Influence of Grafting on Tomato Yield : 2016 Progress Report on Fresh and Processing types

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Why graft tomatoes?

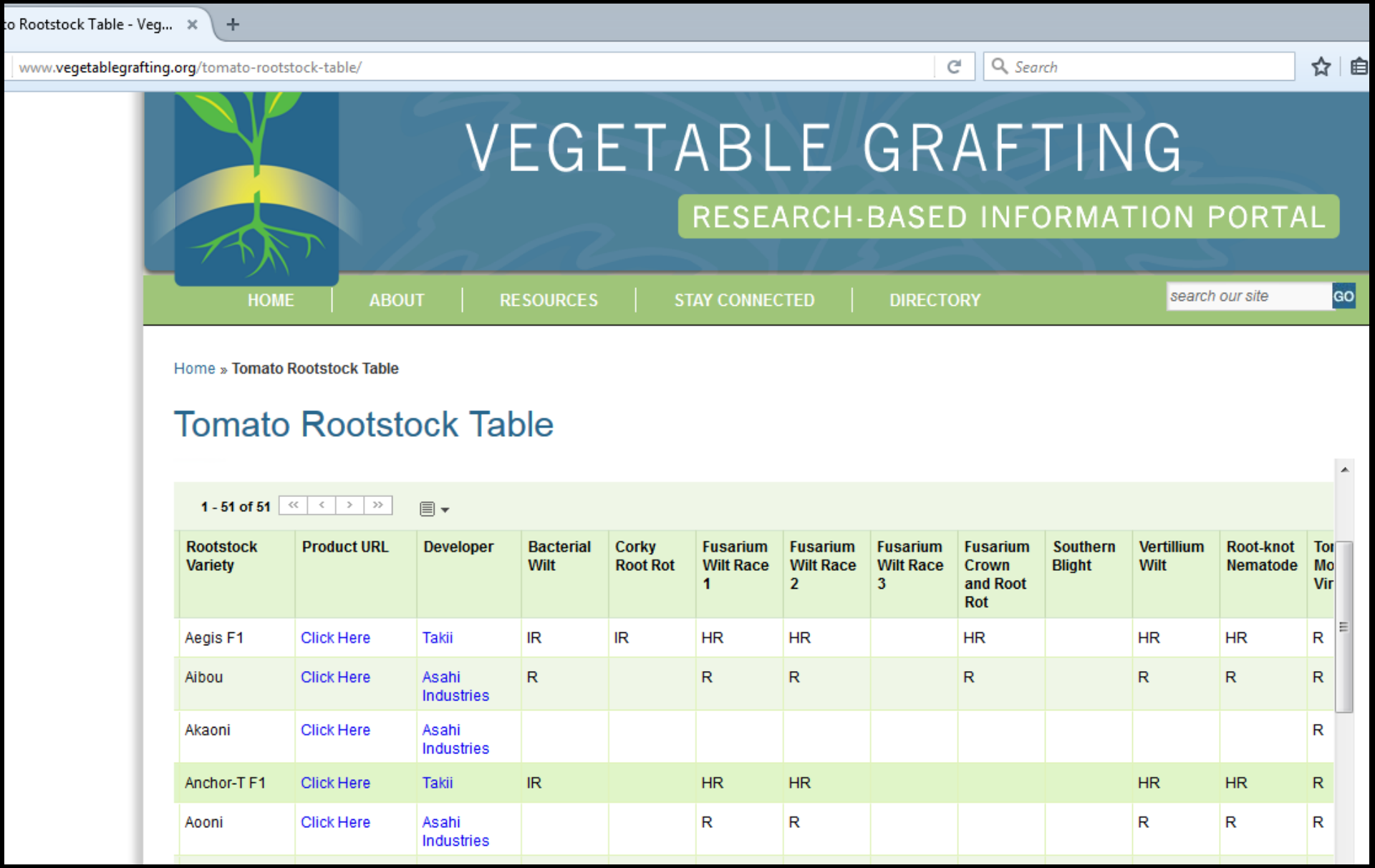
- Increase in vigor, fruit size and yield
- Combine features of two varieties

Scion: Desirable fruit traits

Rootstock:

- Increased vigor
- Resistance and/or tolerance to soil-borne disease
- Increased stress tolerance

Source: www.mightymato.com (Plug Connection)



