.575	a
2	compost 'mimic'	2.349	a	2.513	a	2.487	ab
3	Potassium KCl	2.366	a	2.406	a	2.337	bc
4	Control	2.234	b	2.226	b	2.191	c
	LSD 1%	0.128		0.176		0.222	
	CV	8		8		8	

- Compost superior beyond NPK value
- KCl alone similar results to NPK compost ‘mimic’

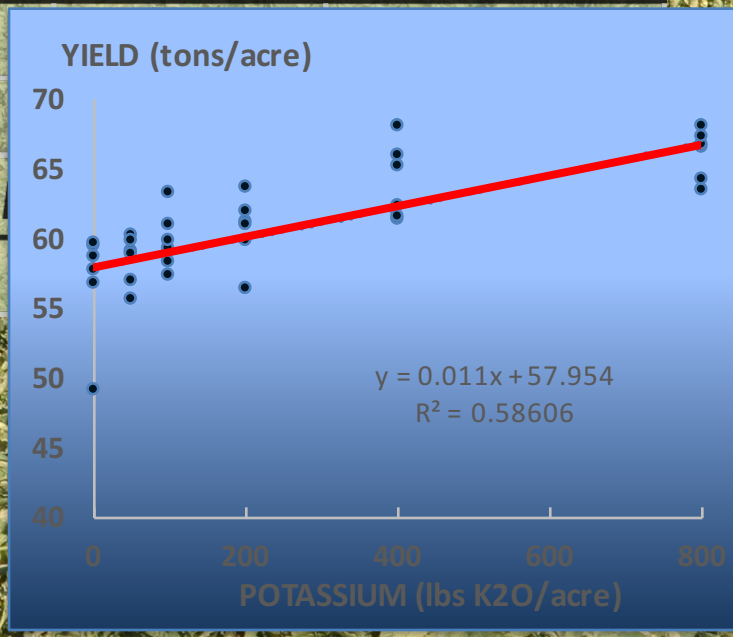
Processing tomato yield (tons/acre)

