**Vitis vinifera, grapevine**

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**Brief facts**

- *Vitis vinifera* (grapevine) is native to Europe as well as East and Central Asia and is suggested to have first appeared ~65 million years ago.

- Grapevine has been planted all over the world for the wine, raisin, and table berries production and is the most economically important fruit crop in the world. The wine production is historically most important use for grape berries. The earliest evidence of wine production was found in Iran at the Hajji Firuz Tepe site about 7,400-7,000 years ago. Seeds of domesticated grapes dated from ~8,000 years ago were found in Georgia and in Turkey. Remains of wild grape seeds at various archeological sites suggest that the grape berries were collected and used since Neolithic period. Grapevines were introduced in New World in 16th century and to South Africa, Australia, and New Zealand in the 19th century.

- *Vitis vinifera* genome is relatively small - approximately 500 Mbp
(four times the size of *Arabidopsis thaliana* genome and one sixth the size of maize genome) but quite complex with only about 4% of the genome transcribed. Today, the genome is a subject of intense research with multinational consortia collaborating in several initiatives to develop genetic markers as well as the complete sequencing.

- Grapevine cultivars result from the selection of genotypes generated by spontaneous crosses centuries ago. These cultivars are propagated vegetatively and each cultivar represents a unique, usually highly heterozygous, genotype. The number of different grapevine varieties held in germplasm collections around the world is estimated at 10,000. However, it is only a pale reflection of diversity that existed as recently as in 19th century. At the end of the 19th century, after several millennia of geographical expansion, pathogens from America reached Europe (mildews, *Phylloxera spp*.) resulting in destruction of many European vineyards and greatly diminishing the number of European cultivars. The European viticulture was restored to some degree by the introduction of several indigenous American, non-vinifera, *Vitis* species that were used as rootstocks and for breeding disease-resistant hybrids. Over the past 50 years, the diversity of cultivated grapevine has undergone another reduction due to globalization of wine companies and markets, resulting in formation of **Big Five** most familiar cultivars: *Chardonnay*, *Cabernet Sauvignon*, *Syraz (Shiraz)*, *Merlot*, and *Sauvignon blanc*.

- Main sources of grapevine diversity: reproduction by seed (each seed represents a unique combination of parental alleles), sexual mutations, and spontaneous somatic mutations. Stable chimeric plants result from somatic mutations if the mutation occurs in a cell of the shoot apical meristem and the mutated cells dominate one cell layer over a period of time. Old grape cultivars that were propagated vegetatively for decades have accumulated mutations over time, extensive annual pruning facilitates isolation of these mutations in individual plants. Many variants were selected this way.

### Developmental stages (life cycle)

**Life Cycle Stages**

*Vitis vinifera* is a perennial plant. Longevity of the grapevine depends on many

- seed stage **MeSH**
- vegetative

### shoot and inflorescence development

- **bud**
  - **latent bud**
    - Inflorescences are initiated in the latent bud during the summer of the first year; in *Vitis vinifera* the simultaneous formation of both vegetative and reproductive forming organ primordia are usually produced by same apex; the formation of flowers occurs during the following spring
  
- **winter bud**
  - E-L stage 1; no visible indication of growth; buds are covered tightly by many layers of bud scales

- **scale crack**
  - E-L stage 2; a small crack occurs between the hard outermost bud scales as the bud begins to swell

- **bud-swell**
  - E-L stage 3; wooly bud; the bud has swollen; by end of this period one or more bulges of leaf tissue are visible and appear green or pink; the bud remains closed around the growing point; activation of all structures in the latent
bud, especially the differentiation of inflorescences and the first steps of floral organ development

- **bud break**
  - also called budburst; leaves have separated at the tip, usually exposing the growing point

- **rapid vegetative growth**
  - E-L stages 7-16; the period starts with first leaf separated from shoot tip and continues until up to 10 leaves separated, shoot elongating rapidly, single flowers in compact groups

  - **1-3 in. shoots**
    - the stem is 4-6 cm in length with 1-3 small leaves

  - **4-8 in. shoots**
    - shoots are 4-8 inches long

  - **10-16 in. shoots**
    - shoots are more than 8 inches long; flower clusters are visible

- **before flowering**
  - E-L stages 17-18; from 10 to about 14 leaves separated; inflorescence well developed, single flowers separated; on stage 18 flower caps still in place but cap color fading from green
• **flowering**

  - **early flowering**
    E-L stage 19-20; first flower caps loosening - 10% caps off

  - **full bloom**
    E-L stages 21-23; most the flowers are open; 17-20 leaves separated

  - **late flowering**
    E-L stages 25-26; 80% caps off - cap-fall complete

• **ripening**

  E-L stages 27-39; grape fruit does not require climacteric respiration or increased ethylene for maturation (non-climacteric ripening)

  - **berry formation**
    E-L stages 27-33

  - **fruit set**
    E-L stages 27-29; young berries enlarging, bunches are at right angles to the stem at the beginning, then, when berries reach pepper-corn size, tend downwards
- **green fruit**
  also called **pre-veraison**; berries are green and hard; during this stage, there is virtually no change in volume or weight of the berries

- **berries pea-size**
  E-L stage 31; berries about 7 mm in diam.

- **berry touch**
  E-L stages 32-33; bunch closure; berries touching; berries still hard and green

- **berry ripening**
  E-L stages 34-47

- **veraison**
  E-L stages 34-35; the period of the beginning of berry ripening; the berries become soft and take on the colors characteristic of their specific varieties; berries are increasing in volume, weight, and sugar content (brix)

- **postveraison**
  E-L stages 36-37; nearly ripe

- **ripe**
  E-L stages 38-39; ripe berries that are ready for harvest; traditionally grapes are harvested 100 days
after flowering, however, ultimate decision is made on case by case basis

- senescent

E-L stages 41-47; after harvest; cane maturation complete; leaves falling

Grapeyard, Maryland
References

Websites

- Understanding grape berry development.
- Virtual Crops: *Vitis vinifera*
- Michigan Grapes
- Grape Growth Stages