2021 Dry Farmed Tomato Variety Trial Report and Draft 2022 Plan: January 2022

2021 SUMMARY

2021 was a hotter drier year than 2020 with record-breaking temperatures in late June.

Ungrafted Tomatoes

Many open pollinated varieties that were considered top performers in 2020 (including those planted on partner farms) had high BER incidence and very soft and blemished fruit in 2021. The 2020-21 top performers are identified in Table 1 (short list: firm fruit and BER < 15%) and Table 2 (long list: all BER < 15%). The list of rejected varieties (BER > 15%, or other unmarketable qualities) are identified in Table 6.

- **Average fruit size across ungrafted varieties trialed in both years decreased** from 0.33 lbs/fruit in 2020 to 0.29 lbs/fruit in 2021.
- **Average blossom end rot (BER) incidence across ungrafted varieties trialed in both years almost tripled** from 10% in 2020 to 25% in 2021. Thus, many varieties that were considered high performing in 2020 (with <15% BER incidence) were not considered high performing in 2021. Ungrafted varieties with BER incidence below the 15% threshold in 2021 are listed in Table 2.
- There was no significant difference in average yield across ungrafted varieties trialed in both years (27.5 tons/acre in 2020 and 27.6 tons/acre in 2021).

Grafted Tomatoes

In 2021, project farmers grew 5 OP tomato varieties that were high performing in 2020 (grafted and ungrafted; Table 3). All of these varieties were unacceptably soft and some had other marketability issues (e.g. catfacing) in the extreme heat. Grafting increased yield and reduced BER incidence but did not increase fruit firmness.

OSU trialed diverse tomato varieties grafted onto DRO141TX, Emperador, and Fortamino rootstocks in 2021 (Table 4). Big Beef and BHN871 were high yielding with large, firm and unblemished fruit and low BER incidence, while fruits of other grafted varieties were soft and blemished.

OSU staff also trialed Big Beef and BHN-871 grafted onto DRO141TX and Fortamino in 2020 and 2021 (Table 5). Fruit of grafted Big Beef and BHN-871 were firm and unblemished in both 2020 and 2021. In addition, grafting improved fruit yield, size, and quality:

- DRO141TX increased yields by 116% on average (range 72% - 197%)
- DRO141TX increased fruit size by 34% on average (range 5% - 79%)
- DRO141TX decreased BER by 81% on average (range 64% - 89%)
- Fortamino increased yields by 117% on average (range 79% - 157%)
- Fortamino increased fruit size by 40% on average (range 19% - 90%)
- Fortamino decreased BER by 93% on average (range 88% - 96%)

We have trialed a handful of rootstocks for dry farm performance. Fortamino and DRO141TX are the top performers with Fortamino outperforming DRO141TX in the 2021 heat. We will compare these two rootstocks again in 2022 with the goal of identifying one of them as the preferred dry farm rootstock going forward. Both of these rootstocks also confer resistance to common tomato soilborne pathogens.

We are collaborating with grafted tomato grower Log House Plants and their partner Plug Connections. We anticipate that this collaboration will result in commercial availability of high performing organic and conventional grafted tomatoes for dry farm production in the future.

2022 PLANS

OSU Experiment Station Ungrafted Tomato Variety Trial

- 2020 and 2021 high performers (see Table 1)

OSU Experiment Station Grafted Tomato Variety Trial. Approx. 50 scion/rootstock combinations.

- Farmers and OSU identify tomato varieties that were of high quality (large firm unblemished fruit) in 2021 heat.
- OSU grafts varieties onto Fortamino rootstock (approx. 38 varieties) and DRO141TX rootstock (approx. 12, replicating 12 of the 38 varieties on Fortamino)

On-farm Trials. Each farm grows (plants supplied by OSU/Plug Connection):

- 10 plants each of BHN-871 and Big Beef grafted onto Fortamino
- If interested: 10 plants of BHN-871 and Big Beef grafted onto DRO141TX
- If interested: 6 plants of the farm's favorite variety grafted onto Fortamino
- If interested: 50 or more additional grafted Big Beef, not for data collection