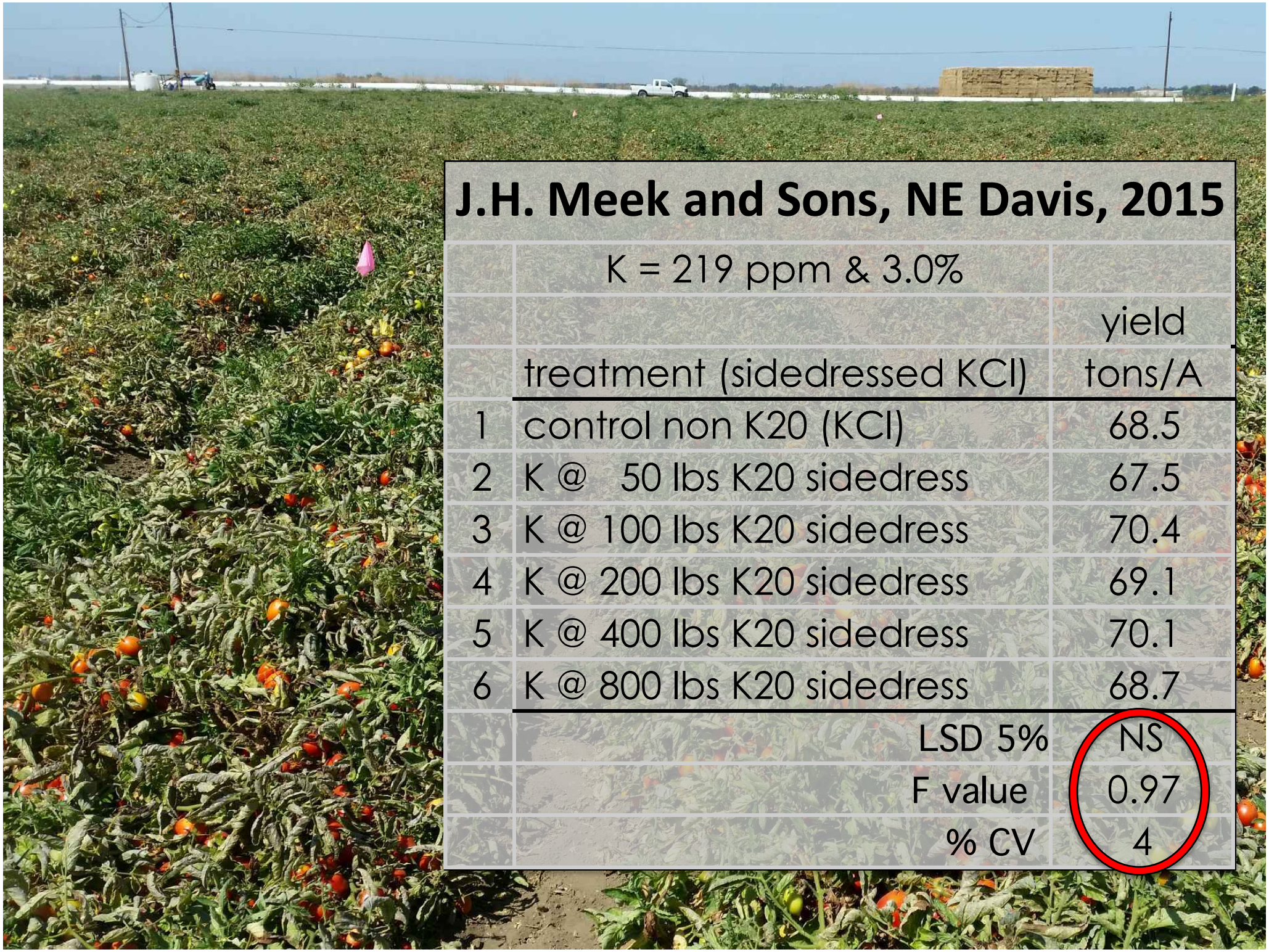
	Treatment	# sites all 7 sites		added material cost	gross marginal income/acre
1	Compost	**56.9**	a	$500	**$36.00**
2	compost 'mimic'	54.1	b	$790	**($478.00)**
3	Potassium KCl	53.8	b	$100	**$188.00**
4	Control	50.2	c	0	**$0.00**
	LSD 1%	1.99			
	CV	5			
	interaction prob	0.000			

Materials			$/unit	$/acre
compost	10 tons		$50	$500
mimic	varies		$790	$790
KCl	200 lbs		$0.50	$100

Barrios Farms, Zamora area, 2015

	(144 to 168 ppm K @ 1.9%)		leaf tissue @ bloom	11 days preharvest visual
	TREATMENT	yield tons/A	% K	greenness
1	control non K20 (KCl)	56.7	1.18	7.5
2	K @ 50 lbs K20 sidedress	58.2	1.21	7.5
3	K @ 100 lbs K20 sidedress	59.6	1.26	8.0
4	K @ 200 lbs K20 sidedress	60.5	1.43	8.0
5	K @ 400 lbs K20 sidedress	63.9	1.60	9.0
6	K @ 800 lbs K20 sidedress	65.9	1.89	9.2
	LSD 5%	2.9		
	% CV	4		
	GROUP CONTRASTS (	*proba*		
	rate: linear response	0.00		





J.H. Meek and Sons, NE Davis, 2015

	K = 219 ppm & 3.0%	
		yield
	treatment (sidedressed KCl)	tons/A
1	control non K20 (KCl)	68.5
2	K @ 50 lbs K20 sidedress	67.5
3	K @ 100 lbs K20 sidedress	70.4
4	K @ 200 lbs K20 sidedress	69.1
5	K @ 400 lbs K20 sidedress	70.1
6	K @ 800 lbs K20 sidedress	68.7
	LSD 5%	NS
	F value	0.97
	% CV	4

