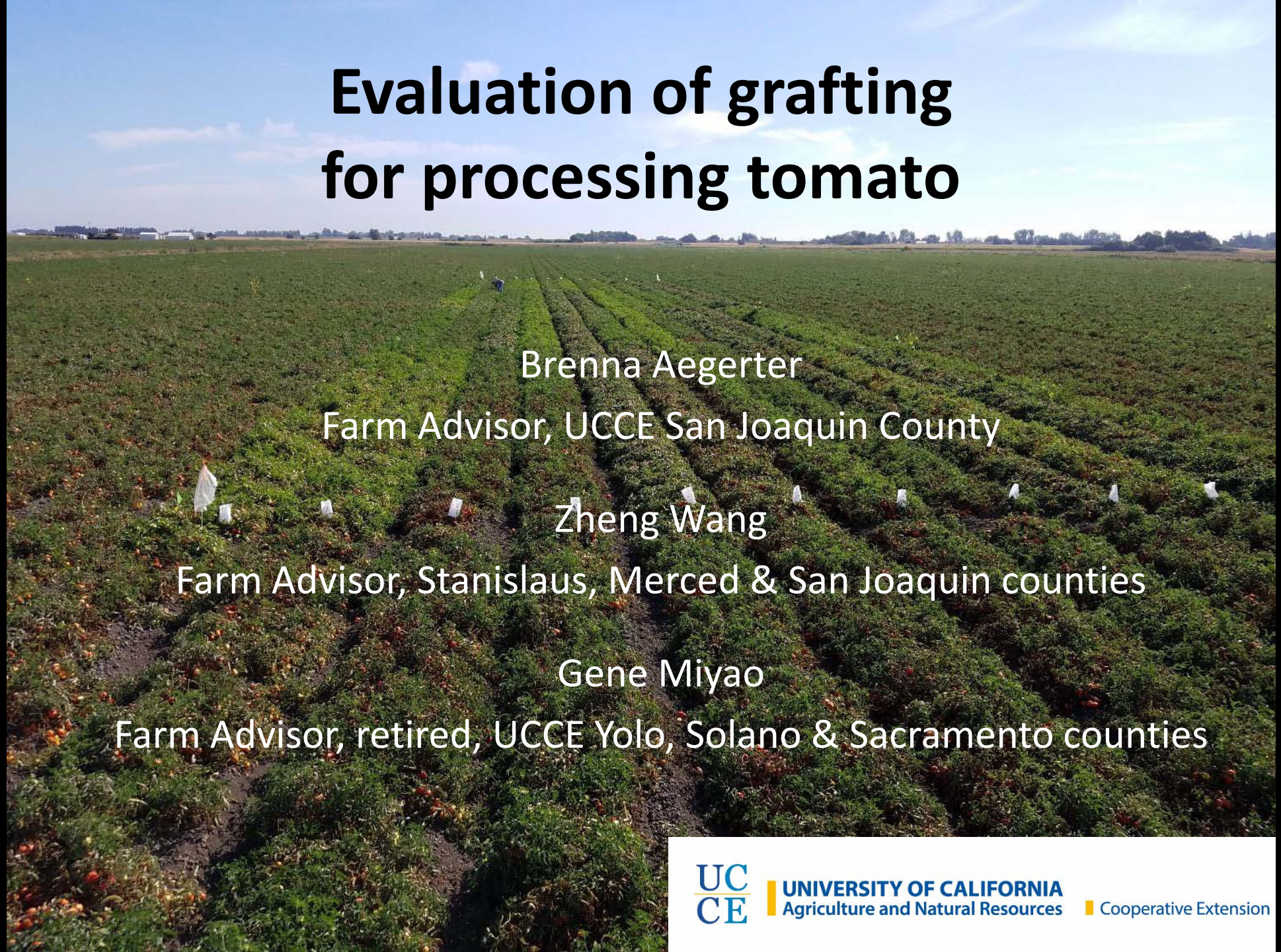
Evaluation of grafting for processing tomato



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Why graft tomatoes?

Combine the features of two cultivars

<u>Scion:</u>
Fruit traits desired by processors, determinant growth habit

<u>Rootstock:</u>

- Resistance and/or tolerance to soil-borne disease and nematodes
- Increased abiotic stress tolerance
- Increased vigor & fruit size, fruiting over a longer period
- Mostly interspecific hybrids between cultivated tomato (*Solanum lycopersicum*) and wild species (typically *S. habrochaites*, less commonly *S. peruvianum* or *S. cheesmaniae*)

Source: www.mightymato.com
(Plug Connection, Vista, CA)

1. Sterile trays & sterile media seeded 4 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

eld trials in processing tomatoes

- Trials within commercial processing tomato production fields; six trials from 2016 through 2020.
- Conducted in cooperation with five different growers in different counties from southern Sacramento Valley to northern San Joaquin Valley.
- Primary interest is yield and fruit quality.
- Primarily looking at different rootstocks, although spacing treatments added in 2019 and 2020.
- Major soilborne diseases are Fusarium wilt race 3 and Verticillium wilt, although these have not been a focus of our trials.