Table 1. Ungrafted varieties: 2020 and 2021 shortlist

Variety	Year	Yield (T/A)	Fruit size (lbs)	BER (%)	Other problems[1]	Firmness[2]	Virus[3]
Spring King (red OP)	2020	24.3	0.25	2.7	Catfacing, green shoulders		
	2021	38.1	0.32	8.9	Catfacing	Firm	Yes
Tiffen Mennonite (pink OP)	2020	36.9	0.63	0.0	Catfacing, green shoulders		Yes
	2021	47.8	0.56	10.2	Cracking, catfacing, green shoulder	Firm	Yes
Manyel (yellow OP)	2020	38.9	0.28	5.1	None		
	2021	24.1	0.24	6.0	None	Firm	No
Baylor Paste (red paste OP)	2020	22.3	0.13	11.4	Green shoulders		
	2021	22.2	0.10	10.2	Green shoulders	Firm	Yes
Fakel (red paste OP)	2020	23.5	0.11	6.1	None		Yes
	2021	27.5	0.12	14.8	None	Firm	Yes
Quadro (red paste OP)	2020	22.0	0.11	4.9	None		
	2021	13.2	0.09	7.7	Green shoulders	Firm	Yes
Teardrop (red paste OP)	2020	29.7	0.12	0.5	None		
	2021	26.5	0.12	9.5	None	Firm	Yes

Data from 2021 collected from weeks 1-10 of the trial

[1] Other problems noted in 2021 if more than 15% of fruit were estimated to be affected

[2] firmness determined in field

[2] Tomato spotted wilt occurred in both years; varieties vary in their susceptibility. Yes indicates that the virus was detected on fruit or in the field. No means that the virus was not detected, but does not necessarily indicate that the variety is resistant. Blank indicates no data was collected.

Table 2. Ungrafted varieties: all passing varieties

Variety	Yield (T/A)	Fruit size (lbs)	BER (%)	Other problems[1]	Firmness[2]	Virus[3]
American Idol (red OP)	36.4	14	0.47	Catfacing, green shoulder	Firm	No
Arbason (red F1)	47.7	3	0.26	Green shoulder	Firm	Yes
Cosmonaut Volkov (red OP)	21.9	12	0.35	Green shoulder	Soft	Yes
Early Willamette (red OP)	29.9	3	0.19	None	Soft	No
Fireworks (red OP)	29.3	11	0.22	None	Soft	Yes
LB21-7-4 (red OP)	20.4	14	0.51	Catfacing, green shoulder	Firm	Yes
Marmande (red OP)	30.0	5	0.21	Green shoulder	Soft	No
Minsk Early (red OP)	23.3	3	0.13	Green shoulder	Soft	Yes
Oregon Spring (red OP)	22.8	10	0.30	Cracking, green shoulder	Soft	Yes
Spring King (red OP)	38.1	9	0.32	Catfacing	Firm	Yes
Starfire (red OP)	31.1	8	0.27	Cracking, catfacing	Soft	Yes
Missouri Pink Love Apple (pink OP)	34.9	12	0.45	Cracking	Soft	No
Rinon Rippled Delight (pink OP)	18.3	9	0.14	Cracking, catfacing	Soft	Yes
TastyWine (pink OP)	15.6	10	0.32	Cracking	Soft	No
Tiffen Mennonite (pink OP)	47.8	10	0.56	Cracking, catfacing, green shoulder	Firm	Yes
Dwarf lemon Ice (yellow OP)	16.1	7	0.21	Green shoulder	Soft	No
Manyel (yellow OP)	24.1	6	0.24	None	Firm	No
Native Sun (yellow OP)	38.1	3	0.21	None	Soft	No
Boronia (purple OP)	18.0	11	0.36	None	Soft	Yes
Fakel (red paste OP)	27.5	15	0.12	None	Firm	Yes
Baylor Paste (red paste OP)	22.2	10	0.10	Green shoulder	Firm	Yes
Quadro (red paste OP)	13.2	8	0.09	Green shoulder	Firm	Yes
Teardrop (red paste OP)	26.5	10	0.12	None	Firm	Yes

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Table 3. On-farm trial summary: 2021

