



CULTIVATION, COLLECTION, CONSERVATION AND ELABORATION OF MEDICINAL PLANTS PRODUCTS

Workbook



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This project has been funded with support from the European Commission.



Introduction

This handbook includes class notes and exercises to learn everything about medicinal plants production

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This material has been produced thanks to the financial assistance of:



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1. Cultivation

Structure of a Cultivation Project

A project of cultivating plants and processing products must be considered following some activities that must be carried out in a certain order.

Here are 14 points to consider for the development of the project:

1. Soil conditioning.
2. Select the species.
3. Planning and design of the crop.
4. Premises, equipment, tools and necessary material.
5. Apply efficient irrigation systems. Predict irrigation strategies.
6. Avoid or reduce evaporation.
7. Cultivation, implantation, maintenance, collection, transformation requirements.
8. Conduct coherent cultural practices.
9. Expenses and yields.
10. Sell image of efficient and sustainable area, concept of biodiversity: Avoid monoculture.
11. Market study.
12. Product development.
13. Marketing.
14. Establish a calendar.



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1. Cultivation

Where can we find difficulties?

The activities where we find the greatest difficulties to pull forward a crop, are specific and match in the majority of farms.

In order to take them into account since the beginning of the project, the difficulties are detailed below:

- Technical support of cultivation and processing.
- Investment for transformation.
- Quality control analysis.
- Commercialization.
- Compliance with health regulations.
- Support in the various decisions to be taken.
- Trained and experienced staff.



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1. Cultivation

Conditions of an organic crop:

Organic farming excludes the use of fertilizers, pesticides, growth accelerators and additives of synthetic origin.

It is based on natural cycles to maintain the natural fertility of the soil and plants health by using the following techniques:

- Crop rotation or alternation.
- Reasonable use of fertilizer.
- Stimulation of entomophagous insect populations and parasite pathogens.
- Vegetation associations (mixed crops).
- Use of mechanical methods for the weeds control.
- Use of sustainable varieties and cattle adapted to environmental conditions.
- Use of pheromone-based devices for parasitic insects.
- Use of preparations of natural ingredients (such as plant extracts).

Watch videos:

Jamaica sustainable Farm Enterprise Program: <https://youtu.be/eVivbLOyn9I>

Cultivares Santa Elena – Colombia: <https://youtu.be/p3AEyM5vw60>



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1.1. Land selection and preparation

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LAND SELECTION AND PREPARATION

Land preparation:

Before planting, it is necessary to remove the ground superficially until it becomes fluffy, trying to keep the minimum of clods and the minimum of weeds. It is time to add fertilizer: manure, manure, compost or other fertilizers.

For this purpose, different tools or equipment can be used. For example:

- Mechanic: cultivator,
- Animal traction: plow,
- Manual: with hoe, shovel, gallows, forge or digging over.

Fertilizer:

Each aromatic and medicinal plant needs a certain fertility. In general, rainfed plants develop properly with low fertilizer levels. In contrast, plants subjected to irrigation have higher requirements of organic matter. The average ranges from 20 to 40 tonnes of manure per hectare, or from 30 to 70 tonnes of compost per hectare.

For example, if 20 tonnes of manure per hectare are added before planting, mint increases production considerably.

The land is prepared for planting when the fertilizer is well buried.



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1. Cultivation

OBTENCIÓN Y MULTIPLICACIÓN DE LA PLANTA PARA EL CULTIVO

Choice of plant material:

The choice of starting plant material (seeds, cuttings, bulbs, roots) is a critical point in the cultivation of aromatic and medicinal plants. Above all, it is important for the success of the crop in the area and to obtain the raw material for proper use (garden, ornament, medicine, food, pest control, ...). Before choosing it is necessary to know fundamental information: the species, variety and chemotype.

Accordingly, it is preferable that the crop plant material is obtained differently depending on whether they are wild or cultivated plants:

- Wild plants: collect plant material from the surroundings (seeds, cuttings).
- Cultivated varieties (basil, aloe, marigold): certified seeds or cuttings purchased from suppliers of special quality.

LEARNING ACTIVITY

- ✓ Prepare a list of local, regional, country suppliers, or consult a supplier (e.g. Richters <https://www.richters.com/>), or those recommended by the European association (<http://www.europam.net/>).
- ✓ Collect mature wild seeds from your own mother plants or local plants. Subsequently, it is necessary to dry, pack, label and store in a cool and dry place.



