

Upcoming Events

Continuing Education for Pest Management Pros

August 24th, 2024

October 1st, 2024

October 8th, 2024

October 15th, 2024

October 22nd, 2024

Time: 8:00 AM – 12:00 PM

Location: 2145 Wardrobe Ave,
Merced, CA 95341

Fee: \$40 per day (cash or check only)

No pre-registration required

Continuing education requested

Bulleled Summary of Issue

On-Farm Technical Support

- UC Cooperative Extension is providing specialized support to identify management practices for irrigation and nitrogen fertilizer use. Check the contacts or QR code below to schedule a consultation.

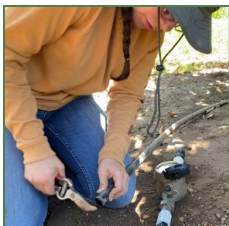
Nematode Resistant Vineyard Rootstock Trials

- Two newer groups of rootstocks have been tested for nematode resistance, but two trails in Madera and Merced counties have been testing their effects in the vineyard. This includes effects to water stress, nutrient uptake, canopy growth, and yield.
- For water stress, both sites saw comparable results with certain rootstocks being less water stressed than others, along with slightly different responses if under sudden high levels of water stress.
- Petiole samples collected over a few years at two in-year growth stages showed consistent results of certain nutrients being affected by rootstocks while other nutrients were commonly or just occasionally effected. Some effects to nutrient was not consistent between the Merced and Madera county sites.
- Canopy growth was effected by rootstocks while year-to-year difference were shown, general difference in growth patterns was the same over several years.
- At the Madera County site, higher yields tended to followed larger canopy size. The Merced County site was more complicated with the last harvest data collected, but it was not at full maturity and may have been affected by delayed spring growth.

Free On-Farm Technical Support for Irrigation and Nitrogen Fertilizer Practices

Local technical assistance is being provided for Merced, Stanislaus, San Joaquin, and some other counties from UC Cooperative Extension. Through the Nitrogen and Irrigation Initiative (NII) program, farm advisors are working with growers to identify management practices, monitoring techniques, and infrastructural upgrades that can reduce nitrogen fertilizer and irrigation use without compromising yield or quality. During this technical consultation, farm advisors will provide individualized recommendations and assist growers with implementing efficient practices.

For Merced, Stanislaus, and San Joaquin counties, please contact:



Jacqueline Vasquez Mendoza

(209) 450-6516

jvasquezmendoza@ucanr.edu

For contacts in other counties, please scan QR code:



Trialing Nematode Resistant Rootstocks for Use in the San Joaquin Valley

By Karl Lund

Rootstocks are an integral part of viticulture. The rootstock controls the interaction of the whole vines with the soil profile. This puts the rootstock in charge of the uptake of nutrients from the soil, water uptake, and defense against soil pests. As such different rootstocks will have a wide range of effects on a vineyard that can majorly change the canopy, yield, and longevity of that vineyard. When new rootstocks are being developed, or soon after release, trials should be conducted to help growers understand how new rootstocks compare to previously available stocks.

Two newer groups of rootstocks were released with advanced nematode resistance. The first of these is the RS rootstocks series, RS3, and RS9, which have strong resistance to aggressive strains of root-knot nematode. The second is the GRN rootstock series, GRN1, GRN2, GRN2, GRN4, and GRN5, which have moderate to strong resistance to a wide range of nematodes. While both groups of rootstocks have been well-tested for nematode resistance, their effect in the vineyard has been much less well-documented.

To test the performance of these rootstocks in the San Joaquin Valley (SJV) several different trials were planted, two of which I have overseen for the past 6 growing seasons. The first of these was planted just outside of the city of Madera. It was planted in 2009 with an eight-foot by ten-foot spacing (within and between rows, respectively) with Petite Verdot as the scion. This site has both RS rootstock, and all 5 GRN rootstocks, as well as Freedom and 1103P as standard controls. Each replicate in this vineyard consists of an 8-vine panel replicated 5 times. The second trial is located a bit north of the city of Merced. It was planted in the fall of 2016 on a five x eleven-foot spacing (within and between rows) with Malbec as the scion. This site has both RS rootstocks, with GRN2, GRN3, GRN4, and 1103P as a standard control. Each replicate consists of an entire row of 388 vines with 4 replicates per rootstock. Overall, this means that the Madera site has a larger variety of rootstocks, while the Merced site has a larger number of vines from which to collect

data.