Variety	Rootstock	Yield (T/A)	Fruit size (lbs)	BER (%)
Astrakhanskie	DRO141TX	34.5 AB	0.59 A	7.8 D
	None	12.2 D	0.33 BC	47.0 A
Azoychka	DRO141TX	35.6 AB	0.32 B	7.4 D
	None	17.0 CD	0.24 C	16.4 C
Baylor Paste	DRO141TX	25.4 BC	0.13 DE	6.7 D
	None	14.2 D	0.10 E	28.0 B
Cosmonaut	DRO141TX	34.1 AB	0.36 B	5.2 D
	None	17.6 CD	0.27 BC	18.1 C
Marmande	DRO141TX	40.4 A	0.24 C	0.7 E
	None	20.9 CD	0.17 D	5.8 D

Data from 5 sites (4 on-farm trials plus the OSU Vegetable Research Farm). The purpose of on-farm trials is to evaluate varietal performance across soils and sites. All farms represented had relatively high soil available water holding capacity (>9" in the first five feet), which is necessary for high dry farm yields. All sites but one were exposed to wind, which typically results in higher % BER and smaller fruit when compared to sheltered sites.

Table 4. OSU Vegetable Research Farm grafted tomato summary: 2021

Scion	Rootstock	Yield (T/A)	Fruit size (lbs)	BER (%)	Other problems[1]	Firmness[2]	Virus[3]
Astrakhanskie (red OP)	DRO141TX	51.8	0.59	3.3	Cracking, catfacing, green shoulder	Soft	Yes
	Fortamino	46.5	0.61	4.8	Cracking	Soft	Yes
	None	16.5	0.38	48.6	Cracking, green shoulder	Soft	Yes
Big Beef (red F1)	DRO141TX	68.5	0.37	17.5	None	Firm	Yes
	Fortamino	76.3	0.41	2.7	None	Firm	No
	None	39.8	0.31	65.5	None	Firm	Yes
Cosmonaut Volkov (red OP)	DRO141TX	35.0	0.39	3.6	Cracking, green shoulder	Soft	Yes
	Fortamino	39.0	0.45	0	Cracking, catfacing, green shoulder	Soft	Yes
	None	21.9	0.35	11.7	Green shoulder	Soft	Yes
Jersey Breeze (red OP)	Fortamino	44.1	0.48	19.2	Cracking, catfacing	Soft	Yes
	None	33.9	0.37	55.2	None	Soft	No
Marmande (red OP)	DRO141TX	50.1	0.27	0.2	Sunburn, green shoulder	Soft	No
	Fortamino	48.7	0.24	0.4	Green shoulder	Soft	No
	None	30.0	0.21	5.0	Green shoulder	Soft	No
Nevsky (red OP)	Fortamino	30.4	0.29	3.2	Green shoulder	Soft	Yes
	None	25.0	0.25	47.4	None	Soft	No
Perfect Rogue (red OP)	Fortamino	42.1	0.24	0.8	Sunburn, catfacing	Soft	Yes
	None	31.8	0.21	32.7	None	Soft	No
Starfire (red OP)	Fortamino	53.2	0.30	0	None	Soft	Yes
	None	31.1	0.27	8.2	Cracking, catfacing	Soft	Yes
Siberian Giant Pink (pink OP)	Fortamino	58.7	0.50	0.9	Cracking, catfacing, green shoulder	Soft	Yes
	None	28.8	0.42	26.9	Cracking, catfacing, green shoulder	Soft	Yes
Tiffen Mennonite (pink OP)	Fortamino	38.1	0.49	1.1	Cracking, catfacing, green shoulder	Firm	No
	None	47.8	0.56	10.2	Cracking, catfacing, green shoulder	Firm	Yes
Azoychka (yellow OP)	DRO141TX	35.1	0.33	5.8	Cracking, catfacing, green shoulder	Soft	Yes
	Fortamino	52.3	0.37	1.6	Cracking	Soft	No
	None	31.1	0.30	15.6	Cracking, catfacing green shoulder	Soft	Yes
BHN-871 (orange F1)	DRO141TX	51.9	0.39	7.2	None	Firm	No
	Fortamino	62.2	0.44	2.9	None	Firm	No
	None	28.9	0.37	55.3	None	Firm	No
Gold Medal	Fortamino	38.5	0.63	7.8	Cracking, catfacing, green shoulder	Soft	Yes

