Oregon Wine Advisory Board
Research Progress Report

1998 - 1999

Evaluation of varieties, clones and rootstocks:

I. Evaluation of phylloxera-resistant rootstocks for the cultivars Pinot noir, Chardonnay, Pinot gris and Merlot

Michael McAuley and M. Carmo Candolfi-Vasconcelos
Department of Horticulture
Oregon State University

INTRODUCTION

With new vineyard planting and the replanting of older vineyards on phylloxera-resistant rootstock on the rise, grape growers are looking for rootstocks that are good fits for a particular site and management style. Making an informed decision on rootstocks before planting can help create a vineyard that will be manageable and profitable. Factors such as vigor, sunlight use efficiency and water transpiration can be useful in evaluating which rootstock might be appropriate for a site with certain limitations or abundance. Side-by-side analysis of rootstocks can help in determining which rootstock has desirable or undesirable traits for a chosen need.

The new rootstock experimental block at the Woodhall III vineyard was planted in the summer of 1997 and includes a trial of Pinot noir (clone FPMS 2A) grafted on nineteen rootstocks plus an own- rooted control. Another trial consisting of Pinot noir (clone FPMS 2A), Chardonnay (clone Dijon 95), Merlot (clone FPMS 3) and Pinot gris (clone Colmar 146) was planted, all four varieties grafted onto nine rootstocks and an ownrooted control. This report summarizes the analysis of the physiological growth responses during the 1998 growing season.

MATERIALS AND METHODS

Experimental design

vineyard is laid out on 7 ft. rows with 4 ft. between vines. Five blocks of five-vine replications are set from the top to the bottom to eliminate experimental error arising from attitude, soil depth and elevation. Vines were pruned to two buds per vine the previous winter. Two shoots were trained up a bamboo stake, one shoot as the future trunk and the other secured loosely to the stake as insurance for damage to the main shoot and as a source of photosynthesis. Measurements were taken from the same shoots of two randomly chosen vines in the replication in the last week of the months June, July and August; the mean of the two sub-samples was used as the observed value. Individual fully expanded leaves from the ninth to fourteenth node were chosen and marked for repeated leaf measurements.

The Pinot noir planted on 20 rootstock selections (PNx20) is a randomized complete block design and the four varieties planted on ten rootstock selections (4x10) is a splitplot design.

Data collectionB

nspiration, Photosynthesis and Water use efficiency (WUE)
Transpiration and photosynthesis were measured at peak leaf activity (between 9:00 and 12:00am, <90° F, photosynthetic flux density >1000Pumol/m^2/s) with a portable infrared gas analyzer (Ciris- 1, PPSYSTEMS, Hitchin, Herts, SG5 I RT UK). WUE is calculated by dividing photosynthesis by transpiration, or in other terms, what are the carbon gains per unit of water loss.

Sunlight use efficiency (FV/FM)
Maximum quantum efficiency of photosynthesis was measured with a portable fluorescence monitoring system (FMS1, Hansatech Instruments LTD, Kings Lynn UK). Leaf tissue was darkness-acclimated, subjected to a pulse of light, and the resulting fluorescence from the leaf measured. This measurement of energy relates to leaf photosynthetic performance.

Chlorophyll content
Light reflectance was measured with a chlorophyll meter (SPAD-502, Minolta CO., LTD, Japan). A correlation between these readings and actual chlorophyll content in the plant was then calculated.

48 leaves of each variety were collected, six leaf disks were cut, measured with the SPAD-502 and the chlorophyll extracted (Hiscock and Isrealstam) and measured by color spectrophotometry. The color spectrophotometer readings were then related to chlorophyll content in the plant and then to the SPAD-502 readings through regression analysis.

Shoot length and diameter
Shoot length was measured from the base of the shoot to the shoot tip with a flexible steel tape measure; the diameter with a digital caliper between the second and third nodes at the maximum reading.

RESULTS AND DISCUSSION

Pinot noir on 20 rootstock treatments

Table 1 summarizes the observations in the PNx20 trial. All of the responses showed differences by month. This was not unexpected, as there was a period of no rainfall and hot temperatures from June to August, which, when coupled with the limited rootzone of young vines, slowed growth through the summer.

Table 1. Ranking physiological responses of Pinot noir grafted to nineteen rootstocks and own-rooted vines.

