INNOVATIVE INTEGRATED TRAINING IN
HEALING PLANTS
BUSINESS

IO3 - The Total Business Plants Training Material

Module No. 1

“Organic cultivation of medicinal plants”

Sofia University “St. Kliment Ohridski”

2. Unit 2 Environmental factors influencing the organic cultivation of MP – ecological tolerance

• Summary

In Unit 2, the environmental factors Influencing the organic cultivation of MP and their ecological tolerance are discussed, namely light; temperature, atmosphere humidity, altitude, rainfall, water supply, greenhouse effect. The significance of MP genetic characteristics and their manipulation for successful cultivation is also commented..

• Learning outcome descriptors

By the end of the Unit, the trainee should be able to:

- ✓ **Knowledge, understanding and professional skills:**
  1. Discuss different factors (agromeliorative and environmental) influencing organic cultivation of MP
  2. Explain ecological tolerance of MP
  3. Evaluate the significance of MP genetic characteristics and their application for cultivation purposes
- ✓ **General and transferable skills:**
  1. Plan a research task.
  2. Work independently or with a minimal guidance where appropriate.
  3. Work in team with minimal guidance where appropriate.
  4. Show good written and oral communication skills.
  5. Demonstrate computer literacy
  6. Perform online (computer) search to develop information technology skills in order to retrieve information from a variety of sources.

2.1 Light:

Light, in addition to the energy of the chemical bonds in the chemical compounds, is the second major type of usable energy and the only external one that provides for maintenance of life on our planet. For plants – it is the only one source. Light influences photosynthesis, opening and closing of stomata, plant movements, seed germination, flowering and vegetative growth like tuber formation. In addition to these basic physiological processes, light stimulates the accumulation of important MP ingredients. For instance, dry sunny weather increases the proportion of glycosides in Digitalis and of alkaloids in Belladonna.

2.2 Temperature:

Temperature is the major factor influencing the cultivation of the MP. Significant fluctuations from the optimal growth temperature in both directions may cause serious injuries even death of the MP cells. For instance, the decrease of the temperature to values around the zero, especially the sudden one, causes the formation of the ice crystals in intercellular spaces of the plant. As a result, water comes out of the cells and ultimately plants die due to drought and desiccation. The ice crystals also mechanical injure the cells. Water absorption decreases at low temperatures and the insufficient free water in the cell threatened the normal metabolic processes in it.

On the other hand, the moderate increase in the temperature stimulates the growth of seedlings and elevates the rate of photosynthesis. The rate of respiration increases with increase in temperature as well.

2.3 Atmosphere humidity:

By definition, the water vapors in the air are called atmospheric humidity. The visible forms of humidity are clouds and fog. The major sources of water vapors in the atmosphere are evaporation of water from earth surface and transpiration from plants. Humidity imposes a major effect on plant life and climate. Evaporation of water, its condensation and precipitation depend upon relative humidity and humidity affects structure, form, and transpiration in all plants, including MP.

2.4 Altitude:

The altitude is the most important factor influencing cultivation of MP. In fact, the altitude restricts the growth of MP. With the increase of the altitude, the temperature, and atmospheric pressure decreases while the wind velocity, relative humidity and light intensity increase.

Some MP can be adapted to grow at high altitudes: these are valerian, angelica, mint, sweet balm, St John's wort, Great burdock, Coneflower. Low altitude, especially under the Mediterranean influence, is very convenient for cultivating species such as thyme, salve, lavender, and rosemary. In such altitude, the extracted essential oil is of better quality and yield.

Thus, the altitude is an environmental factor that interrelates various indices that determine the climatic conditions in an ecological niche.

2.5 Rainfall:

The rainfalls are also an important factor influencing cultivation of MP. The main source of water for the soil is rainwater. Rainfall and snowfall have a large effect on the climate condition. The water from rainfall flows into the rivers and lakes percolates into the soil to form groundwater, and remaining is evaporated. The minerals in the soil get dissolved in water and are then absorbed by plants. Water influences morphological characteristics, as well as the physiology of MP. Continuous rain, can lead to a loss of water-soluble substance from leaves and root by leaching; this is known to apply to some plants producing glycosides and alkaloids.

2.6 Water supply:

The place for cultivation is very important for the growth of a given culture as well as for the proper irrigation. It is substantial to avoid the formation of swamps or stagnant waters. MP cannot be cultivated in heavy and water retaining soils.

