Project Annual Report 2022-2023

California Grape Rootstock Improvement Commission

1. Summary

Project Title: Evaluation of Seven Rootstocks under Saline Irrigation for Eleven Grape Varieties in the Southern San Joaquin Valley

Principle Investigator (PI): George Zhuang

Summary:

Two field trials have been established in 2021 at University of California West Side Research Station. The first replicated field trial is to study two wine grape varieties, Colombard and Barbara. A two-way (2 × 7) factorial split block design was established with two water deficit regimes and seven rootstocks, replicated in 4 times, and seven vines were planted as one experimental unit. One vine row was assigned to one water deficit regime and seven rootstocks were assigned in the vine row. The replicated field trial map is shown in Table 1 A. The second non-replicated field trial is to demonstrate 9 grape varieties grafted on the same 7 rootstocks. One vine row was assigned to one grape variety and seven rootstocks were assigned in the vine row. The non-replicated field trial map is shown in Table 1 B. Both replicated and non-replicated trials are adjacent to each other. Vines were planted in July of 2021 and stakes/wires/drip hoses were installed after. GRN3 and Ramsey were delayed and planted in July of 2022. First year's harvest data were collected at the end of 2023 and data were presented in Table 2 and 3.

2. Annual or Final Report

This is an annual report (year 3)

3. Project Title and UGMVE proposal number

"Evaluation of Seven Rootstocks under Saline Irrigation for Eleven Grape Varieties in the Southern San Joaquin Valley." (Proposal # 2022-2724)

4. Principle Investigator/Cooperator(s)

Principle Investigator:

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5. Objective and Experiments Conducted to Meet Stated Objective

Project Objective

Rootstocks are commonly used in grape growing regions and have been studied extensively. The first, and still primary, reason to use rootstocks is to protect against soil pests such as nematodes and phylloxera. However, the Sustainable Groundwater Management Act (SGMA) and the drought in the southern San Joaquin Valley (SJV) are becoming the increasing challenges for growers and forcing growers to use low quality water, like well water, during the drought. Therefore, I propose to evaluate *Vitis vinifera cv.* Colombard and Barbera grafted on seven rootstocks under two water deficit regimes under saline irrigation water in the southern SJV. In addition, I propose to establish a variety demonstration plot for extension and growers' observation. The non-replicated demonstration trial will provide the useful field information, like yield and fruit quality characteristics, on the other 9 grape varieties grafted on the same 7 rootstocks. The ultimate objective for both replicated and non-replicated field trials is to select the optimum salt and drought resistant rootstocks for sustainable high yielding and good fruit/wine quality under the saline condition.

Experiments

Vineyard Site: The experiment is conducted at University of California, Westside Research and Extension Center (WSREC) in Fresno County, CA (36°20'36.6"N 120°06'32.9"W). The soil type of the planting site is Cerini clay loam with 85% Cerini clay, described as well drained (www.nrcs.usda.gov). Planting density is 6' × 10' (vine × row) with North to South row orientation. The vineyard is drip-irrigated with two pressure-compensating emitters per vine at the distance of 36" and each delivers 0.5 GA/hr. The replicated field trial, Barbera (red/black cultivar) and Colombard (white cultivar), were trained in the bilateral cordons and the other nine varieties were trained the same to establish the non-replicated demonstration trial. The grapevine cordon is trained to 1.7 m (68") height above the vineyard floor, and vines will be mechanically pruned after the year 3 according to Zhuang et al. 2019.

Plant Materials: The replicated trial focuses on Barbera and Colombard and the non-replicated demonstration trial includes the other nine varieties, such as Rubired, Syrah, Caberent Sauvignon, Chardonnay, Pinot Gris, Chenin Blanc, Muscat of Alexandria, Primitivo, and Sunpreme. Seven rootstocks are assigned to the vine row, and the rootstocks are listed in Table 1 A and B.