Rootstock	Transpiration			Photosynthesis			WUE			FV/FM			Chlorophyll			Shoot Length			Shoot Dia.		
	June	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*
Riparia x Rupestris																					
Couderc 3309	H[1]	L	L	H	M	M	M	M	H	H	L	M	H	M	M	M	M	M	H	H	H
MG 101-14	M	M	M	M	M	M	M	M	L	M	M	M	L	L	L	L	M	L	M	H	M
Schwarzmann	M	L	L	M	L	L	M	L	L	H	L	L	M	L	L	H	H	H	M	M	M
Riparia x Berlanderi																					
Kober 5BB	M	L	M	M	M	M	M	H	M	L	L	L	M	M	M	M	M	M	M	M	M
MG 420A	L	M	M	M	M	H	H	L	H	M	H	M	M	H	H	L	M	M	M	M	M
SO4	L	M	M	M	M	M	H	M	L	H	M	M	H	H	M	L	L	L	L	H	M
Couderc 161-49	M	H	M	M	H	H	L	M	H	H	L	M	L	M	H	M	L	M	M	M	M
Kober 125AA	M	M	H	M	M	H	L	H	M	L	L	M	L	M	M	L	L	L	M	L	M
Teleki 5C	M	M	L	M	M	M	M	M	M	M	M	L	M	H	M	H	H	H	H	H	H
Teleki 8B	M	L	L	H	L	L	M	H	M	M	H	M	H	M	M	H	M	M	H	M	H
Rupestris x Berlanderi																					
Richter 110	M	M	M	M	M	H	M	H	H	L	M	M	M	L	H	M	M	L	M	M	M
1103 Paulsen	H	M	H	H	M	H	M	M	H	M	M	L	M	L	L	M	M	M	M	H	H
Richter 99	H	M	M	H	M	M	M	M	L	L	H	M	L	M	M	M	M	H	H	H	H
Ruggeri 140	H	M	M	H	M	M	M	H	L	M	M	H	L	L	L	M	M	M	M	M	M
Riparia																					
Riparia Gloire	L	M	L	M	M	L	H	H	L	L	H	L	H	M	M	L	H	M	L	M	L
Riparia x Rupestris x Cordofolia																					
4453 Malègue	M	M	M	M	M	M	M	L	M	H	M	M	M	M	L	H	H	H	H	M	M
Riparia x Rupestris x Berlanderi																					
Gravesac	M	M	M	H	M	M	H	L	M	M	M	H	H	M	H	M	M	M	M	L	M
Riparia x Solonis																					
Couderc 1616	M	M	L	M	H	L	M	M	L	L	M	M	H	M	M	M	H	H	L	H	M
Riparia x Cinerea																					
Börner	L	H	H	L	H	H	M	L	M	M	M	H	L	M	H	L	L	L	L	L	L
Vinifera																					
PN Own-rooted	L	H	H	L	H	H	H	H	H	M	H	H	M	H	H	L	L	L	M	M	M
Significant F																					
Rootstock		*[2]			ns			ns			ns			*			ns			*	
Month		*			*			**			***			**			***			**	
Rootstock x Month		***			*			*			ns			ns			ns			ns	

[1] H, M, L indicate highest, middle and lowest third as compared to the median, respectively.

[2] ns, *, **, *** indicate not significant and statistical significance at the 0.05, 0.01 and 0.001 levels, respectively.

In three of the responses, transpiration, chlorophyll content, and shoot diameter, the rootstock appeared as significant sources of variability. The three responses do not seem to be inter- related, although further observations will be made next year.

In three related responses, rootstock by month is a significant factor. Transpiration, photosynthesis and the resulting calculated WUE all show significant differences. Transpiration has an inverse effect on WUE; i.e. increased transpiration rates are a sign of lowered efficiency if photosynthesis is constant. If the vine closes the stomata in order to conserve water, it cannot photosynthesize. Closing down the stomata may decrease transpiration, but decreases photosynthesis also.

Four varieties on ten rootstock treatments

When analyzing the effect that variety has on the growth responses, six measurements showed no variety by rootstock significant differences, as listed in Table 2. As in the PNx20 trial, the date of the measurement was a significant variable.

Table 2. Ranking physiological responses of Pinot noir, Chardonnay, Merlot and Pinot gris grafted to nine rootstocks and own-rooted vines.

Rootstock	Transpiration			Photosynthesis			WUE			FV/FM			Chlorophyll			Shoot Dia.		
	June	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*	*June*	*July*	*Aug*
Riparia x Rupestris																		
Couderc 3309	M	H	M	L	M	M	L	M	L	L	H	L	L	L	L	M	H	M
MG 101-14	H	H	H	L	M	H	L	M	M	L	L	M	L	L	M	L	M	M
Riparia x Berlanderi																		
Kober 5BB	M	L	M	M	M	M	H	M	H	H	M	H	M	M	M	H	H	H
MG 420A	M	H	H	M	M	H	M	L	M	M	H	H	M	M	M	M	M	M
SO4	M	M	M	M	M	M	M	M	L	M	L	L	M	M	L	L	L	L
Rupestris x Berlanderi																		
Richter 110	M	M	M	M	M	M	M	H	M	L	L	L	M	M	L	L	M	M
Riparia																		
Riparia Gloire	H	L	M	H	M	M	H	M	M	M	M	M	H	M	M	H	H	M
Riparia x Rupestris x Cordofolia																		
4453 Malegue	L	M	L	L	M	L	H	M	L	M	M	M	H	H	M	L	M	L
Riparia x Rupestris x Berlanderi																		
Gravesac	H	L	M	H	L	M	L	M	L	M	L	M	M	M	M	H	H	H
Vinifera																		
Ungrafted	L	H	H	M	H	H	H	H	H	H	H	H	H	H	H	M	L	M
Significant F																		
Rootstock		***[2]			***			ns			***			***			*	
Month		*			*			**			***			***			***	
Rootstock x Month		*			***			ns			ns			***			ns	