Depending on water supply, different types of soil exist:

- High water supply: irrigated land (sprinklers) or big volume of rainfall,
- Low water supply: dry land (trickle irrigation).

The adequate soil for the cultivation of MP is the one in the dry zones. It is proven that in such type of soil, the quality and abundance of essential oils in plant biomass is higher than in the irrigated soil. For instance, such tendency is found during cultivation of lavender, thyme, rosemary and St John's wort. In addition, good yields have been registered with cumin, fennel and aniseed.

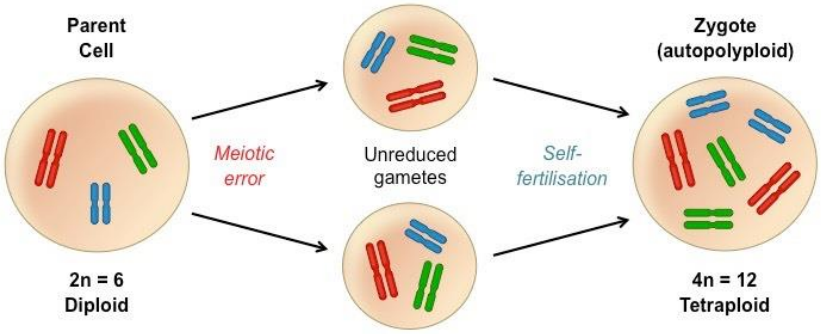
The irrigated soil is suitable for cultivation of a number of species like mint, basil, peppermint, valerian, used as a whole plant either their leaves or root.

2.7 Plants polyploidy significance – ecological considerations

Plants cells that contain two sets of chromosomes, derived at fertilization from the union of one set from the pollen and one set from the egg cells, are named diploids and denoted by "2n". The term polyploidy is applied to plants with more than two sets of chromosomes in the cells; when four sets are present, the plants are described as tetraploids and denoted by "4n".

Tetraploidy is induced by treatment with colchicine, which inhibits spindle formation during cell division so that the divided chromosomes are unable to separate and pass to the daughter cells. The two sets of chromosomes remain in one cell and this process results in tetraploid plants.

Treatment with colchicine may be applied in different ways. Besides, all the treatments depend on the effects they produced in the meristem tissue. For instance, the seeds may be soaked in a dilute solution of colchicine. Alternatively, the seedlings, the soil around the seedling or the young shoots may be treated with colchicine solution. The tetraploid condition is designated by the increased size of the pollen grains and stomata, and by chromosome counts in root-tip preparations. These robust and healthy tetraploid plants represent ecological advantages, since they are easily grown with good harvest yields.

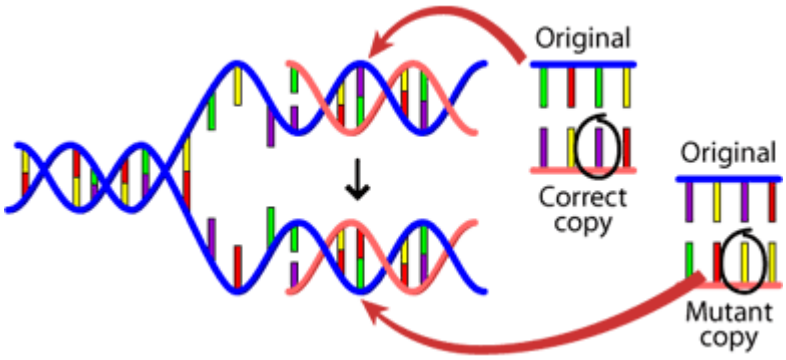


2.8 Heredity, variability and ecology

Mutation:

Any heritable change in the structure of a gene on a chromosome or change in the chromosome number is denoted as mutation. Plant mutations can be classified by their way of induction (spontaneous and induced mutations); the time of their phenotypic appearance (recessive and dominant mutations); the type of cells they affect (somatic and germinal mutations); the type of genetic material they affect (chromosomal, genomic and point mutations), and mechanisms of action (forward, back and suppressor mutation).

Certain agents, called mutagens or mutagenic agents can artificially produce induced mutations. The basic types of mutagens are classified as physical mutagens and chemical mutagens.