Water stress

The ability to supply water to the scion is one of the major differences between different rootstocks. During the 2021 and 2022 growing seasons the Merced vineyard site saw the same number of days with temperatures at or above 100 °F. However, the distribution of these days was different between the two growing seasons. The 2021 growing season started hot with June and July seeing 8 more days with temperatures at or above 100 °F in comparison to June and July of 2022.

On the other hand, the 2022 growing season ended hot seeing eight more days in August and September with temperatures at or above 100 °F than the 2021 growing season. In addition, the 2021 growing season also started with extremely dry soil conditions that led to many California vineyards having delayed growth problems at the beginning of the season. The differences in these two growing seasons mean that the water stress at the Merced site was high at the start of the 2021 growing season, while during 2022 it was high towards the end of the season.

The differences in the growing seasons were expressed in the midday leaf water potential

(Image 1). The early stress of the 2021 growing season leads to a decline in leaf water potential in late June and early July before lower stress levels return in August and September. In contrast, in 2022 water potential generally declined through the growing season, especially during August and September. Despite these differences, the performance of the rootstocks is similar between the two years. GRN2 is normally the least water-stressed rootstock or is in the lower water-stressed group. On the other side, vines on RS3 or RS9 were more stressed throughout both seasons. For most of the season vines on GRN3, GRN4, and 1103P were similar to vines on GRN2 or segregated into a separate moderately water-stressed group.

The one exception to this general rule is when GRN3 is put under sudden high levels of water stress. Two dates when this can be seen are 6/18/2021 and 9/1/2022. Both of these dates were extremely hot and all vines became more stressed on those dates. In both cases, vines on GRN3 quickly changed from low or moderate water stress to highly stressed. While vines on GRN3 quickly become more water-stressed, they also recover quickly. After the heatwave in 2021, the vines on GRN3 recovered from the high levels of water stress. GRN3 is the least water-stressed rootstock after the

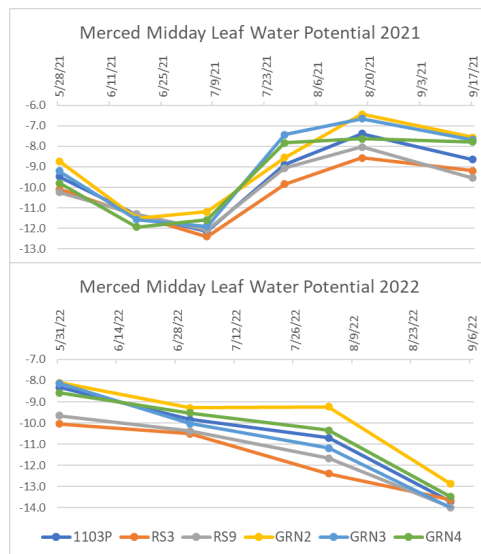


Image 1. Midday Leaf Water Potential data from 2021 (top) and 2022 (bottom) for the Merced trial site show water stress differences between the two different growing seasons.

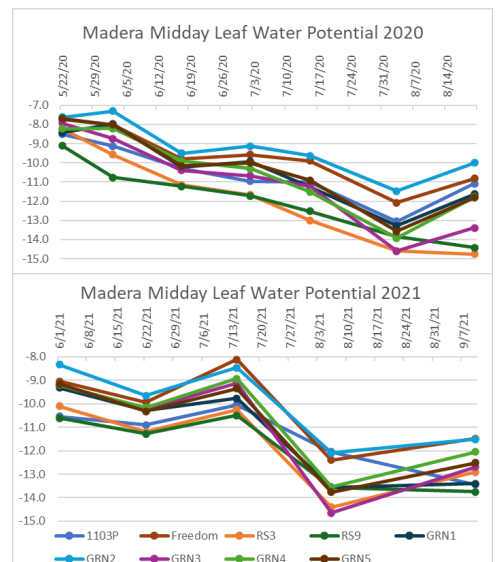


Image 2. Midday Leaf Water Potential data from 2020 (top) and 2021 (bottom) for the Madera trial site.