2020 trial located within a commercial field, northern San Joaquin Valley

- Grafted plants produced at California Masterplant, Tracy, CA
- Machine transplanted 12-May (hand planted some gaps on 20-May), graft union located several inches below soil surface
- Two scions (N 6428 - Nunhems and SVTM 1082 - Seminis)
- Three rootstocks (FusaPro, Estamino, Maxifort) plus nongrafted control
- All scion-rootstock combinations planted at two plant densities (approx. 4,000 vs. 8,000 plants per acre)
- Four replicate blocks of 100 ft (30.5 m) each

Spacing treatment

- Grower standard spacing of approx. 13" (33 cm) compared with half the density (approx. 26" or 66cm)
- Note that a more common in-row spacing would be 14" (35.6 cm)
- Photo is from 17-June (36 days after transplanting)

Machine harvest

- Harvested at 136 days after transplanting
- Harvester run as per normal grower practice with both optical and human sorters
- 20 liter fruit sample off harvester graded by hand (green, breaker, mold, sunburn, etc.)
- 3 kg sample to grading station for Brix, color, pH

Scion	Rootstock	Spacing	Yield (tons/ac)		Increase relative to standard practice	Soluble solids	Color	pH	Green fruit at harvest (%)
N 6428	FusaPro	normal	78.72	a	*20.8%*	4.70	19.88	4.50	1.94
N 6428	Maxifort	normal	78.66	a	*20.7%*	4.63	20.13	4.53	2.53
N 6428	Estamino	normal	77.24	ab	*18.6%*	4.50	20.13	4.53	4.15
N 6428	FusaPro	wide	72.82	bc	*11.8%*	4.90	19.75	4.47	2.89
N 6428	Maxifort	wide	72.60	bc	*11.4%*	4.80	19.75	4.50	3.05
N 6428	Estamino	wide	72.26	c	*10.9%*	4.65	19.88	4.52	2.97
N 6428	non-grafted control	normal	65.15	defg	*standard practice*	4.93	20.13	4.50	1.60
N 6428	non-grafted control	wide	60.59	g		5.20	19.63	4.48	1.36
SVTM 1082	Estamino	normal	69.34	cd	*28.2%*	5.15	20.25	4.38	2.38
SVTM 1082	Maxifort	normal	68.66	cde	*26.9%*	5.43	20.13	4.37	2.44
SVTM 1082	FusaPro	normal	65.75	def	*21.6%*	5.35	19.88	4.36	2.20
SVTM 1082	Estamino	wide	65.40	defg	*20.9%*	5.43	19.75	4.39	1.96
SVTM 1082	FusaPro	wide	63.94	efg	*18.2%*	5.43	19.88	4.37	1.19
SVTM 1082	Maxifort	wide	63.69	fg	*17.7%*	5.40	20.00	4.37	2.35
SVTM 1082	non-grafted control	normal	54.10	h	*standard practice*	5.65	19.75	4.36	0.83
SVTM 1082	non-grafted control	wide	47.84	i		5.80	19.50	4.37	0.74
		Mean	67.3			5.12	19.90	4.44	2.16
		P value	< 0.0001			< 0.0001	0.0072	< 0.0001	0.0087

Year	2016	2017	2018	2018	2019	2020
Trial location	Woodland, Yolo Co.	Madison, Yolo Co.	Dixon, Solano Co.	Walnut Grove, Sacramento Co.	Manteca, San Joaquin Co.	Manteca, San Joaquin Co.
Average of all grafted plots	**60.4 tons** **10%**	**49.9 tons** **19%**	**83.5 tons** **8%**	**67.5 tons** **27%**	**81.1 tons** **20%**	**70.8 tons** **24%**
Non-grafted plots	**55.2 tons**	**41.9 tons**	**77.1 tons**	**53.0 tons**	**68.4 tons**	**56.9 tons**
P value	*0.001*	*< 0.0001*	*< 0.0001*	*< 0.0001*	*< 0.0001*	*< 0.0001*
Max increase	15%	32%	20%	55%	33%	28%
	DRI 0319 on DR 0138TX	HM 3887 on Maxifort	HM 3887 on FusaPro	HM 3887 on Maxifort	N 6428 on Estamino	SVTM 1082 on Estamino

Averaged across all six trials, there was about a 10-ton yield increase (17%)

Economics of grafting

- Averaged across all six trials, there was about a 10-ton yield increase (from 59 tons to 69 tons per acre, ~17%)
- 26" (66cm) in-row spacing seems to have been a bit too low density, although it seemed fine in 2019 so we are probably close to the correct density.
- If we assume 5,000 grafted plants per acre are needed (21" or 53 cm in-row spacing), then a 10-ton yield increase would pay for an increase of about $0.16 per plant (grafting cost plus rootstock seed). Would rootstock seed prices come down if that is what the grower can bear?

Summary

- Fruit yields increased, though responses varied considerably with trial location, rootstock and scion. Soluble solids decreased with higher yield. Otherwise, fruit quality not greatly changed.
- Fruit maturity was slightly delayed with higher levels of immature fruit at harvest. Larger vine size, late vigor favorably increased fruit canopy cover.
- With factorial analyses, no statistically significant interactions between scion and rootstock factors were observed.
- In the field, the level of rootstock shoots that emerged was low considering graft union was planted several inches below the soil surface
- Results on spacing suggest that grafted plant densities nearly half the normal density might be sufficient. Cost of rootstock seed and grafting still needs to come down to make practice commercially feasible.

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California Masterplant	Vilmorin/H.M.Clause
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