Fusarium wilt, race 3

Muller, Woodland, 2015

K soil: 165 ppm and 2.2%

	treatment	yield ton/A	% sun burn	F. wilt % plants	4-Aug green rating	% K
1	non treated	50.3	11.5	17	6.3	2.4
2	compost 5 tons trench	40.4	20.8	21	2.8	2.8
3	compost 10 tons trench	42.3	19.9	20	2.8	2.6
4	compost 5 tons surface shallow	45.7	18.8	21	3.8	2.5
5	compost 10 tons surface shallow	44.5	19.4	23	3.3	2.5
6	NPK mimic 10 tons compost surface	48.8	15.6	18	5.3	2.6
7	NPK mimic at 10 tons compost deep	53.3	12.1	16	6.3	2.5
8	K @ 50 lbs K20 sidedress	51.5	12.8	14	6.8	2.3
9	K @ 100 lbs K20 sidedress	55.2	10.4	16	7.0	2.5
10	K @ 200 lbs K20 sidedress	54.2	13.1	13	6.8	2.6
11	K @ 400 lbs K20 sidedress	57.5	9.7	13	7.0	2.4
12	K @ 800 lbs K20 sidedress	47.3	13.8	18	4.8	2.5
	LSD 5%	NS	NS	NS	2.7	0.25
	% CV	15	45	26	36	7
	GROUP CONTRASTS					
A	control vs	50.3	11.5	16.8	6.3	2.35
	any compost	43.2	19.7	21.0	3.1	2.60
	Probability	0.10	0.03	0.11	0.01	0.02

Barrios Farms, Yolo (town) area, 2015

	(195 ppm K @ 2.8%)	# plants	14-Apr	May 14 % vine	yield
	treatment	replant	vigor	size	tons/A
1	non treated	1.8	9.5	100	54.8
2	compost 5 tons trench	1.5	9.8	100	55.4
3	compost 10 tons trench	1.8	10.0	100	56.8
4	compost 5 tons surface shallow	0.8	9.5	100	56.1
5	compost 10 tons surface shallow	1.0	10.0	100	57.1
6	NPK mimic 10 tons compost surface	2.8	9.0	100	55.0
7	NPK mimic at 10 tons compost deep	3.8	7.3	96	50.3
8	K @ 50 lbs K20 sidedress	2.0	9.3	100	55.1
9	K @ 100 lbs K20 sidedress	1.8	8.5	100	53.7
10	K @ 200 lbs K20 sidedress	1.0	8.0	100	53.4
11	K @ 400 lbs K20 sidedress	4.3	6.8	91	50.2
12	K @ 800 lbs K20 sidedress	35.8	6.0	81	45.7
	LSD 5%	8.1	1.2	5.3	4.5
	F value	12.1	10.9	9.6	4.6
	% CV	116	9	4	6

KCl >>> salt toxicity at high rates


~6 lbs. K2O per ton:
tomato fruit removal

Composted poultry manure applications (supplemental) 2011-2014

soil lab determinations as:

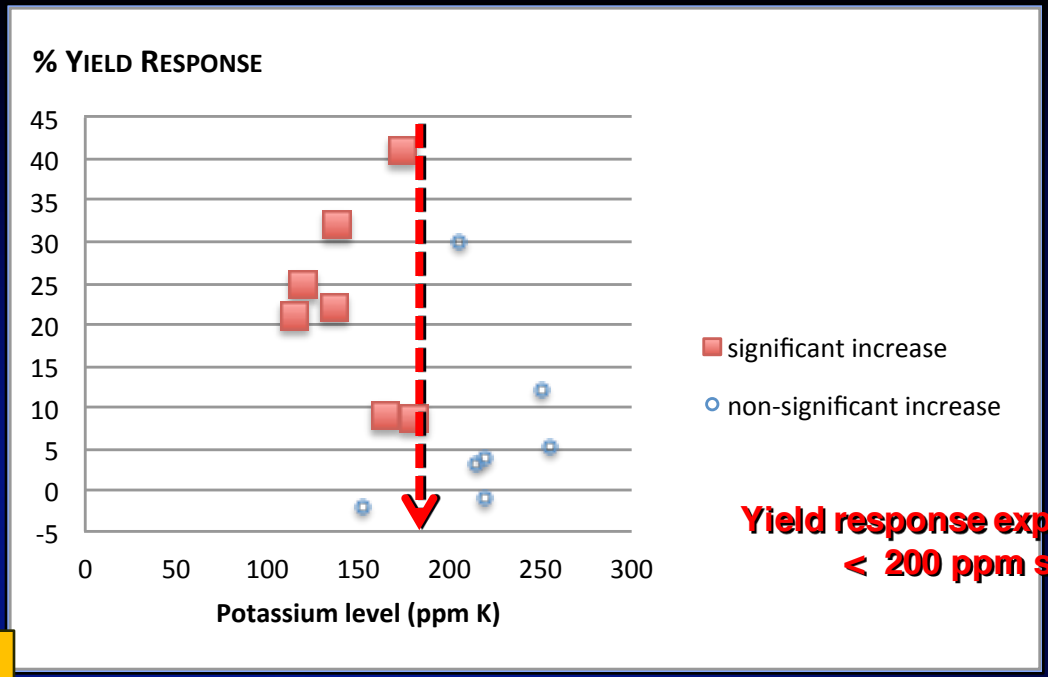
ppm K

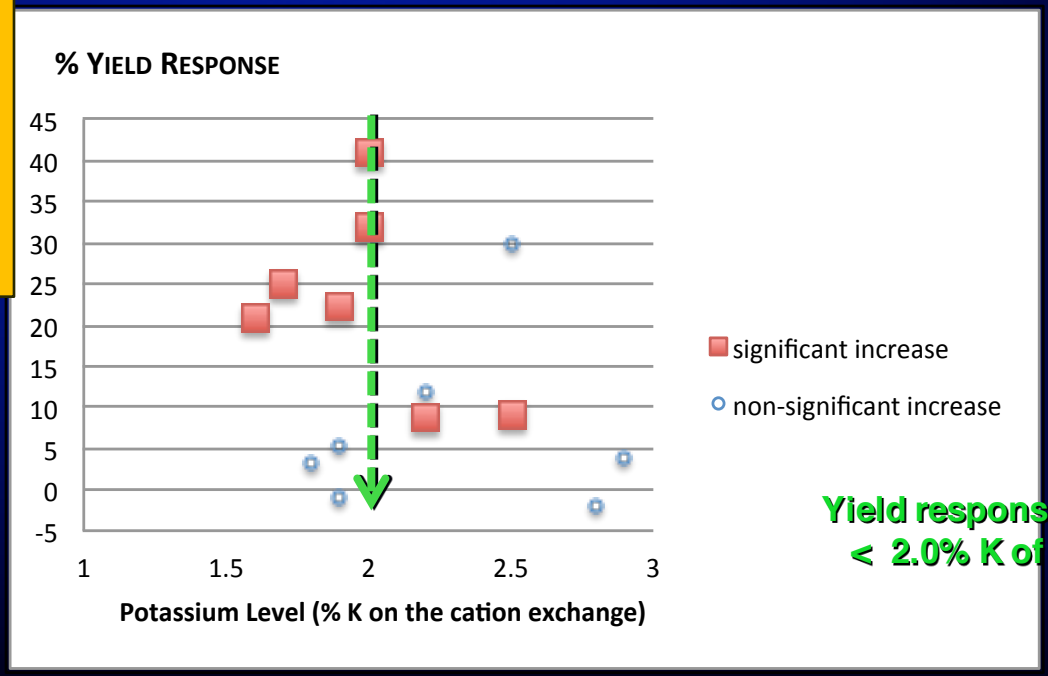
Response expected @

< 200 ppm K

< 2.0% K on CEC (secondarily)

% K of cations





Year 2015 Cooperators:

Sam & Steve Meek
Colin, Frank & Louie Muller
Tom & Bryan Barrios

Research collaborators:

Johan Leveau
Nilesh Maharaj
Mark Kochi
Karina Perez
Hung Doan & many others

California Tomato Research Institute

KCl fertilizer donated by
Agriform & Tremont Group
Sprayer equipment
Growers Ag Service

Compost: UCD Russell Ranch