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Sexual multiplication: obtaining the seed

The seeds will produce a crop with high genetic variability.

Once the seeds have been obtained, bought and/or collected, it is time to prepare the seedling tray.

A previous step is to check the state of the seeds and the ability to germinate using a very simple test.

LEARNING ACTIVITY

Germination test for seeds:

Use tissues, large enough to fold them twice in half with the seeds inside. Moisten the tissue and remove excess water. Put 100 seeds inside and fold the tissue in four. Put it on a tray or on a plate in a place at room temperature (between 15 and 25 °C). Spray water periodically to maintain moisture.

- Quick germination seeds: 3 to 5 days
- Normal germination: 1 or 2 weeks
- Slow germination: 2 to 3 weeks



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Asexual multiplication: obtaining the cuttings

The conditions for obtaining the cuttings are listed below:

- They are usually obtained from multi-annual plants, mother plants, or plants in the area.
- During the vegetative period, in spring or autumn, whether perennial plants (they do not lose their leaves in winter: rosemary, ...), or deciduous (they lose the leaves in winter: lemon verbena,...).
- The part to be cut of perennial plants are the tips, usually up to where the woody part begins (cuttings of 8 to 15 cm in length). In deciduous plants, the most tender tips are cut, usually in the period of greatest growth (tips 2 to 3 cm in length).
- Cuttings need some leaves to promote root formation. However, the presence of too many leaves will promote perspiration and consequent loss of water. Therefore, small leaves are left in the upper part of the apex, and the rest are removed.
- It is very important to keep the cuttings in a humid place if they are not planted.
- They can be wrapped in wet paper inserted in a closed plastic bag and stored in a cool place. In these conditions they can withstand one day, maximum two, but not more.
- Keep the mother plants healthy: well watered and healthy.
- The plants that we obtain by cutting will be exactly equal to the mother plant and will have an initial growth faster than a plant obtained from a seed.
- If we make a wound (a cut in the cortex) in the lower part of the cutting we will stimulate the formation of roots (acceleration of the cellular division).

Once obtained the cuttings of wild plants in the surroundings, plants grown in the area, or "mother plants", it is time, without delay, to make the seedling tray or send them to a specialized nursery.



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INSTALLING THE CROP IN THE FIELD

Design

In order to prevent inconveniences and minimize incidents, it is advisable to make a complete design of the plantation, taking into account where the field is, when and how it will be planted, what machines, equipment, plants and people we have.

The factors to be taken into account in the design of a field and its implementation are shown below:

- Take measurements and make a map of the spaces.
- Make a list of what you want to plant: one or more species, how many of each.
- Think a place for compost.
- Think about where you are going to put the perennials and where the annuals, grouping by families, think about the rotations.
- Think of sun exposure, irrigation (separate irrigation plants from rainfed), grass height (take into account the planting of trees, shrubs and grasses), etc.
- Think about the type of plantation: rows, spirals or terraces, distance between rows, and density of plantation, depending on machinery or tillage.
- Access and distance to local and plantation, collection or transformation infrastructure

<http://www.wikihow.com/Grow-Hops-for-Brewing-Beer>



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Direct seeding

It is not a recommended option for aromatic and medicinal plants. It can work fairly well with fennel, as long as adventitious growth is controlled, as well as rain or irrigation.

Seedling tray

The seedling tray is without a doubt the best option for the crop implantation of aromatic and medicinal plants

The conditions for maintaining a healthy seedling tray are described below:

- *Constant humidity*: always well watered. Do not over water. It is necessary to think that cuttings lose water and they have no roots that can absorb it from the soil.
- *Where*: One option is to cover the plant with a plastic to keep the relative humidity high around the seedlings. In this case, it needs to be ventilated from time to time to avoid the proliferation of fungi. Once the roots have been formed, the seedlings can be removed outdoors (between 5 and 15 °C). Attention to low temperatures.
- The ideal *temperature* for the formation and proliferation of roots is 15-20°C (initially).
- *Root formation time*:
 - 10 to 15 days: annual herbaceous plants
 - 20 to 30 days: woody plants (shrubs, trees)
 - 2 to 3 months to move to the field.