Experimental Design: The field trial for *Vitis vinifera cv.* Colombard and Barbera was set up using a two-way factorial (two water deficit regimes × seven rootstocks) split-block design, replicated in four times. Water deficit, as the main treatment, includes a) 50% ETc; b) 80% ETc. Different amount of irrigation is applied in the vine row by adjusting the number of emitters per vine. Seven

rootstocks, as the sub treatment, are assigned in the vine row and each experimental unit comprises of seven vines. The non-replicated demonstration trial includes nine varieties, and each variety is designated to a vine row and seven rootstocks are assigned in each row. Field experimental designs for Barbera and Colombard as well as the non-replicated demonstration trial are shown in Table 1 A and B.

Soil and Irrigation Water Test: Well water sampled in 2016 indicated high pH (pH at 9.3) and high boron (B at 1.3 ppm). Irrigation water and soil samples were sampled in 2022 and 2023 to monitor the salinity level on site, and data were presented in Table 4.

6. Summary of Major Research Accomplishment and Results by Objective

The experimental vines (green potted vines) were planted in July of 2021 and stakes/wires/drip hoses were installed right after. Due to the limited availability, GRN3 and Ramsey rootstocks (green potted vines) were delayed and planted in July of 2022. The overall progress of this experiment is on schedule as the previous proposal suggested (Photo 1). The first year's harvest data were presented in Table 2 and 3, and both yield data and field canopy looked typical for the SJV. Interestingly, we noticed that scions behaved very differently with more boron toxicity on Barbera than Colombard although there were under the same rootstock and irrigation management (Photo 2). The field observations agreed with previous findings from Christensen (2003) that Colombard is more resistant to Boron toxicity and Barbera is more susceptible to Boron toxicity. It will be important to test the same rootstock on different scions since scions can show different Boron susceptibility as our field trial showed. Tissue nutrient samples from bloom and version will be prepared and sent to the laboratory for nutrient as well as salinity test soon.

7. Outside Presentations of Research

Oral presentation at 2023 Sustainable Ag Expo at San Luis Obispo

8. Research Success Statements

9. Funds Status

Fund from 2022-2023 will be fully spent to cover the cost of pruning and vineyard management in the winter of 2023.

Literature Cited

Zhuang, S., Fidelibus, M., Kurtural, K., Lund, K., Torres, G., Stewart, D., and Summer, D. (2019) Sample Cost to Establish A Vineyard and Produce Winegrapes. University of California Agricultural and Natural Resources. 2019 Sample Costs to Establish a Vineyard and Produce Winegrapes – Fresno, Madera, Merced, and Stanislaus Counties – Cabernet Sauvignon Variety (ucdavis.edu).

Christensen, L. P. (2003) Wine Grape Varieties of California. University of California Agricultural and Natural Resources. First Edition. ISBN-13: 978-1879906631.

Photo 1. First year's harvest on Colombard vines at UC WSREC, Five Points

Photo 2. Barbera leaf showed typical Boron toxicity (left) and Colombard canopy showed no symptom under the same rootstock and irrigation management (right)

Table 1 A. Replicated Field Experimental Design of *Vitis vinifera cv.* Barbera and Colombard