Rootstock Variety	Product URL	Developer	Bacterial Wilt	Corky Root Rot	Fusarium Wilt Race 1	Fusarium Wilt Race 2	Fusarium Wilt Race 3	Fusarium Crown and Root Rot	Southern Blight	Vertillium Wilt	Root-knot Nematode	Tor Mo Vir
Aegis F1	Click Here	Takii	IR	IR	HR	HR		HR		HR	HR	R
Aibou	Click Here	Asahi Industries	R		R	R		R		R	R	R
Akaoni	Click Here	Asahi Industries										R
Anchor-T F1	Click Here	Takii	IR		HR	HR				HR	HR	R
Aooni	Click Here	Asahi Industries			R	R				R	R	R

www.vegetablegrafting.org

Premature vine senescence

66 days before harvest

fruit sizing

18 days before harvest

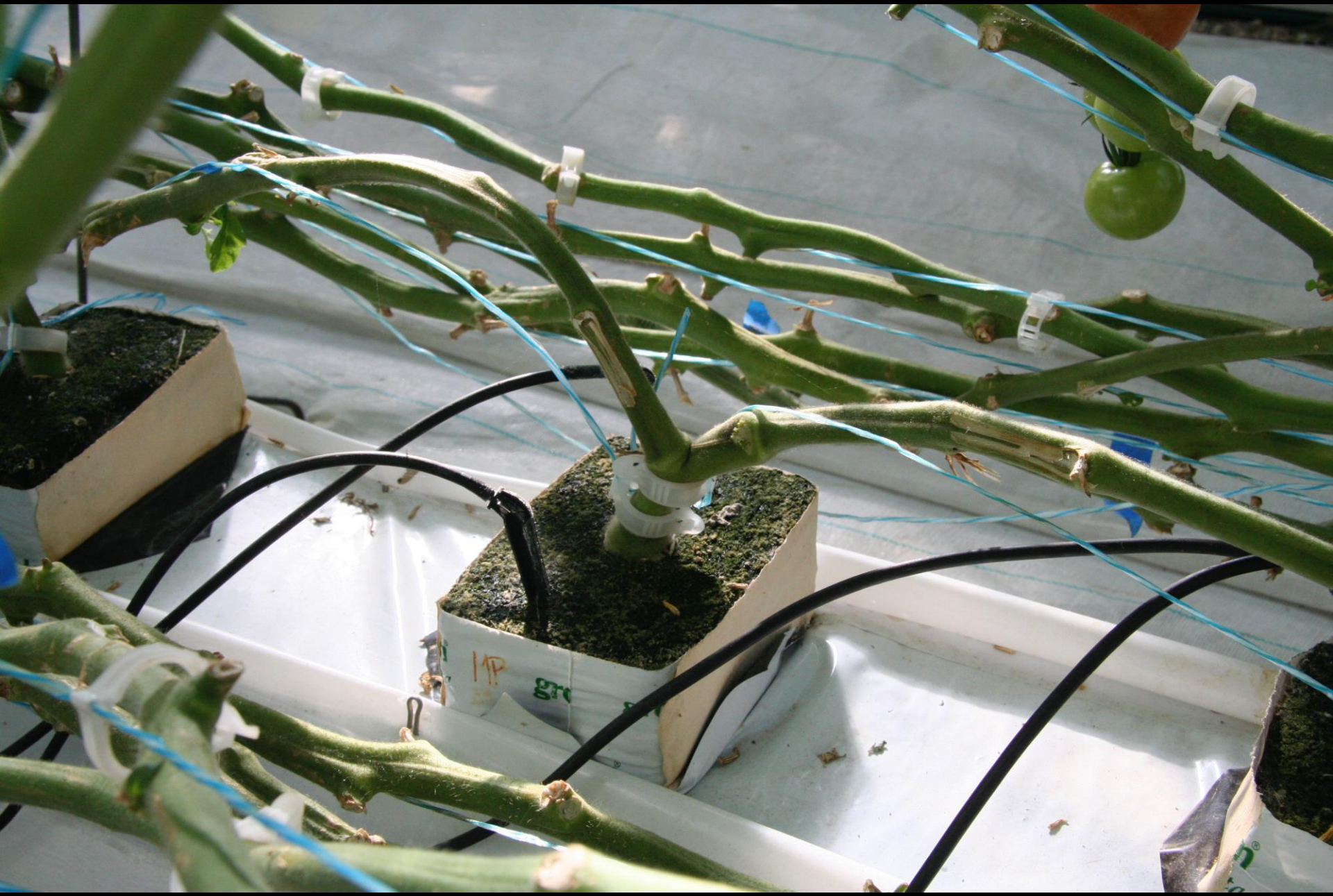
fruit ripening

8 days before harvest

approaching harvest

Gene Miyao, UCCE Yolo, Solano & Sacramento counties


Vine length: 30+ feet
Production: 8 to 10 months



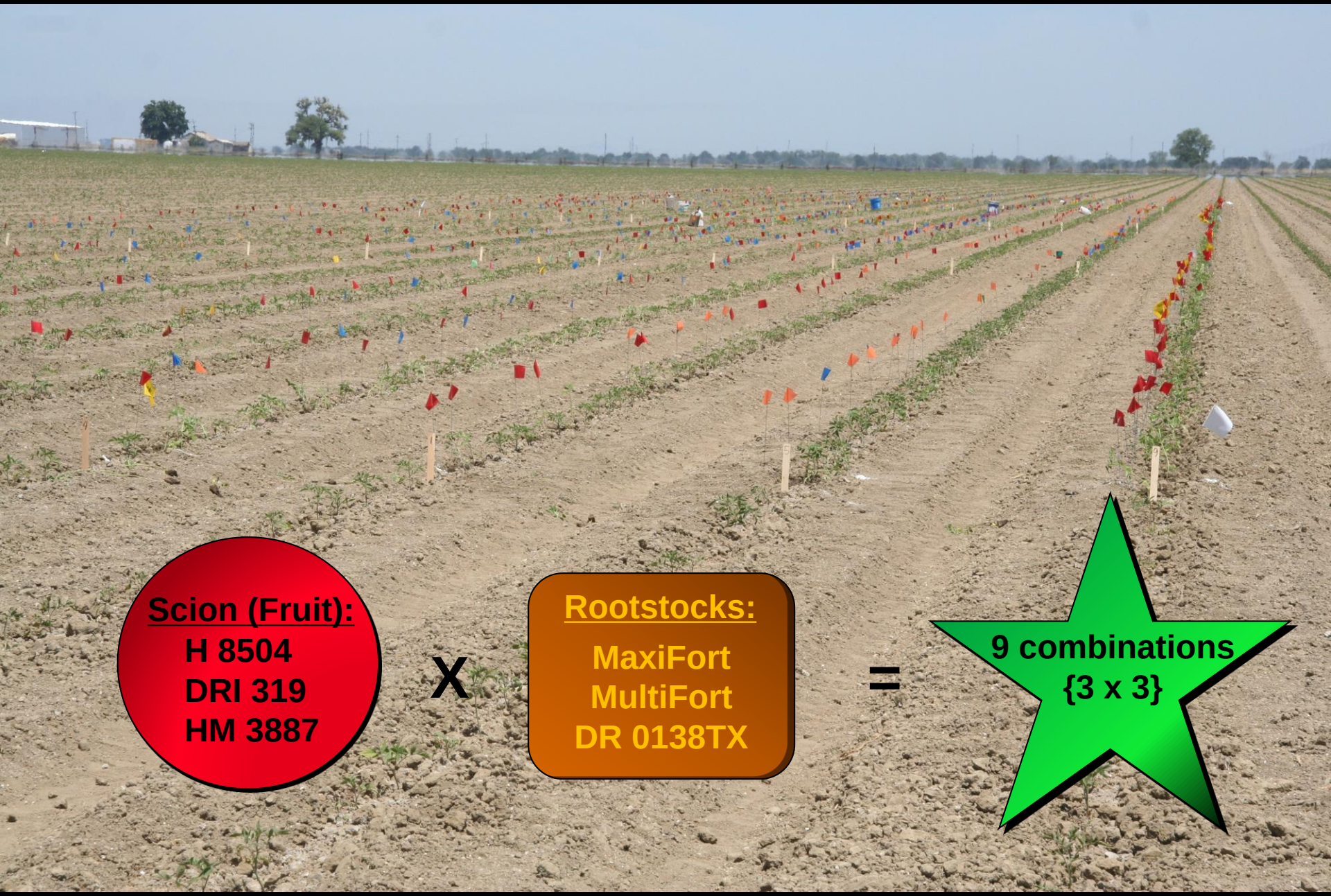
1) Sterile trays & sterile media seeded 5 weeks before grafting