Hybridization:

A hybrid is the resultant of mating or crossing two genetically dissimilar plants with desired genes or genotypes that are brought together into one individual. Hybridization is the process through which hybrids are formed. A hybrid is an organism, which results from crossing of two species or varieties differing at least in one set of features.

Hybridization between homozygous strains, which have been inbred for a number of generations, introduces a heterozygosis effect that results in better vigor or plant dimensions and in other characteristic of the plants.

The procedure for obtaining hybrids, including from MP encompasses the following steps:

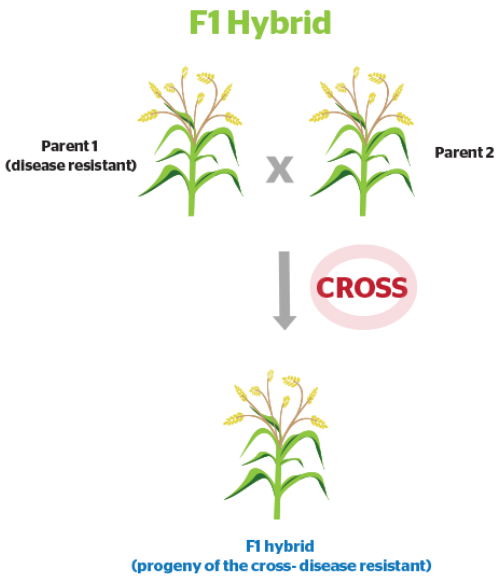
1. Choice of parents: between the two parents to be selected, at least one should be as well adopted and proven locally variety.

2. Emasculation: the process of removal of stamens or anthers, or killing the pollen grains of a flower without affecting the female reproductive organs. Emasculation is essential in bisexual flowers.

3. Bagging: immediately after emasculation, the flowers or inflorescences are enclosed in bags of suitable sizes to prevent random cross-pollination.

4. Pollination: mature, fertile, and viable pollens are placed on a receptive stigma.

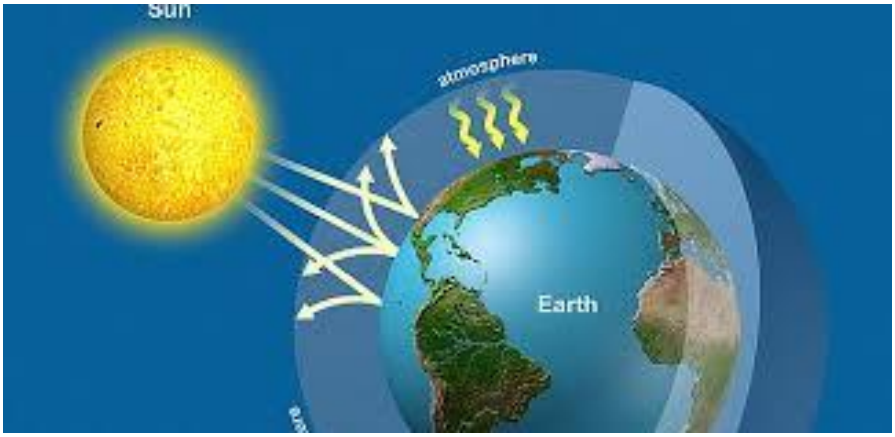
5. Raising F1 (first-generation) plants: pollination is followed by fertilization. Fertilization results in the formation of seeds. Mature seeds of F1 generation are harvested, dried and stored. These seeds are grown to produce F1 hybrids - robust and healthy.



2.9 Greenhouse effect:

In norma, sunrays reach the earth and the heat is radiated back into space. However, when carbon dioxide concentration increases in the atmosphere, it forms a thick cover and prevents the heat from being re-radiated. As a consequence, the atmosphere gets heated and the temperature elevates. This is called greenhouse effect. In the recent pass, amount of carbon dioxide has increased from 290 ppm to 330 ppm due to the cutting of forests and excessive burning of fossil fuels. The rate at which the amount of carbon

dioxide in the atmosphere is increasing, it is expected to cause the rise in global temperature. The so-called global warming by two or three degrees would cause polar ice caps to melt, floods in coastal areas, change in the hydrologic cycle and islands would get submerged. The gases producing greenhouse effect are carbon dioxide, sulfur dioxide, oxides of nitrogen, chlorofluorocarbons, etc.



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