[1] H, M, L indicate highest, middle and lowest third as compared to the median, respectively.

[2] ns, *, **, *** indicate not significant and statistical significance at the 0.05, 0.01 and 0.001 levels, respectively.

The rootstock variability was of very high significance in transpiration, photosynthesis, FV/FM and chlorophyll and significant in shoot diameter.

The interaction between rootstock and month was (as in the PNx20 trial) different when measuring transpiration and photosynthesis, but unlike the PNx20 trial, this trial shows differences in chlorophyll content.

The response that did realize an effect measured significant by statistical analysis was shoot length. Table 3 breaks down the rankings by month, variety and rootstock.

Table 3. Ranking the interaction of rootstock and variety on shoot length of Pinot noir, Chardonnay, Merlot and Pinot gris grafted to nine rootstocks and own-rooted vines.

Variety	Pinot noir			Chardonnay			Merlot			Pinot gris		
Rootstock	June	July	Aug	June	July	Aug	June	July	Aug	June	July	Aug
Riparia x Rupestris												
Couderc 3309	L	L	L	H	H	M	M	M	M	M	L	L
MG 101-14	M	L	L	L	L	L	H	H	M	M	L	L
Riparia x Berlanderi												
Kober 5BB	M	M	M	L	M	M	M	M	M	L	H	M
MG 420A	L	L	M	M	H	M	M	M	L	L	L	L
SO4	H	H	H	L	L	L	L	L	L	M	M	M
Rupestris x Berlanderi												
Richter 110	M	M	M	L	L	M	H	M	M	M	H	H
Riparia												
Riparia Gloire	M	M	M	H	M	M	L	L	L	H	H	H
Riparia x Rupestris x Cordofolia												
4453 Malegue	L	M	M	M	L	M	L	M	M	M	M	M
Riparia x Rupestris x Berlanderi												
Gravesac	H	H	H	H	H	H	M	M	L	M	H	H
Vinifera												
Ungrafted	L	L	L	H	M	H	H	H	H	M	M	L
Significant F												
Variety	ns											
Rootstock	ns											
Month	***[2]											
Variety x Rootstock	**											
Rootstock x Month	ns											
Variety x Month	ns											
Variety x Rootstock x Month	ns											

[1] H, M, L indicate highest, middle and lowest third as compared to the median, respectively.

[2] ns, **, *** indicate not significant and statistical significance at the 0.01 and 0.001 levels, respectively.

CONCLUSIONS

The rankings in Tables 1, 2 and 3 illustrate the differences in varieties, rootstocks, months and the interaction between the three, but just as important, how those responses change over the growing season. Considering the growing season Oregon experienced this year, performance of a particular rootstock during the hot, very dry month of August might give an indication of susceptibility to drought. Shoot length in the wet Spring of 1998 would allow analysis of vigor control possibilities. High rankings of photosynthesis in the Fall would indicate a possible advantage in ripening fruit as compared to the vines with lower rankings. Interpretation of this data in conjunction with other information is the key to success in choosing an appropriate rootstock.

FUTURE RESEARCH

We will continue the new rootstock block analysis in the 1999 growing season. The project will include continuing the measurements conducted in 1998 to compare seasonal differences. Additionally, phenology surveys of budbreak, bloom and viraison will be conducted, as well as fruit composition analysis of brix, pH and titratable acidity in hopes of creating a comprehensive data base for grape growers and winemakers.

ACKNOWLEDGEMENTS

We would like to gratefully acknowledge Steve Castagnoli, Matt Compton, Scott Robbins and the whole OSU viticulture crew for their hard work throughout the year. Thanks also to Walt Mahaffee's USDA Plant Pathology crew for their help during crunch time. Finally, thank you, Oregon Wine Advisory Board for your financial support.

REFERENCES

Hiscox, J. D., and G. F. Isrealstam. 1979. A method for the extraction of chlorophyll from leaf tissue without maceration. Can. I Bot. 57: 1332-1334.