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first data collection point after the heat wave ended and only comes in with more stress than GRN2 for all remaining data collection points.

At the Madera trial, we see comparable results to Merced. In Madera, GRN2 and Freedom are constantly the two least water-stressed, or among the least water-stressed group. On the other end, RS3 and RS9 are normally among the high water-stressed group. 1103P is not well adapted to the Madera trial site and performs below expectations. During 2021, 1103P spent most of its time in the high water-stress group, while in 2020 it spent most of its time at the bottom of the medium water-stress group. GRN1, GRN3, GRN4, and GRN5 will be grouped either in the low water-stress group or as an independent medium water-stress group.

The Madera vineyard site uses a post-veraison dry down to add late-season water stress as part of their fruit quality program. This can be seen in the data during the first week of August in both years. Much like during the heatwaves at the Merced site, all the vines at Madera become more stressed during the yearly dry-down. Also just like at Merced, during the dry-down in Madera GRN3 jumps into the high water-stress group and becomes one of the most water-stressed vines. And again, just like in Merced, after the initial dry down in Madera GRN3 recovers after irrigation is increased. The agreement between the two sites with GRN3 gives a good overall look at how it handles water stress. Whether the water stress is due to

purposeful (Madera site) or accidental reduction in irrigation, or due to elevated water need from a heatwave (Merced site), GRN3 cannot handle these events and becomes overly water stressed. The data also supports that once the events leading to elevated water stress have been removed GRN3 recovers rapidly.

Nutrient Uptake

As rootstocks control the interaction of the plant and soil, different rootstocks will uptake different nutrients differently. Understanding these differences allows a vineyard manager to better dial in their nutrient management program. To test these differences petiole samples were collected in Merced at bloom and veraison in 2018, 2019, and 2021. At each sampling, Potassium, Calcium, and Magnesium were affected by rootstock. Chloride and Manganese were usually affected as well, and Zinc and Boron were also commonly affected. Phosphorus and Sodium were occasionally affected by rootstock, Copper was only affected by rootstock at one timepoint during bloom of 2018, while Nitrogen and Iron were not affected by the rootstock at any timepoint. At the vineyard in Madera, samples were collected at veraison in 2021. While this is only at one time point it allows for a comparison between the two different vineyard locations.

Potassium uptake shows a consistent pattern in Merced. GRN2, GRN3, and GRN4 rootstocks have higher potassium concentration levels than RS3, RS9, and 1103P. In Madera

GRN2, GRN3, GRN4, GRN5, and Freedom, had the highest K uptake. RS9 has switched from the low concentration level group in Merced to the higher uptake group in Madera. GRN1 has joined RS3 and 1103P in the low potassium concentration level group.

Calcium shows a similar uptake to potassium at the Merced vineyard. GRN2, GRN3, and GRN4 again have higher concentration levels than RS3 and RS9. This time 1103P is in the higher concentration level group. In Madera a consistent pattern with Merced with GRN2, GRN3, GRN4, and 1103P being in the high concentration level group. Freedom, GRN1, and GRN5 all also join the higher concentration level group in Madera. Finally, RS3 and RS9 again were in the lower concentration level group.

Magnesium shows a reversal of the pattern seen in the previous two nutrients at the Merced Vineyard. GRN2, GRN3, and GRN4 all show low concentration levels, while RS3, RS9, and 1103P show higher concentration levels. While the Madera samples do not statistically separate, the trend holds steady with 1103P, RS3, and RS9 having higher magnesium concentrations than the remaining rootstocks.

Chloride shows higher concentrations in GRN3, GRN4, and especially GRN2. GRN2 had the highest concentration in 5 of 6 times and moved into a separate very high concentration group during both 2021 sampling events. As chloride can become toxic in grape leaves this may be an early indication that GRN2 may have problems in high chloride situations. 1103P shows the lowest chloride concentration at 5 of 6 time points, separating into its own super low concentration category for 3 of the 6 time points. 1103P is considered to have moderate salinity tolerance compared to other standard rootstocks, meaning GRN3, GRN4, and especially GRN2 should be considered to have a lower tolerance for salinity.

