*Summary 77*

VITICULTURE & ENOLOGY
UNIVERSITY OF CALIFORNIA DAVIS

# "Grapevine root system and soil characteristics in a vineyard maintained long-term with or without interrow sward"

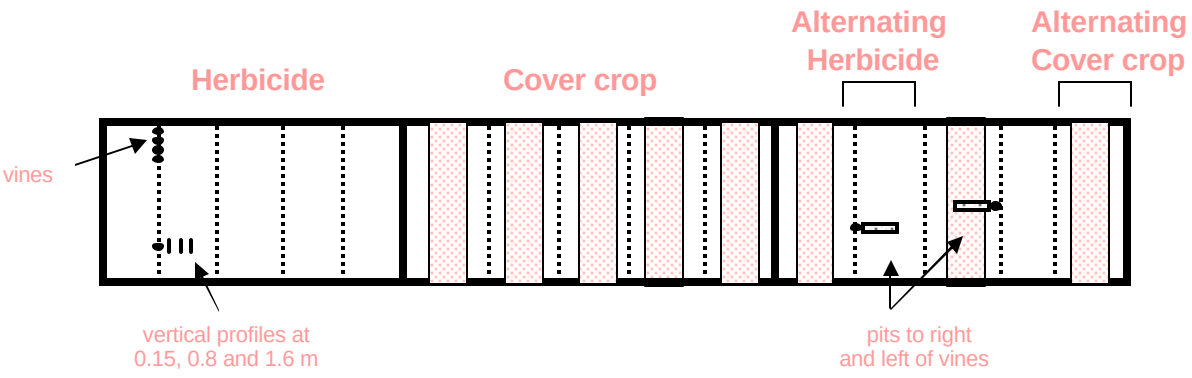
By: René Morlat and Alain Jacquet

In: Am. J. Enol. Vit. 54(1)1-7. 2003

In what seems one of the longest formal vineyard experiments ever, these French authors compare the root distribution and soil properties in a vineyard maintained for 17 years with or without a cover crop in the interrows.

- Some of the benefits attributed to cover crops include: 1) improvement of soil physical properties, 2) increase of organic matter, 3) reduction of run-off and erosion, 4) decrease of vine vigor, and 5) reduction of bunch rot by *Botrytis*. Drawbacks mentioned in some situations may include: 1) competition for water and nutrients, and 2) low nitrogen levels in resultant musts, necessitating correction.

- In 1977 the authors decided to study the long-term effects of a cover crop by comparing 3 soil management systems: 1) herbicide in the whole vineyard (**H**), 2) permanent cover crop in all the interrows, but not under the vines (50% of vineyard floor covered) (**CC**), and 3) a combination of both, that is, cover crop in alternating interrows (25% of vineyard floor covered). Because within this latter treatment, the authors study those interrows treated with herbicide separately from those treated with cover crop, they refer to them throughout the text as two different sub-treatments: alternating herbicide treatment (**AH**) and alternating cover crop treatment (**ACC**). The cover crop was the grass *Festuca arundinacea* (tall fescue).




**Modified from the authors**

- The trial site was the Loire Valley (France), which has a relatively dry climate (550 mm, or 21 inches, of rain a year). The vineyard was planted to Cabernet Sauvignon onto SO4 at 1.2 x 3.2 m spacing (4 x 10.5 ft). The soil was loamy-clayey in the A-horizon, with a clayey B-horizon, between 0.8 and 1 m of depth altogether, and holding abundant water reserves (185 mm, or 7 inches, in the first meter). There were 6 replicates per treatment, and 84 vines per replicate.

- To measure **root distribution**, the authors dug 6 pits per treatment, 3 to the right, and 3 to the left of the vine, to account for any root asymmetry. In each pit, they measured fine, medium, and large root interceptions (<1 mm, 1 to 2 mm, and >2 mm) within each of 3 *vertical profiles* situated at increasing distances from the vine trunk (0.15, 0.8 and 1.6 m), and at each of 3 depths or *horizons* (0 to 0.2 m, 0.2 to 0.45 m, and 0.45 to 0.9 m). Results were expressed as number of root interceptions/$m^2$.

- The authors also measured the following **soil properties**: soil bulk density, soil strength (as measured by a penetrometer), water at field capacity, soil organic matter, pH, total nitrogen, phosphorus ($P_2O_5$), potassium (K2O), and magnesium (MgO).

- **Effect of cover crop on root distribution**. Fine roots (<1mm) were the most abundant type of root, representing 73-98% of total roots counted. Closer to the vines (0.15 m profile) fine roots were significantly higher in the cover crop and the alternating cover crop treatments. Farther away from the vine (1.6 m profile), roots were much more numerous in the herbicide and the alternating herbicide treatments. In other words, **with the cover crop, fine roots tended to concentrate more around the trunk**. As for woody roots (>2 mm), there were no significant differences, except for more roots in the 0.8 m profile for the herbicide treatment. That is, **more large roots tended to reach further out in the herbicide treatment.** In general, root density was higher in the upper soil layers than the deeper ones.

- The authors found a negative correlation between roots of grass (dry mass) and roots of vines (counts) in the upper horizons. They concluded **grass was inhibiting the growth of vine roots in the upper horizons**. Finally, by comparing amount of roots found in the right and left pits, they were able to calculate a degree of *root asymmetry* for each treatment. They found that the asymmetry was highest for the alternating herbicide treatment. This means that, even though everything looks the same above ground, alternating cover crop and herbicide caused roots growing towards the herbicide side to be very different from those growing to the cover crop side.

- **Effect of cover crop on soil properties.** The following effects were mainly in the topsoil (0 to 0.2 m and 0.2 to 0.45 m horizons). Organic matter, nitrogen level, C/N ratio, pH, exchangeable potassium, and moisture at field capacity were all significantly higher in the cover crop treatments. *Available phosphorus* was low, and similar for all treatments, whereas *exchangeable magnesium* was high in all treatments. *Bulk density* and *soil strength* were significantly lower in the cover crop treatments. (Lower values for these latter two parameters mean looser, more porous soils and are desirable.)

- **Effect of cover crop on vine growth.** From 1980 to 1994, the presence of a cover crop had significant effects on vine performance. Pruning weights, lateral shoots, yield, and Botrytis infection were all reduced in the cover crop treatment when compared to the herbicide treatment. Sugar, anthocyanins, and tannin content were all also higher in the cover crop treatment (better grape composition). Finally, temperature and sun exposure were improved in the cover crop treatment. These effects were due to the competition of the grass for water and nutrient uptake. As the authors point out, the limitation of aboveground biomass (as shown by less lateral shoots) is likely an adaptation mechanism of the vine to reduced water supply.

In summary, under permanent grass cover, there is a decrease in the number of vine roots in the interrow due to competition, but an increase closer to the trunk. The amount of organic matter, nitrogen, exchangeable K, pH, and soil moisture at field capacity all increase under grass cover. In contrast, bulk density and mechanical resistance of the soil decrease. So do we gain or do we lose with cover crops? The authors do not make recommendations. They do point out that, while cover crops increase organic nitrogen in the upper layers, uptake of that nitrogen by the vine is also reduced due to fewer roots and less water available in the soil. In situations that can handle some degree of de-vigoration and yield reduction, cover crops can greatly improve soil physical properties and juice quality.

*Author: Bibiana Guerra, Editor: Kay Bogart. This summary series funded by* J. Lohr Vineyards & Wines.