Variety	Irrigation	Row/Vine	1-7	8-14	15-21	22-28	29-35	36-42	43-50
Border row									
Barbera	0.8 ETc	2	Freedom	OR*	140Ru	RS3	GRN3	Ramsey	1103 P
Barbera	0.5 ETc	3	Freedom	OR	140Ru	RS3	GRN3	Ramsey	1103 P
Barbera	0.8 ETc	4	GRN3	Freedom	1103 P	Ramsey	RS3	140Ru	OR
Barbera	0.5 ETc	5	GRN3	Freedom	1103 P	Ramsey	RS3	140Ru	OR
Barbera	0.5 ETc	6	OR	1103P	Ramsey	140Ru	GRN3	RS3	Freedom
Barbera	0.8 ETc	7	OR	1103P	Ramsey	140Ru	GRN3	RS3	Freedom
Barbera	0.5 ETc	8	140Ru	OR	Freedom	GRN3	RS3	1103P	Ramsey
Barbera	0.8 ETc	9	140Ru	OR	Freedom	GRN3	RS3	1103P	Ramsey
Colombard	0.8 ETc	10	Freedom	OR	Ramsey	140Ru	GRN3	RS3	1103P
Colombard	0.5 ETc	11	Freedom	OR	Ramsey	140Ru	GRN3	RS3	1103P
Colombard	0.5 ETc	12	GRN3	Freedom	1103P	OR	RS3	140Ru	Ramsey
Colombard	0.8 ETc	13	GRN3	Freedom	1103P	OR	RS3	140Ru	Ramsey
Colombard	0.8 ETc	14	OR	1103P	RS3	Ramsey	140Ru	GRN3	Freedom
Colombard	0.5 ETc	15	OR	1103P	RS3	Ramsey	140Ru	GRN3	Freedom
Colombard	0.5 ETc	16	140Ru	GRN3	Ramsey	Freedom	RS3	1103P	OR
Colombard	0.8 ETc	17	140Ru	GRN3	Ramsey	Freedom	RS3	1103P	OR
Border row									

*OR: Own rooted

Table 1 B. Non-replicated Field Demonstration Design of Nine Grape Varieties

Variety	Irrigation	Row/Vine	1-7	8-14	15-21	22-28	29-35	36-42	43-50
Sunpreme	0.8 ETc	1	OR*	140Ru	Freedom	Ramsey	RS3	1103P	GRN3
Syrah	0.8 ETc	18	OR	140Ru	Freedom	Ramsey	RS3	1103P	GRN3
Chardonnay	0.8 ETc	19	OR	140Ru	Freedom	Ramsey	RS3	1103P	GRN3
Cabernet Sauvignon	0.8 ETc	20	OR	140Ru	Freedom	Ramsey	RS3	1103P	GRN3
Pinot Gris	0.8 ETc	21	OR	140Ru	Freedom	Ramsey	RS3	1103P	GRN3
Rubired	0.8 ETc	22	OR	140Ru	Freedom	Ramsey	RS3	1103P	GRN3
Muscat of Alexandria	0.8 ETc	23	OR	140Ru	Freedom	Ramsey	RS3	1103P	GRN3
Primitivo	0.8 ETc	24	OR	140Ru	Freedom	Ramsey	RS3	1103P	GRN3
Chenin Blanc	0.8 ETc	25	OR	140Ru	Freedom	Ramsey	RS3	1103P	GRN3

*OR: Own rooted

Table 2. First year's harvest yield data of *Vitis vinifera cv.* Barbera and Colombard in 2023

Rootstock	Cluster No./vine		Yield (tons/acre)	
	Barbera	Colombard	Barbera	Colombard
1103 Paulsen	59	65	6.7	7.3
140 Ruggeri	61	71	6.7	9.7
Freedom	71	75	8.9	9.3
RS 3	68	52	7.6	5.9
Own root	75	72	7.1	9.1

Table 3. First year's harvest fruit chemistry of *Vitis vinifera cv.* Barbera and Colombard in 2023

Rootstock	Brix		pH		TA (g/L)	
	Barbera	Colombard	Barbera	Colombard	Barbera	Colombard
1103 Paulsen	24.4 a*	20.0	3.3	3.2	5.6	8.6
140 Ruggeri	24.6 a	18.3	3.4	3.2	5.6	9.0
Freedom	21.9 b	18.6	3.5	3.3	5.5	9.0

RS 3	24.6 a	20.4	3.4	3.3	5.5	8.5
Own root	26.1 a	18.7	3.4	3.2	5.7	8.6

*Different letters within columns represent significant differences according to Tukey's honestly significant difference at $p<0.05$.

Table 4. Soil chemistry on experimental site at UC WSREC

Soil depth (ft)	pH	EC (ds/m)	B (ppm)
2021			
0-12	7.6	1.00	0.5
12-24	7.9	1.00	0.5
24-36	7.8	0.60	0.4
2023			
0-12	7.6	1.46	1.8
12-24	7.6	1.79	1.0
24-36	7.7	1.76	0.9