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Overview of Environmental Agents

- Microclimate and soil affect growth and life processes of grapevine.
- Their total impact on particular varieties is referred to as environmental factors.

Classification of environmental factors:

- Climate factors: Light, heat, water, air
- Soil factors: Physical, chemical and biological properties of soil
- Topographic factors: Location, elevation, terrain, slope, exposure of the slope
- Anthropogenic factors: Human impact on the environment

- Site selection (proper climatic and soil factors) is an essential prerequisite for successful grapevine cultivation. Selection of a proper vineyard site location and exposure affects future growth and development of the vine as well as quality and quantity of the yields.

CLIMATIC FACTORS

Light:

- Light perception is an important factor for the whole site as well as for grapevine training and canopy management.

- A bloom set is most affected by temperature and light intensity. Amount of light perception during May through July affects number of flowers in a next year crop. Amount of light reception three months before a harvest is a significant indicator for grape-berry ripeness.
- Grapevine is a light-demanding plant and does not tolerate shading. Lack of sunlight causes development of thin and long shoots with long internodes. Light intensity affects shape, size and colour of leaves. Serious shading causes leaf fall (leaves turn yellow).
- All cropping measures aim to provide the plant with a maximum amount of light - proper spacing, aspect of a slope (north-south, east-west in southern regions) and vine training.

Heat:

- The most important site factor (vine is a heat-demanding plant). Average daily temperature of 10 °C is an active temperature initiating life processes in above-ground parts of the plant.
  - Temperature at 0.30 m soil depth during a phase of the so called vine bleeding: 5-6 °C
  - Warming of air during a bud-break phase controls timing, intensity and place of the bud-break. Critical air temperature (depending on genetic properties of a variety): 8-12 °C
- Daily average temperatures must not drop below 15 °C during and before a vine flowering phase. Pollen loses its germinating ability at 10-13 °C and cannot be used for pollination – a flower drop. Flowering date may be calculated as a sum of average daily temperatures higher than 15 °C (total of 180 °C).

- Critical temperature during bloom set is 20 °C for at least 4 hours a day. Temperature rise has positive impact up to 30 °C.
- Shoot growth: Temperature in a previous day affects growth speed of a shoot the following day.
- Berry development: Temperature along with other factors affects berry size (both in the first and third stages of the berry development).
- Berry ripening and lignification of shoots: Temperature accelerates a flow of assimilates into a berry, and formation of colorants, tannins, and amino-acids; negative impact on aromas. Temperature defines differentiation of internal tissues of a phloem, which together with other factors affects vine shoot maturation.

- Dormancy stage: Temperature affects degree of dormancy of winter buds; proper range of temperatures hardens the vine shoots.
- Growing season: Starts at temperatures higher than 10 °C and terminates in the autumn with temperatures below 10 °C. Very early varieties: 105-115 days of a growing season ('Irsay Oliver', 'Sieger'). Early varieties: 115-125 days ('Julski biser', 'Královna vinic') - Medium-early varieties: 130-145 days (Müller Thurgau, Frühroter Veltliner, Chassellas Blanc, Chassellas Rosé, Pannónia Kincse). Late varieties: 150-165 days (Pinot Blanc, Pinot Gris, Pinot Noir). Very late varieties: 165-180 days (Welschriesling, Rhine Riesling, André, Limberger).
- Average annual temperature: Min. 9 °C, optimum: 11-16 °C. Average temperature during the whole growing season is a rough point of reference and should not drop below 14 °C in winemaking regions. Average temperature of the warmest month (July) should not drop below 17 °C. Average July temperatures of 19 °C produce good-quality wines; above 19 °C: Czech wines have excellent quality. Sum of active temperatures (all average daily temperatures above 10 °C) during a growing season must reach min. 2,200 °C (the most early varieties); sum of 2,500 °C - Müller Thurgau; sum of 2,700 °C – most of medium-late wine grape varieties.