3) Grafting clips positioned half-way on rootstock stems

2) Both rootstock & scion plant stems clipped at ~45º angle

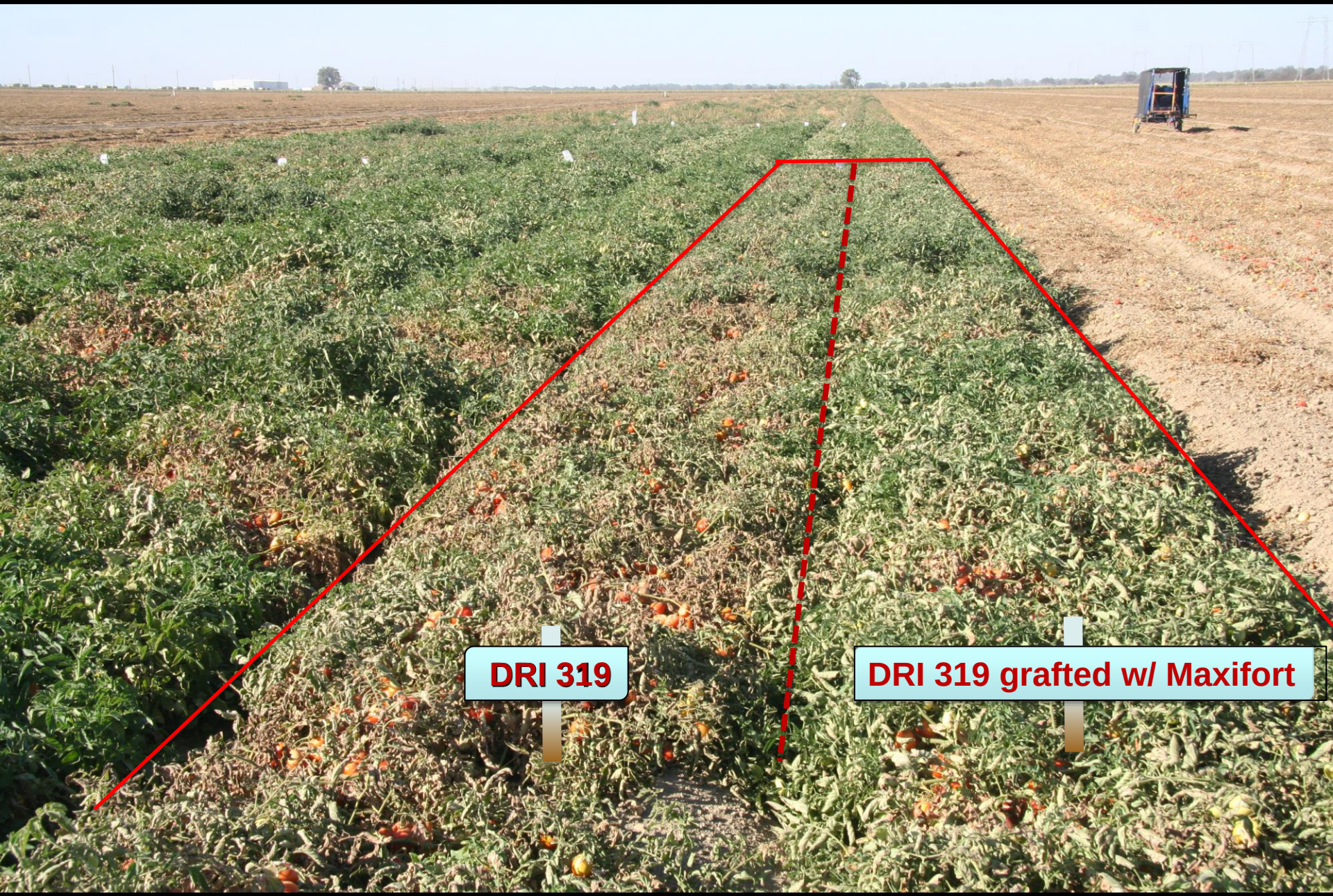
4) Scion stems align to rootstock angle with attention to match stem diameter


1
2
3



Gene Miyao, UCCE Yolo, Solano & Sacramento counties

Rootstock: vigor and growth without grafted scion in place (~6’ tall x 15’ wide)



Gene Miyao, UCCE Yolo, Solano & Sacramento counties

Grafted rootstocks for processing tomatoes, Harlan Family, Woodland, 2016

	Rootstock	Scion	Marketable yield Tons/A		non-grafted yield (%)
1	-	H 8504	48.6	c	-
2	MaxiFort	H 8504	52.1	bc	107
3	MultiFort	H 8504	52.3	bc	108
4	DRO 138TX	H 8504	56.0	b	115
5	-	DRI 319	54.9	b	-
6	MaxiFort	DRI 319	62.4	a	114
7	MultiFort	DRI 319	62.6	a	114
8	DRO 138TX	DRI 319	63.3	a	115
9	-	HM 3887	62.1	a	-
10	MaxiFort	HM 3887	63.5	a	102
11	MultiFort	HM 3887**	65.5	a	106
12	DRO 138TX	HM 3887	66.0	a	106
	average		59.1		
	LSD 5%		6.0		
	%CV		7		

CLASS COMPARISONS:

Grafted vs	60.4		110
non grafted	55.2		100
Probability	0.001		

Gene Miyao, UCCE Yolo, Solano & Sacramento counties

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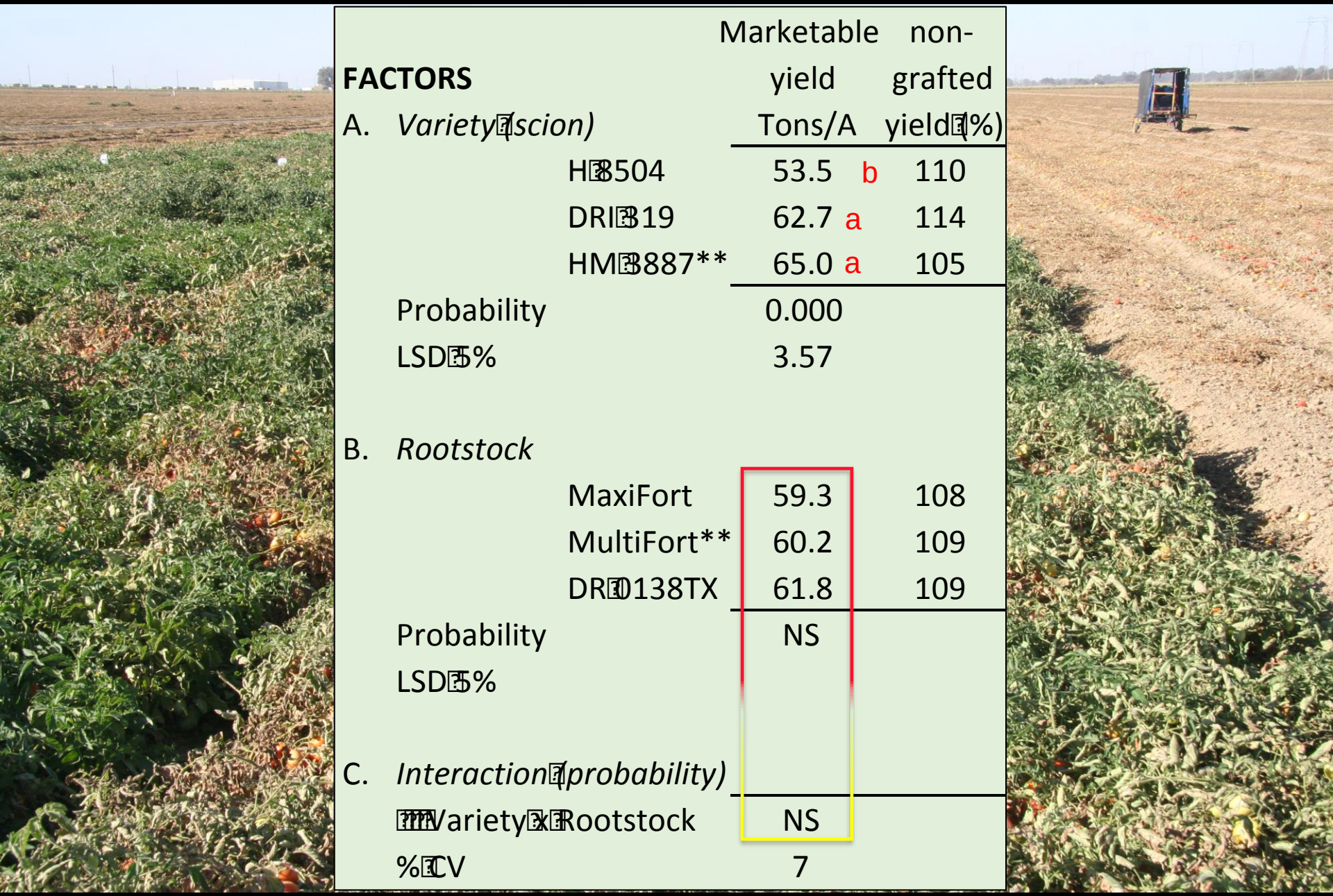

FACTORS		Marketable yield Tons/A		non-grafted yield (%)
A. *Variety (scion)*				
	H 8504	53.5	b	110
	DRI 319	62.7	a	114
	HM 887**	65.0	a	105
Probability		0.000		
LSD 5%		3.57		
B. *Rootstock*				
	MaxiFort	59.3		108
	MultiFort**	60.2		109
	DR 0138TX	61.8		109
Probability		NS		
LSD 5%				
C. *Interaction (probability)*				
Variety x Rootstock		NS		
% CV		7		

Gene Miyao, UCCE Yolo, Solano & Sacramento counties

Evaluation of grafting for the mature green tomato production system

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California Department of Food & Agriculture
Specialty Crop Block Grant 14027

California Department of Pesticide Regulation
Pest Management Research Grant 16–PML–R004

Initial literature survey of field trials

- 265 results (place, time, rootstock/scion pair)
- Experimental success measured as ratio:

  yield(grafted)/yield(non-grafted scion variety)

- Grafted plants: avg. ratio of 1.67 (n=234)
- Ratio distribution of the grafted plants:

Ratio range	Number
0.45-0.99	59
1.00-1.25	67
1.26-2.00	58
> 2.00	51

Yield ratios of hybrid tomato rootstocks in the survey

Rootstock	Ratio average	No. comparisons	Source
hybrid, Beaufort	1.67	8	DeRuiter Seeds
hybrid, BHN1054	2.36	6	BHN Seeds
hybrid, BHN998	2.22	5	BHN Seeds
hybrid, Big Power	2.59	2	Rijk Zwaan
hybrid, Cheong Gang	3.06	2	Seminis
hybrid, CRA 66	1.66	2	Asahi Industries
hybrid, Dai Honmei	2.26	6	Asahi Industries
hybrid, DR-BWR-NCS2	3.96	2	DeRuiter Seeds
hybrid, Hawaii 7996	1.95	15	Univ. Hawaii
hybrid, He-Man	1.28	3	Syngenta Seeds
hybrid, Jjak Kkung	2.16	2	Seminis
hybrid, Maxifort	1.25	16	DeRuiter Seeds
hybrid, Multifort	1.22	7	DeRuiter Seeds
hybrid, Robusta	0.91	4	Bruinsma Seeds
hybrid, RST-04-105	1.85	6	DP Seeds
hybrid, RST-04-106-T	1.61	4	DP Seeds
hybrid, Survivor	1.00	6	Takii Seeds
hybrid, TMZQ702	1.70	2	America

Grieneisen and Zhang, UC Davis

2016 fresh market field trials: Vernalis, San Joaquin Co. and Le Grand, Merced Co.