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Seedling tray

The following procedure describes how to make the seedling tray from the seeds harvested or purchased, or with the cuttings of wild and/or cultivated plants

1. Material required:

- Containers (alveoli).
- Outdoor soil (substrate).
- Watering can.
- Seeds or cuttings.
- A space with direct sunlight for a couple of hours a day, sheltered from the wind, temperature at 15-25°C and plenty of light.

2. Preparing the substrate for the seedling tray:

- Buy substrate for outdoor plants, or
- mixing fine, nutrient-rich materials (compost or sieved forest soil), together with thicker materials that facilitate aeration (perlite, vermiculite), as well as materials that increase water retention capacity and give lightness to the substrate (coconut fibre and vermiculite).

Mixtures:

- Compost (70%) + vermiculite (25%) + perlite (5%)
- Compost (50%) + coconut fibre (50%)
- Compost (50%) + sand (50%). You can add a little perlite or vermiculite.





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Seedling tray

3. Procedure to make the seedling tray:

- Check that the containers have a hole.
- Fill the container with the substrate. Do not compact it!
- Use a different container for each species.
- Put 2 or 3 seeds or a cutting in each place (separate 5 cm between groups of seeds).
- Extend a thin layer of soil above.
- Water gently.
- Keep the soil always moist but do not soak it.

4. It is essential to ensure:

- Water and draining.
- The substrate.
- The light.
- The sun exposure.
- Nutrients.
- The temperature, etc.



<http://www.wikihow.com/Cultivate-Lemongrass>

<http://www.wikihow.com/Plant-Aloe-Vera>

<http://www.wikihow.com/Grow-Basil>



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Seedling tray

LEARNING ACTIVITY

Preparing the substrate for the seedling tray

- Compost (60%) + coconut fibre (40%)

Get seeds and/or cuttings of different aromatic and medicinal plants.

Follow the procedure explained above.

- One week after sowing, check how many seeds have germinated.
- At 2 weeks look at how many leaves the seedlings have and dig up a plant to see the number of roots.
- Repeat the action at 3 and 4 weeks.
- Make a comparative table between species.

A seedling must have enough roots before being transplanted to the field (that is why it is important to plan in advance the collection of plant material)





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Implantation

Finally, when the roots of the seedlings are well developed, it is time to transplant, to a larger container or directly to the field.

To plant the seedlings obtained or purchased must take into account the planning and prior design. It is preferable to water the seedling tray well, so that the seedling plug is well wet; to have favourable weather forecasts for the next few days (rain, and/or low heat). It is also important to add padding around each seedling; to irrigate the rainfed seedlings by spacing the irrigation time gradually and planting each one in its place (solar exposition, with or without irrigation), at the proper distance.

Often, planting density determines the success of the crop. We can err in planting them too close, thinking that such a small plant will not grow, and sometimes, too far, which increases the proliferation of adventitious plants.

The passage of machinery and the size of the plant will determine the design of the plantation and the amount of plant. For example, a power tiller must have a minimum of 1,20 cm of passage and a lemon verbena occupies about 0,60 m. Thus, a plant occupies 0,72 m², so the density of planting will be 7.200 plants/ha.





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Implementation

LEARNING ACTIVITY

Design a cultivation project in a field of 200 m² for a particular species.

TIP: Look for information on plant dimensions or crop sheets where planting density is indicated

Websites examples:

A study for the development of a handbook of selected Caribbean herbs for industry

<https://core.ac.uk/download/pdf/41744760.pdf>

Growing greener cities in Latin America and the Caribbean

<http://www.fao.org/3/a-i3696e.pdf>



Cultivation and collection of aromatic and medicinal plants (UCO - Colombia)

<http://www.uco.edu.co/investigacion/fondoeditorial/libros/Documentos/Libro%20Plantas%20Aromaticas%202013.pdf>

How to grow cardamom (Colombia): https://youtu.be/cgDWsS_fBM



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CULTIVATION MAINTENANCE

Fertilization

It must be taken into account that fertilization will depend on the nutritional requirements of the plant. It is not usual to carry out fertilization during the cultivation of an annual plant. In the case of multi-annual irrigated plants, organic matter is usually supplied once a year.

Weeding

The prevention of adventitious herbs is essential. The padding with organic plant material is the first choice: about 5 cm of freshly cut green grass, straw and other plant remains, located around each plant, and if possible between rows. Plastics or meshes may also be used.