(yellow OP)	None	21.6	0.55	50	Cracking, catfacing	Soft	No
Manyel (yellow OP)	Fortamino	39.3	0.27	0.4	None	Soft	No
	None	24.1	0.24	6.0	None	Firm	No
Thorburn's Terra Cotta (yellow OP)	Emperador	48.2	0.30	8.2	Cracking, catfacing	Soft	No
	None	24.4	0.19	40.6	Cracking, catfacing	Soft	No
Cherokee Carbon (dark F1)	Emperador	43.5	0.43	2.2	Cracking, catfacing	Soft	
	None	35.4	0.40	45.5	Cracking, catfacing	Soft	No
Cherokee Purple (dark OP)	Emperador	48.9	0.38	1.1	Cracking, catfacing	Soft	Yes
	None	37.2	0.39	25.3	Cracking, catfacing	Soft	No
Mavritanskite (dark OP)	Fortamino	45.9	0.40	5.7	Cracking, catfacing	Soft	Yes
	None	29.4	0.34	67.5	Cracking, catfacing	Soft	No
Baylor Paste (red paste OP)	DRO141TX	28.3	0.11	6.1	Cracking, green shoulder	Firm	Yes
	Fortamino	52.6	0.14	3.2	Cracking, green shoulder	Firm	No
	None	22.2	0.10	10.2	Green shoulder	Firm	Yes
Cuor di Bue (red paste OP)	Emperador	46.7	0.44	14.4	Nonce	Firm	No
	None	33.8	0.23	64.2	Cracking, green shoulder	Firm	No
Quadro (red paste OP)	Fortamino	24.8	0.09	0.4	Green shoulder	Firm	Yes
	None	13.2	0.09	7.7	Green shoulder	Firm	Yes
San Marzano (red paste OP)	Emperador	39.0	0.11	23.8	Green shoulder	Firm	No
	None	40.9	0.14	52.9	None	Firm	Yes

Data presented is from weeks 1-10 of the trial, week 11 was an incomplete harvest

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[3] Tomato spotted wilt occurred in both years; varieties vary in their susceptibility. Yes indicates that the virus was detected on fruit or in the field. No means that the virus was not detected, but does not necessarily indicate that the variety is resistant. Blank indicates no data was collected.

Table 5. Grafted Big Beef and BHN-871: 2020 and 2021

Scion/rootstock	Trial	Yield (T/A)	Fruit size (lbs)	BER (%)
Big Beef on DRO141TX	OSU Veg Farm 2020	83.4	0.53	3.4
	On Farm 2020	43.2	0.39	5.5
	OSU Veg Farm 2021	68.9	0.37	17.3
Big Beef on Fortamino	OSU Veg Farm 2020	97.8	0.80	1.7
	On Farm 2020			
	OSU Veg Farm 2021	77.8	0.41	2.6
BHN-871 on DRO141TX	OSU Veg Farm 2020	82.1	0.61	5.4
	On Farm 2020	41.7	0.44	14.6
	OSU Veg Farm 2021	53.1	0.39	7.4
BHN-871 on Fortamino	OSU Veg Farm 2020	66.2	0.48	2.8
	On Farm 2020	33.0	0.38	4.8
	OSU Veg Farm 2021	63.3	0.44	3.4

BER = blossom end rot

Table 6. OSU Vegetable Research Farm Variety Trial: 2021. Varieties and scion/rootstock combinations unsuitable for dry farm production in the Willamette Valley (%BER > 15% and/or other unmarketable qualities)