Bed configuration: 60” beds, 16” -20” spacing in row

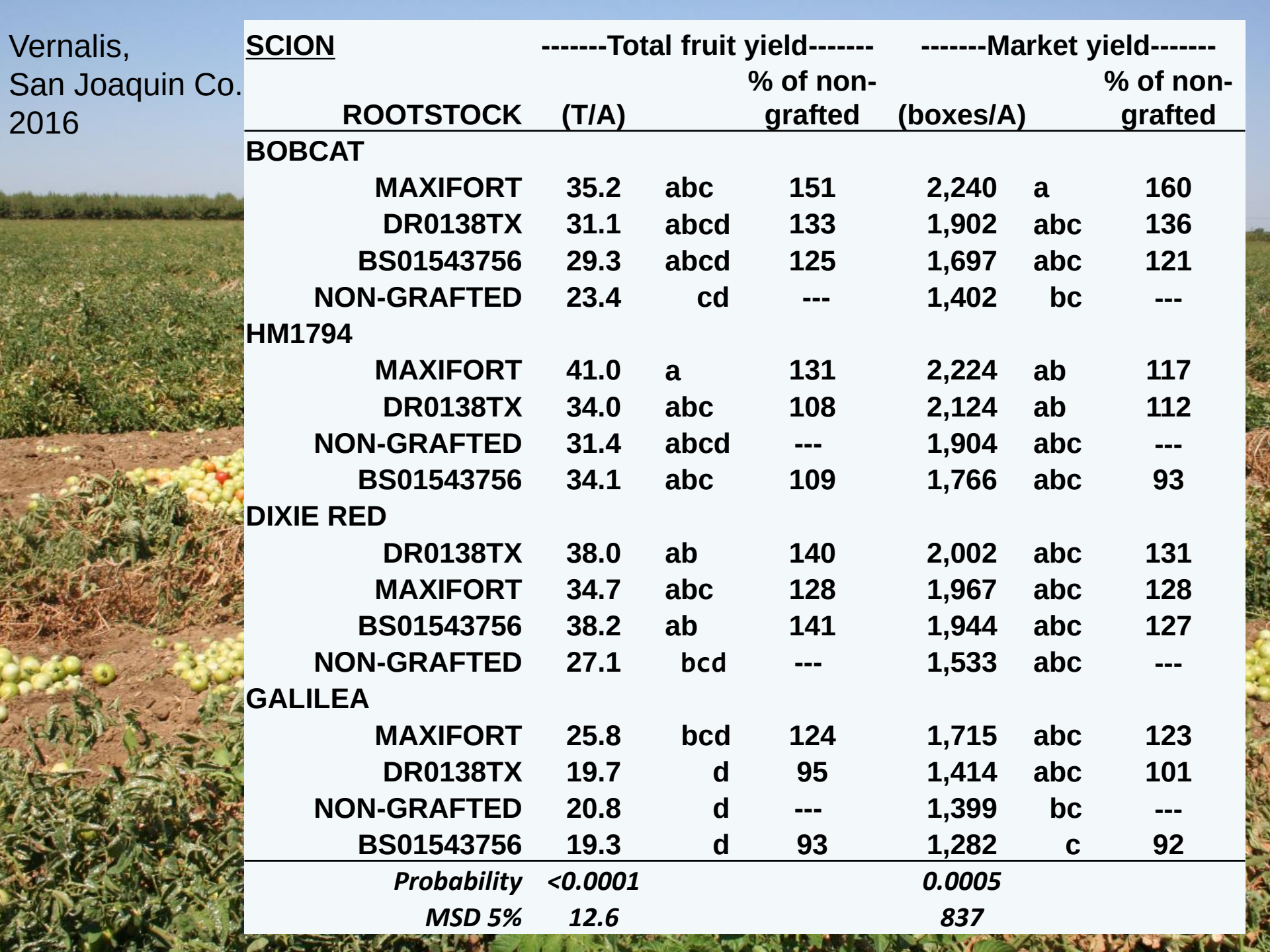
Replicates: four 40-ft plots

Fruit from 10-ft section of each plot sized, culled & weighed to get total fruit biomass & marketable yield by size category