- Low temperatures have a negative impact on bud break, flowering, and grape and shoot ripening; wines are sour and less alcoholic. Very low temperatures - frosts damage individual vine organs and sometimes even the whole plants.
- Common frost periods in the Czech Rep.:
  - Late spring frosts, at the onset of a growing season till bud break (formation of short shoots); commonly in mid-May. Temperatures of -2 °C freeze young shoots and destroy future harvest. Protection from frost injury: Proper vineyard site selection, do not disintegrate the soil (preventive measures, direct protection – irrigation)

- Premature spring frosts, especially strong and long-lasting frosts are dangerous. Mature vine shoots and buds tolerate a short-term frost period of max. -20 °C. Long-term frost periods combined with strong winds damage the vines at -15 °C. Temperatures below -15 °C: Damage of the old wood. Preventive measures – proper cropping practices (nutrition, fertilization, pruning and training); all these measures promote healthy ripening of the vine shoots. Tilling of soil in young vineyards protects graft unions.

Water:

- The most important part of a grapevine, especially of all young plant parts. Water is a dissolvent and a transport means for nutrients; it keeps balance of the plant cells and participates in many metabolic processes.

- Precipitation is important in its total as well as in its distribution throughout the growing season. Minimum precipitation equals 300 mm, optimum is 600-800 mm. Northern wine-growing regions have maximum precipitation in summer (June, July); southern regions in winter (October through March). Decrease in water reception in southern regions during summer together with high light perception and heat absorption causes less vigorous shoot growth, accelerated grape ripening and lignification, increase in grape sugar content and decrease in concentrations of acids, namely malic acid.

Grapevine has three basic periods for increased water reception:

- 1. Before bud break – water is crucial for buds breaking on a vine. Lack of water results in few breaking buds and bark cracks; excess water causes breaking of buds on vine shoots as well as breaking of dormant buds on the old wood.

- 2. After blossom loss, during berry set – amount of water in soil affects quantity of berry setting and thus also future cluster compactness. Water has positive impact on cell division in berries during the first stage of berry development; berries may thus become larger during swelling.

- 3. Right before verasion when water is transported from soil to the berries.
- When evaluating the vineyard site, it is important to observe not only total precipitation and its distribution throughout the year but also the form of the precipitation. Rainstorms are dangerous on slopes due to the possible soil erosion.
- Frequent morning dews are dangerous due to potential occurrence of peronospora. Frequent fogs promote fungi diseases of the vine; however, they also promote development of aromas in ripening grapes and elimination of acids. Hailstorms damage young, delicate shoots.

- They also reduce yields and spread fungi diseases. Snow is an insulation layer preventing frost-damage. Snow also protects the root system from freezing. Snow supplies soil with moisture.

Air:

- Air streams and the atmosphere have enormous influence on grapevine. Winds may change temperature in the vineyard sites. Air streams are commonly classified as either cooling or warming. In Czech climate, cooling air streams are more frequent; they delay harvest and yields are worse than in protected vineyard sites. Mechanical factors also have a negative impact on grapevine, especially during a flowering phase (Neuburger, Muskat Ottonel, Chasselas Blanc, Chasselas Rose). Wind reduces berry set and damages leaves (Portugal, Müller Thurgau).
- Carbon dioxide concentrations in air are important. Emissions from commercial facilities are destructive (sulphur dioxide – leaves deformation, exhaust fumes, herbicides evaporation – sensitive varieties, such as Veltliner, Gewurztraminer, Portugal).

Soil factors

- There are various types of soils in vineyard sites. Grapevine requires specific soil types, and may be cultivated only in areas with well aerated soil which has sufficient moisture and nutrients content. Grapevine is sensitive to a soil type, mechanical composition of soil, irrigation and temperature, minerals and depth of a soil layer. Depth and looseness of soil are basic prerequisites for proper development of a grapevine root system. Vineyard sites with thick soil layer: Shallow tilling of soil before vineyard establishment (0.5-0.6 m deep); shallow, dry soil layers: Deep tilling (0.7-1.0 m).
- Optimum temperature for root growth is 25 °C, roots growth is reduced if temperatures drop below 10 °C or exceed 30 °C. Best conditions for roots growth: adequately moist soil. Oxygen concentrations decrease with soil depth while carbon dioxide concentrations increase.