Variety	Reason for failure	Date Dropped	BER Incidence (%)
Amish Paste on Emperador	High BER Incidence	September 13th	33
Astrakhanskie	High BER Incidence	September 13th	49
Azoychka	High BER Incidence	September 20th	16
Beorange	High BER Incidence	September 20th	43
BHN-871	High BER Incidence	September 13th	55
Big Beef	High BER Incidence	September 13th	66
Big Beef on DRO141TX	High BER Incidence	September 20th	17
BQ273	High BER Incidence	August 9th	93
California Brandywine	High BER Incidence	September 13th	48
Carmello on Emperador	High BER Incidence	September 13th	26
Cherokee Carbon F1	High BER Incidence	September 13th	46
Cherokee Purple	High BER Incidence	September 20th	25
Cordova F1	High BER Incidence	August 9th	57
Cubalibre	High BER Incidence	September 20th	29
Cuor di Bue	High BER Incidence	September 13th	64
Druzba	High BER Incidence	August 16th	33
Dwarf Beauty King	High BER Incidence	September 13th	46
Dwarf Champion	High BER Incidence	September 13th	28
Dwarf Confetti	High BER Incidence	September 13th	35
Dwarf Sweet Sue	High BER Incidence	September 13th	25
Early Girl	High BER Incidence	September 20th	66
Eva Purple Ball	High BER Incidence	September 13th	31
Fantome du Laos	High BER Incidence	September 13th	21
Galahad	High BER Incidence	August 16th	70
Genovese Cimelo Liguria	High BER Incidence	August 16th	34
Geronimo	High BER Incidence	August 16th	26
Giant of Siebenburger	High BER Incidence	August 16th	67
Gold Medal	High BER Incidence	September 13th	50
Granadero F1	High BER Incidence	August 16th	49
Great Lakes	High BER Incidence	September 13th	39
Heirloom Marriage Marzinera F1	High BER Incidence	August 9th	88
Jersey Breeze	High BER Incidence	September 13th	55
Jersey Breeze on Fortamino	High BER Incidence	September 13th	19
Jersey Shortstake	High BER Incidence	August 16th	42
KC-146	Unknown	August 16th	9
Lampchen	High BER Incidence	September 20th	17
Magnus	High BER Incidence	August 16th	58
Manalucie	Fruit too small	August 16th	1

Marglobe	High BER Incidence	August 16th	39
Mavritanskite	High BER Incidence	September 13th	68
Moskvich	High BER Incidence	August 16th	67
Mt Miracle XL Pink Hybrid Swarm	High BER Incidence	August 9th	27
Napoli Roma	High BER Incidence	August 16th	42
Nevksy	High BER Incidence	September 13th	47
Nistru Plum	High BER Incidence	September 20th	20
“Oh My” Black Hybrid Swarm	High BER Incidence	September 20th	23
Old Brooks	Inconsistent/small fruit size	August 16th	2
Oneda's German	High BER Incidence	August 16th	73
Palestinian	High BER Incidence	August 16th	42
Paul Robeson	High BER Incidence	September 20th	30
Perfect Rogue	High BER Incidence	September 20th	33
Pineapple Rose	Too soft, small and ugly	September 7th	1
Pleated Red Rock	High BER Incidence	August 16th	22
Pomodoro Nasone del Cavallino	High BER Incidence	August 9th	58
Pomodoro Squisito F1	High BER Incidence	August 9th	80
Roma VF	High BER Incidence	August 9th	83
Ropreco	High BER Incidence	August 9th	72
Ruby Red	High BER Incidence	September 20th	35
San Marzano	High BER Incidence	September 13th	53
San Marzano on Emperador	High BER Incidence	September 20th	24
Sarah Black	High BER Incidence	September 20th	35
Sausage	High BER Incidence	August 9th	83
Siberian Giant Pink	High BER Incidence	September 20th	27
Sokolades	High BER Incidence	September 13th	22
Sunset's Red Horizon	Unknown	August 16th	16
Super Fantastic on Emperador	High BER Incidence	September 13th	26
Tasmanian Chocolate	High BER Incidence	September 13th	24
Thorburn’s Terra Cotta	High BER Incidence	September 13th	41
True Black Brandywine	High BER Incidence	September 13th	24
Viva Italix	High BER Incidence	August 9th	41
White Tomesol	High BER Incidence	September 13th	32
Wood's Famous Brimmer	High BER Incidence	August 16th	50