Treatments (scion/rootstock combinations)

- Scions: Bobcat, HM1794, Dixie Red, Galilea (Roma)
- Rootstocks: Maxifort, DR0138TX, BS01543756
- All combinations of the above, plus non-grafted controls

Vernalis,
San Joaquin Co.
2016



SCION / ROOTSTOCK	-------Total fruit yield------- (T/A)		% of non-grafted	-------Market yield------- (boxes/A)		% of non-grafted
BOBCAT						
MAXIFORT	35.2	abc	151	2,240	a	160
DR0138TX	31.1	abcd	133	1,902	abc	136
BS01543756	29.3	abcd	125	1,697	abc	121
NON-GRAFTED	23.4	cd	---	1,402	bc	---
HM1794						
MAXIFORT	41.0	a	131	2,224	ab	117
DR0138TX	34.0	abc	108	2,124	ab	112
NON-GRAFTED	31.4	abcd	---	1,904	abc	---
BS01543756	34.1	abc	109	1,766	abc	93
DIXIE RED						
DR0138TX	38.0	ab	140	2,002	abc	131
MAXIFORT	34.7	abc	128	1,967	abc	128
BS01543756	38.2	ab	141	1,944	abc	127
NON-GRAFTED	27.1	bcd	---	1,533	abc	---
GALILEA						
MAXIFORT	25.8	bcd	124	1,715	abc	123
DR0138TX	19.7	d	95	1,414	abc	101
NON-GRAFTED	20.8	d	---	1,399	bc	---
BS01543756	19.3	d	93	1,282	c	92
Probability	*<0.0001*			*0.0005*		
MSD 5%	*12.6*			*837*		

Vernalis,
San Joaquin Co.
2016

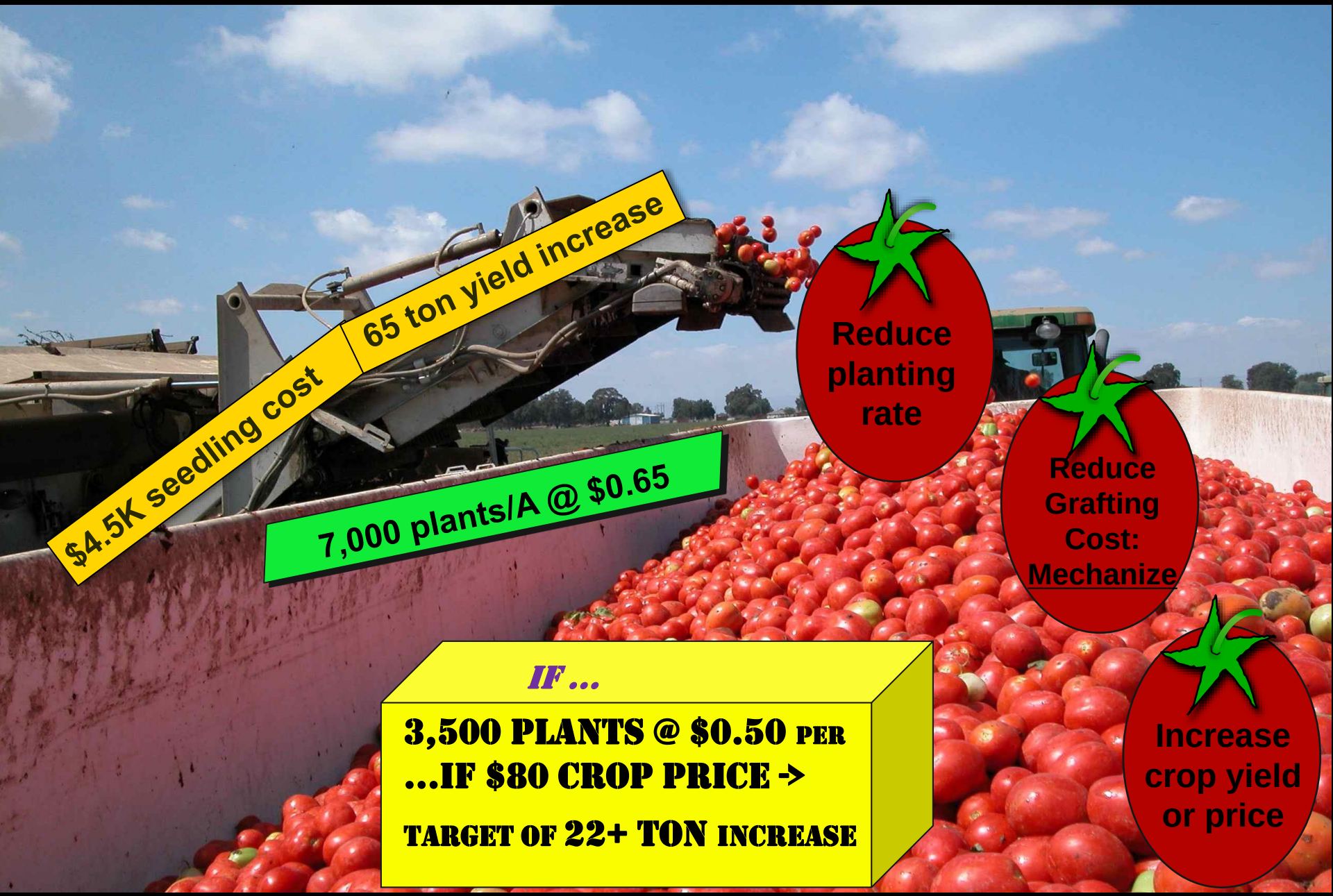
ROOTSTOCKS	---Total fruit yield--- (T/A)		% of non-grafted	-----Market yield----- (boxes/A)		% of non-grafted
MAXIFORT	34.2	a	133	2,036	a	131
DR0138TX	30.7	a	119	1,861	ab	119
BS01543756	30.2	ab	118	1,672	b	107
NON-GRAFTED	25.7	b	---	1,560	b	---
MSD 5%	*4.6*			*308*		
Rootstock effect probability	*0.0002*			*0.0008*		
CONTRAST:						
GRAFTED VS.	31.7		123	1,856		119
NON-GRAFTED	25.7			1,560		
Contrast probability	*0.0001*			*0.0029*		