RS3 and RS9 are generally in between the other rootstocks at the Merced trial. Sometimes they slide into the lower concentration group with 1103P and sometimes they group with

Table 1. Concentration Level Comparison of Rootstocks at the Merced Trial from 6 timepoints over 3 years. The concentration levels are only compared to other rootstocks within the trial and not an overall uptake level.

Rtstck	N	P	K	Ca	Mg	Ch	Mn	Zn	B
1103P	ND	ND	Lower	Higher	Higher	Lower	Higher	Mod	Higher
RS3	ND	ND	Lower	Lower	Higher	Mod	Lower	Higher	Lower
RS9	ND	ND	Lower	Lower	Higher	Mod	Lower	Higher	Lower
GRN2	ND	ND	Higher	Higher	Lower	High - V High	Higher	Lower	Higher
GRN3	ND	ND	Higher	Higher	Lower	Higher	Higher	Lower	Higher
GRN4	ND	ND	Higher	Higher	Lower	Higher	Higher	Lower	Higher

N = Nitrogen, P = Phosphorus, K = Potassium, Ca = Calcium, Mg = Magnesium, Ch = Chloride, Mn = Manganese, Zn = Zinc, B = Boron, ND = No Difference, Mod = Moderate

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GRN3 and GRN4. Indicating they probably have a better salinity tolerance than GRN2, GRN3, and GRN4, but lower tolerance than 1103P. At the Madera trial, Freedom took over the highest chloride concentration group. This matches its lower level of salinity tolerance. GRN2, GRN3, GRN4, and GRN5 are now in the middle group confirming their high uptake (but not as bad as Freedom) from the Merced trial. RS3, RS9, GRN1, and 1103P again show up in the lower concentration group.

GRN2, GRN3, GRN4, and 1103P had higher concentrations of Manganese than RS3 and RS9 at the Merced trial. The Madera trial showed a stark change in results from Merced. In Madera 1103P and GRN4 remain in the high concentration group and are joined by GRN5 and Freedom; as well as RS9 which was in the concentration group in Merced. RS3 is still in the lower concentration group in the Madera Trial, along with GRN1; and is now joined by GRN2 and GRN3 which had previously been in the high concentration group.

Zinc showed high concentration levels in RS3 and RS9 at the Merced trial. At the Merced trial, GRN2, GRN3, and GRN4 have low zinc concentration levels. 1103P sits in between the two groups. Here again, we see major differences between Merced and Madera. In Madera,

the data shows that 1103P, GRN2, and GRN3 form the higher concentration group. RS3, GRN5, RS9, and GRN4 form the middle concentration group, while Freedom and GRN1 form the lower concentration group.

Boron is an element that can become deficient on the east side of the San Joaquin Valley, while growers only an hour's drive away on the west side of the San Joaquin Valley have to deal with boron toxicity. At the Merced trial, RS3 and RS9 showed lower concentration levels of Boron. GRN2, GRN3, GRN4, and 1103P all generally show higher concentration levels, with GRN2 and 1103P often being near the top.

At the Madera trial, RS3 again shows the lowest concentration level of Boron, and GRN2 and 1103P are again at the top. However, RS9 has again switched groups from the low concentration group to the higher concentration group. The identification of RS3 showing low concentration could make it important for areas with high boron levels in soil or irrigation water.

Canopy Growth

The growth of the canopy can be affected by the rootstocks' ability to uptake water and nutrients. Canopy growth differences can be seen easily when touring either of the rootstock trials. There are always some year-to-year differ-

ences in growth patterns, but the general growth pattern has remained the same over the past several growing seasons. For these trials canopy growth was measured using a Paso Panel placed under the canopy to evaluate the width of the canopy at each data collection point. As both vineyards involved in this work were on a single high-wire trellis, there was a maximum canopy size that each vineyard could achieve. Once the canopy has reached this maximum size any additional growth would no longer increase the width of the canopy but add additional length to the canopy.