There are periods, especially the rainiest, that adventitious growth can collapse the crop. Its control is of absolute importance, especially when its growth is initial. It is the time to weed manually between plants or with hoe or tractor between lines by combining mechanical and manual weeding. Some very comfortable and interesting system for the weeding is the wheel hoe (for example: <http://www.ecoprac.com/>).

Weed management in small scale organic production

<https://youtu.be/jsqa6cahRxI>

Wheel hoe videos:

<https://youtu.be/8SbMVsv7l4w>

<https://youtu.be/QsL6tKAoMWQ>



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CULTIVATION MAINTENANCE

Irrigation

If water is not available for irrigation, is recommended:

- To choose drought-resistant plants,
- To choose plants adapted to rainfall conditions of the zone where the field is located.

In case of having irrigation capacity, you can grow plants with a higher water requirement:

- Drip irrigation (localized irrigation) is the best way to save and maximize water consumption.

Types of irrigation

- *By spraying*: it is conducted under pressure until it reaches the sprinklers, which produce drops, similar to how the rain would do. It consume little water. It can stain the leaves of plants with drops of mud, not being a quality product in herbalism.
- *By gravity*: The water is distributed on the ground thanks to its own weight, that is, it circulates through the conduits in favour of the slope. It is the most widely used system, but it consumes a lot of water. It favours the growth of weeds.
- *Local irrigation*: it makes small contributions of water, continuously, in a place near the plant, moistening only part of the soil. This method saves a lot of water because it is easy to control the amount needed and evaporation is avoided.



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CULTIVATION MAINTENANCE

Diseases and pests

Each plant is associated with a characteristic pest or pathology, although, it can be said that these are not overly problematic crops.

For the control of pests or diseases it is preferable to follow some guidelines in order to prevent more than cure:

- Health control of the seedling tray.
- Control and periodic observation of crops, especially in times of high rainfall, drought, etc.
- Training to identify causes of diseases (fungi, viruses) and recognition of pathogenic fauna (insects), distinguishing them from beneficial ones.
- Avoid excess water and moisture.

Another option is to apply preparations based on plant extracts. Some have a great effectiveness: nettle, horsetail, chamomile, valerian, neem, etc.



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CULTIVATION MAINTENANCE

Diseases and pests

One of the most versatile and effective preparations is **garlic extract**. It is used in numerous crops, for different pests and diseases, because it is an insecticide and fungicide.

Three different extracts made from garlic (*Allium sativum*) are described below, with the fresh bulb, whose main active principles are derived from sulphur:

Garlic extract

Decoction method:

Ingredients: 100 g of fresh crushed garlic + 1 litre of rainwater

- Decoction for a few seconds. Cover and keep one hour. Filter.
- Conservation: it is better to use it on the same day.
- Dilution: Not necessary.
- Application: Use it pure in direct irrigation.
- Uses: insecticide and fungicide. Preventive of fungi.
- For: fruit trees (peaches, *Prunus* sp.), Horticultural (strawberry), medicinal.



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CULTIVATION MAINTENANCE

Diseases and pests

Garlic extract

Maceration method:

A) *Ingredients:* 1 head of fresh crushed garlic (approx. 50 g) + 5 litres of rainwater

- Maceration for 7 days. Filter.
- Keep: tightly closed.
- Dilution: to 50% (1 litre of maceration in 1 litre of water).
- Application: spraying or watering.
- Use: aphids, mites, onion fly.
- For: fruit, horticultural, medicinal, ornamental..

B) *Ingredients:* 100g of fresh crushed garlic (approx. 50 g) crushed + 2 tablespoons of flax oil

- Maceration for 12 h. Filter. Add 1 litre of rainwater. Leave 1 week.
- Keep: it is better to use it immediately.
- Dilution: 5% (50 ml in 1 litre).
- Application: spraying.
- Use: aphids, mites, onion fly.
- For: fruit, horticultural, medicinal, ornamental.



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LEARNING ACTIVITY

Surf the Internet and search for concepts such as:

"Cultivation + medicinal + aromatic + plants"

"Seeds + medicinal + aromatic + plants"

"Market + aromatic + medicinal + plants"

+ Country (eg "Jamaica")

You will find numerous websites from different organizations that cultivate, research and edit materials (associations, cooperatives, etc.).

Make a list of the most representative data of your country:

- Technical aspects of cultivation
- Seed Suppliers
- Cultivated species
- Production companies