Le Grand,
Merced Co.
2016

SCION	ROOTSTOCK	-Total fruit yield- (T/A)		---Market yield--- (boxes/A)	
BOBCAT					
	BS01543756	52.5	ab	3,206	abcd
	DR0138TX	48.2	ab	2,655	abcd
	NON-GRAFTED	46.1	ab	2,687	abcd
	MAXIFORT	43.4	ab	2,512	bcd
HM1794					
	BS01543756	60.5	ab	3,671	ab
	NON-GRAFTED	58.3	ab	3,428	abc
	MAXIFORT	47.1	ab	2,893	abcd
	DR0138TX	45.4	ab	2,615	bcd
DIXIE RED					
	NON-GRAFTED	66.4	a	3,864	a
	DR0138TX	62.7	ab	3,569	abc
	BS01543756	60.2	ab	3,675	ab
	MAXIFORT	36.9	b	2,158	cd
GALILEA					
	BS01543756	48.4	ab	2,525	bcd
	MAXIFORT	46.6	ab	2,284	cd
	NON-GRAFTED	43.4	ab	2,516	bcd
	DR0138TX	40.9	b	2,099	d
	Probability	*0.001*		*< 0.0001*	
	CV %	*17.6*		*16.2*	

Some Challenges

- High establishment costs > $0.65 each??
- No rootstocks with resistance to:
  Fusarium wilt race 3 or
  Verticillium wilt race 2
- Location of graft union relative to soil surface
- Variability between trials, rootstock x scion interactions in some trials
- Coordination of rootstocks w/ scion plants- doubling greenhouse space
- Special healing facility; plus time to recover



Processing tomatoes, Gene Miyao

Fresh market tomato partial budget analysis

	Conv.	Grafted $0.60@	Grafted $0.40@
yield box/A	1,300	1,600	1,600
cultural $/A	$1,600	$3,784	$2,912
pick/haul/pack $4/box	$5,200	$6,400	$6,400
Total $/A	$6,800	$10,184	$9,312

	CONVENTIONAL		GRAFTED	$0.60@	Net revenue	$0.40@	Net revenue
Box $	Gross $/A	Net $/A	Gross $/A	Net $/A	Difference	Net $/A	difference
$5.00	$6,500	-$300	$8,000	-$2,184	-$1,884	-$1,312	-$1,012
$6.00	$7,800	$1,000	$9,600	-$584	-$1,584	$288	-$712
$7.00	$9,100	$2,300	$11,200	$1,016	-$1,284	$1,888	-$412
$8.00	$10,400	$3,600	$12,800	$2,616	-$984	$3,488	-$112
$9.00	$11,700	$4,900	$14,400	$4,216	-$684	$5,088	$188

Assumptions:
conventional plant density of 5,808 per acre (18" spacing), grafted plant density of 4,356 per acre (24" spacing)
conventional cost of establishment (materials only): plants $31 per thou, seed $43 per thousand = $74 per thousand

2016 Cooperators:

Blake Harlan, Harlan Family Farm, Woodland
Live Oak Farms, Le Grand
Pacific Triple E, Tracy
Matt Cultrera, Vernalis

Seminis Vegetable Seeds
Ag Seeds
Growers Transplanting Inc.
- Josh Chase
- Joan Venegas

Future Trials:

Brenna Aegerter & Scott Stoddard (fresh market) – supported by DPR
Gene Miyao & Brenna Aegerter (processing) – supported by USDA
Margaret Lloyd (heirloom tomatoes) – supported by USDA

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