

A few words on grapevine roots

Alain Deloire¹, Anne Pellegrino¹, Suzy Rogiers²

¹ Montpellier SupAgro, France

² NWGIC, DPI-NSW, Australia

(Contact : alain.deloire@supagro.fr)

Three phases of root development (Branas and Vergnes, 1957) have been described:

1. Juvenile or colonisation phase:
 - During the year of planting, new roots grow from the cutting, elongate and spread to form the future root system.
 - During the second year, any further root elongation and spread may be the result of the development of roots from the periderm. The annual total root system elongation decreases because the growth capacity is divided between numerous root tips.
2. Adult phase:
 - This is the phase when the average annual root elongation has slowed and stabilised.
 - During phase 1, the nature of the root system is dictated by soil characteristics.
 - It takes 7 to 8 years for a root system to be established.
 - At this age, root colonisation is practically complete and above-ground vigour (Ev = Expression vegetative) reaches a maximum.
3. Aged phase:
 - Ageing and decline of vine roots are the result of many causes (cell ageing, pest and diseases, soil problems as salt, dryness...).

Roots can be separated into two classes depending on their diameter, lifespan and function. Thick roots (diameter > 2mm) are generally woody and perennial. Although they represent a low proportion of the total root system, they play a major role for plant anchoring in soil and for carbohydrate storage. They also take part in water absorption. Fine roots (radicelles in french) diameter is lower than 1 mm. Their lifespan is shorter than the growing season. They are mainly responsible for water and nutrient absorption, are found in the top 100 - 600 mm soil depth.

The growth of fine roots occurs mainly from bud break to flowering, drawing on vine carbohydrate reserves because at this period of development, the vine is heterotrophic.

It is Important to note that after harvest and if the leaves remain functional on the vines (usually in a temperate-warm climate), new fine roots will grow and this will allow the vine to continue to replenish the carbohydrate and nitrogen reserves (water is needed for that purpose).

According to Mahmud et al. (2018), fine root growth of grapevines was found to have a pronounced diel pattern, and it was established that an endogenous circadian clock appears to orchestrate this rhythm. Soil temperature modified the amplitude of this pattern (relative to 22°C, 30°C of soil temperature halved root growth), but the authors argued that, as evidenced from exhausted starch reserves within root tips by early morning, carbon supply from photosynthesis is also required to maintain maximum root growth.

The mass of the root system of a single vine varies between 4.5 kg and 7 kg depending on age, and increases with years.

As an example and according to Esau (1967), a 12-year-old *Vitis rupestris* vineyard produced a total root mass of 20 t/ha, while a 58-year-old vineyard produced 31 t/ha.

A few references

Mahmud M.P., Holzapfel B.P., Guisard Y., Smith J.P., Nielsen S., Rogiers S.Y., 2018. Circadian regulation of grapevine root and shoot growth and their modulation by photoperiod and temperature. *Journal of Plant Physiology*, 222, 86-93. Branas, J. & Vergnes, A., 1957. Morphologie du système racinaire. *Prog. agric. vitic.*, Tome CLXV, 74me année, Nr. 3-4:29-32; Nr. 7-8:94-104; Nr. 9-10:122-129; Nr. 11-12:147-158; Nr. 13:173-183; Nr. 14-15:203-209. Esau, K., 1967. *Anatomy of Seed Plants (1st ed.)*. Int. Ed. John Wiley & Sons, Inc: New York.

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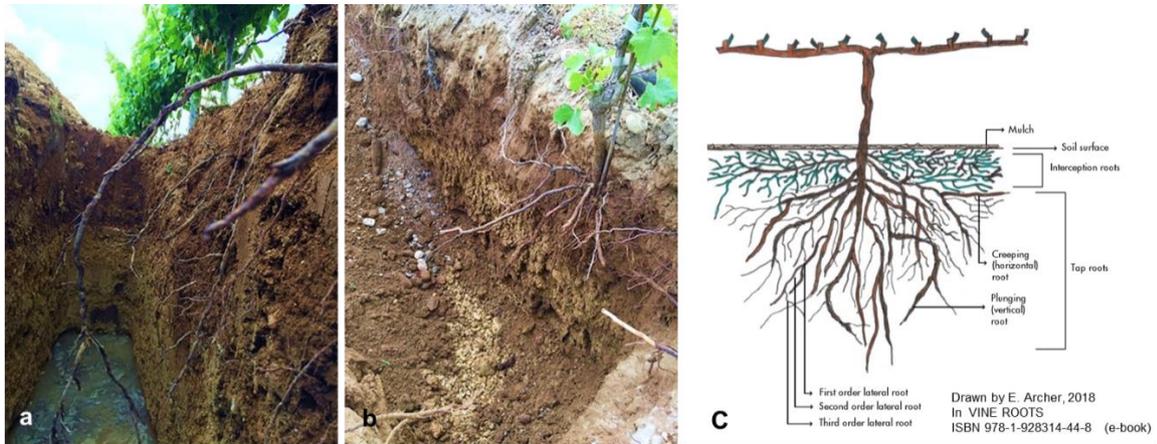


Figure 1: Examples of grapevine root systems: a) deep roots in a clay soil; b) shallow roots in a sandy soil; c) schematic showing the interception roots (fine roots) located within the upper layers of the soil (first 10 to 60 cm) and the tap roots (thick adult roots) which have developed at depth (photos from A. Deloire; schema drawn by E. Archer).