At the Madera site, the vines grafted on GRN2 and Freedom are always the largest canopies. The vines grafted on GRN4 and GRN5 normally group with those grafted on GRN2 and Freedom but are slightly smaller through the early growing season. Overall, the canopies on these four rootstocks all hit the maximum canopy size every year. The vines grafted on GRN3 are another step behind those on GRN4 and GRN5, but also normally hit maximum canopy size at the Madera vineyard site as it did in 2023 (Image 3). In some years, the vines grafted on GRN3 do not make it to the maximum canopy size and stay slightly smaller than those on Freedom, GRN2, GRN4, and GRN5.

As was mentioned back in the water stress section, 1103P is not well adapted to the Madera Vineyard site. As such the vines grafted on 1103P are normally one of the smallest canopies every year at this site. The vines grafted on RS9 and GRN1 also consistently have smaller canopies and group with vines grafted 1103P. The canopies of vines grafted on RS9 and 1103P do lead to some sun-related fruit damage at the Madera vineyard site. Vines grafted on GRN1 will also have some mild fruit exposure issues, but they are much less than those grafted on RS9 and 1103P. Vines grafted on RS3 are also on the smaller side of canopy sizes, in 2023 it grouped with 1103P, RS9, and GRN1 (Image 3). However, in some years they do achieve a large enough canopy to separate into a medium-sized canopy group with the vines grafted on GRN3.

Table 2. Concentration Comparison of Rootstocks at the Madera Trial from 1 timepoint. The concentration levels are only compared to other rootstocks within the trial and not an overall uptake level.

Rootstock	N	P	K	Ca	Mg	Ch	Mn	Zn	B
1103P	ND	ND	Lower	Higher	ND	Lower	Higher	Higher	Higher
Freedom	ND	ND	Higher	Higher	ND	Higher	Higher	Lower	Mod
RS3	ND	ND	Lower	Lower	ND	Lower	Lower	Mod	Lower
RS9	ND	ND	Higher	Lower	ND	Lower	Higher	Mod	Higher
GRN1	ND	ND	Lower	Higher	ND	Lower	Lower	Lower	Mod
GRN2	ND	ND	Higher	Higher	ND	Mod	Lower	Higher	Higher
GRN3	ND	ND	Higher	Higher	ND	Mod	Lower	Higher	Mod
GRN4	ND	ND	Higher	Higher	ND	Mod	Higher	Mod	Mod
GRN5	ND	ND	Higher	Higher	ND	Mod	Higher	Mod	Mod

N = Nitrogen, P = Phosphorus, K = Potassium, Ca = Calcium, Mg = Magnesium, Ch = Chloride, Mn = Manganese, Zn = Zinc, B = Boron, ND = No Difference, Mod = Moderate

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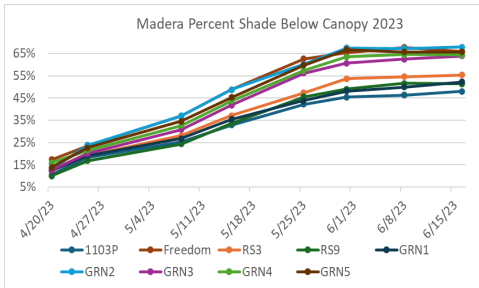


Image 3. Percent Shade Below Canopy at Madera Vineyard Site 2023.

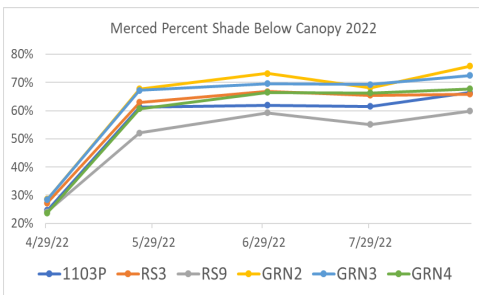


Image 4. Percent Shade Below Canopy at Merced Vineyard Site 2022

The Merced vineyard site is again similar to the Madera site for canopy growth. The vines grafted on GRN2 again have the largest canopy throughout most of the growing season. In Merced, the vines grafted on GRN3 have a larger canopy and groups with GRN2 in the large canopy group. The vines grafted on GRN4, RS3, and 1103P make a moderate canopy size group that does group with the large canopy group at some collection points. 1103P is much better adapted to the Merced Vineyard site, so this is more representative of where it is expected to align. The vines grafted on RS9 again sit in the small canopy group (Image 4). The vines grafted on RS9 have canopies that are small enough in Merced to receive sun-related fruit damage in most growing seasons.

Yield

Yield is going to be influenced by every factor that has been discussed so far. Both the flowers and resulting berries will require water and nutrients to properly grow. A strong canopy is needed to supply the berries with sugar to help them mature, as well as provide them protection from the San Joaquin Valley sun. In Madera, the yields from the rootstocks break

into 5 separate groups. Freedom stands alone with the largest yield at over nineteen tons per acre. GRN2 and GRN3 are in the next group with approximately sixteen tons per acre. GRN1, GRN4, and GRN5 are in the third group with between fourteen and fifteen tons per acre. RS3 is next and is between thirteen and fourteen tons per acre, while RS9 and 1103P are in the bottom group with below twelve tons per acre. Overall, this shows a general matching between canopy size and yield at the Madera site. The five members of the large canopy group are among the six highest yielding. The three smallest yielding rootstocks all come from the small canopy group. The one outlier is GRN1, which is among the small canopy group, but is in the middle yield group, and overall had the fourth-highest yield in Madera.

The picture gets more complicated when looking at the yield results from Merced. The vineyard had not yet reached maturity when the last harvest data was collected and was suffering from the results of the delayed spring growth seen across the state back in 2021. The data did not separate into groups due to the large amount of variability seen across the research block. Overall GRN3 had the highest yield followed by RS3. RS9, followed closely by GRN4 and 1103P then followed, while GRN2 had the lowest yield. This is a vastly different picture in general, but a couple of constants do show through. GRN3 is again at the top of the yield ladder, while RS3 and GRN4 outproduced 1103P. However, the vast shift in production of RS9 and GRN2 is perplexing. Should we believe the yield data from Madera or Merced? Unfortunately, the vineyard where the research trial is located was top-grafted at the beginning of 2023. I won't be able to collect more data from that vineyard again until at least 2025.

To help solve this mystery it is helpful to check in with other trials run with these rootstocks. George Zhaung working on wine grapes in Fresno County found that GRN2 took longer to fully establish and produce large yields. Tian Tian working on table grapes in Kern County also found that GRN2 took a couple extra years to establish itself, with low yields in the begin-

ning before climbing to become a high-yielding rootstock. Her work also identified GRN2, GRN3, and 1103P as all belonging to the highest-yielding group of rootstocks. With Freedom, RS3, and GRN4 being intermediate producers. Lastly, Rhonda Smith working on wine grapes in Sonoma County again found that GRN2 had the largest vine (canopies). She also found that RS3 and RS9 had the smallest canopies and low yields.

Incorporating the information from both of my trials and the work done by other UCCE researchers. GRN1 has good yields with a smaller-sized canopy. GRN2 has a consistently large canopy, low levels of water stress, and can have large yields. It does typically take a couple of extra years for vines on GRN2 to reach their full potential. GRN3 has consistently large yields, with a solid canopy. GRN3 can become water stressed quickly. GRN4 has good yields and a good canopy. Overall, my only complaint about GRN4 is that it doesn't stand out as good or bad in any of the data, which isn't the worst thing to complain about. GRN5 also has good yields and a good canopy similar to GRN4. RS3 can have moderate yields and canopy but is often on the smaller side for both. RS3 is always on the higher end for water stress. RS9 is always on the smaller end of canopy growth often leading to overexposed fruit. RS9 is also always on the higher end of water stress.

About the author

Karl Lund is the UC Cooperative Extension Viticulture Advisor for Madera, Merced, and Mariposa counties. If you wish to get more information on these trials or need vineyard help from an advisor, he can be reached at klund@ucanr.edu

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources
Cooperative Extension Merced County
2145 Wardrobe Avenue
Merced, CA 95341-6445

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Tree and Vine Notes

August 2024

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Merced County Cooperative Extension
2145 Wardrobe Avenue
Merced, CA 95341
Phone: (209) 385-7403
Fax: (209) 722-8856
www.cemerced.ucanr.edu

Cameron Zuber, Farm Advisor
cazuber@ucanr.edu
https://cemerced.ucanr.edu/Orchard_Crops/
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