Community Cloth

Guide Book

Natural dyeing

– a handbook for educators

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Natural dyeing - a handbook for educators

Authors
Alice Bernardo
Guida Fonseca

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Smuss Studio

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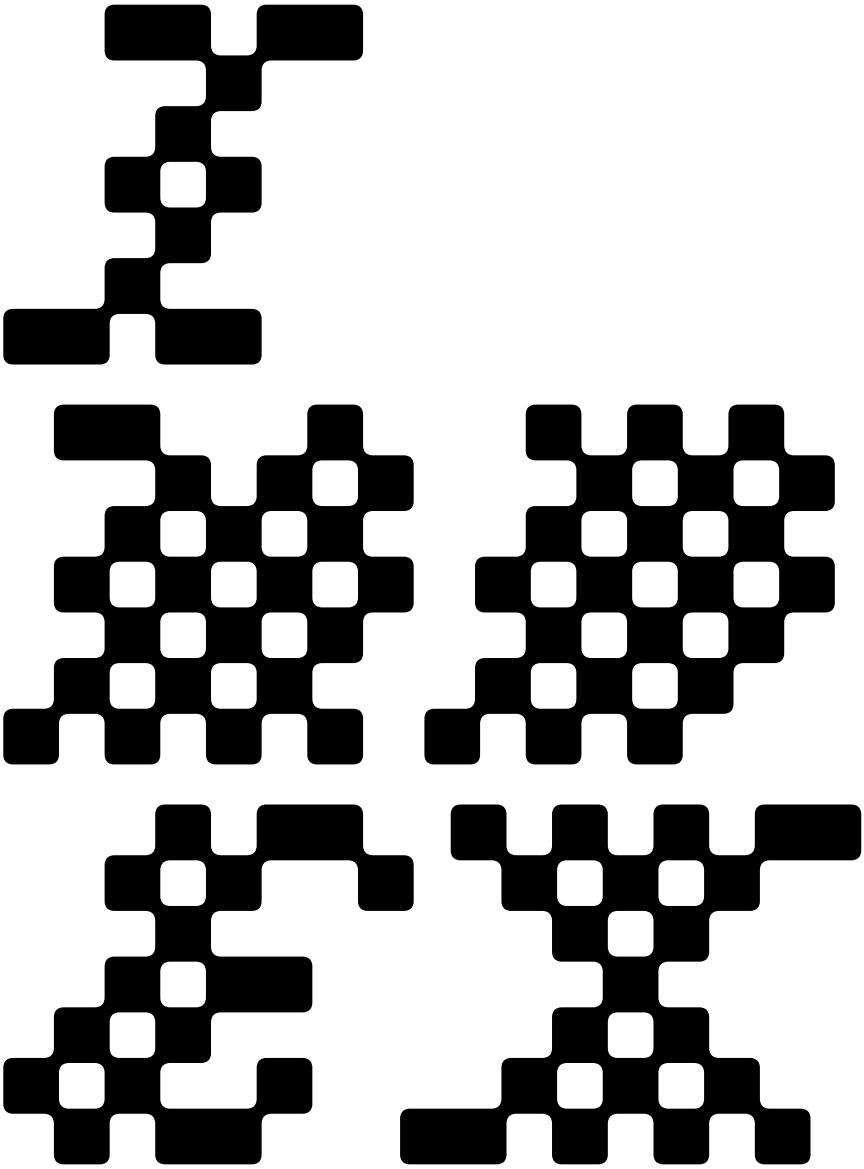


About Erasmus+ CommunityCloth project

CommunityCloth is an innovative initiative developed under the Erasmus+ Programme, dedicated to pioneering new community-driven learning models while promoting sustainable farm-to-cloth textile production. This project aims to create educational tools, disseminate technical knowledge, and establish a robust network of educators. During this project, a group of educators will be trained and equipped to implement programs that not only advance urban transition practices but also support communal farming efforts and stimulate job creation cost-effectively.

For this project, a collection of handbooks has been conceived to support educators and their fieldwork. This introduction to natural dyeing is one such handbook, and it is available to the public to support your own educational activities as well.

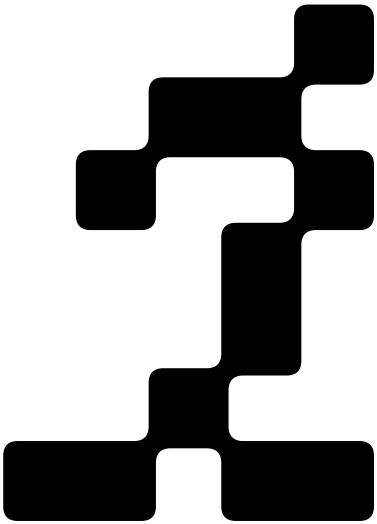
Due to the framework of the CommunityCloth project, this manual focuses only on wool as a textile material and on the dyes that we consider the most important for those starting in this world. In addition to all the information dedicated to the practice of natural dyeing, we have also included a chapter devoted to cultivating some species of dye plants, hoping to motivate you to produce your own materials.

What is natural dyeing

Natural dyeing is the practice of extracting dyes from natural materials, such as plants, fungi, roots and even insects, to dye textile fibres such as cotton, wool, silk and linen.

Over thousands of years, communities worldwide have discovered and developed different methods of extracting and fixing colours, taking advantage of local biodiversity. Natural dyeing requires in-depth knowledge of the available flora and of the dyeing processes, which involve preparing the fabrics, extracting the colourants, dyeing and finishing the textiles.

As educators, natural dyeing offers a unique opportunity to integrate science education, art and sustainability. By developing educational activities based on this craft, you can inspire creativity, environmental awareness and respect for small-scale production techniques, shaping a new generation that is more connected to nature and aware of the environmental impact of their choices.



The basics of natural dyeing

Dyes

Dyes are chemical elements, in this case of natural origin, which have the property of giving fibres their colour. Only very rarely is there a correspondence between the colour of the plant or animal and the dye obtained from it, as the most interesting colouring matters rarely show off their potential.

Some colourants can be extracted very easily: they are soluble in water, and all we have to do is boil the portion of the plant that contains them. Others, however, are not directly soluble in water and require prior fermentation.

Most natural dyes need a binder to set the dye to the fibres effectively - this binder is called a mordant and we will learn more about them in the next chapter. However, some dyes can be used for colouring without the assistance of a mordant: these are called direct dyes. An example of such dyes are walnut husks or lichens, which have a natural affinity with the wool fibre, to which they chemically bond.

Mordants, assistants and tannins

Mordants

Mordants are metallic salts whose function in natural dyeing ensures the bond between textile fibre and dye.

In the case of protein fibres, such as the wool we will be working with, the mordant binds to the fibre. However, for cellulose based fibres, such as cotton and linen, the mordant is deposited on the fibre. In both cases, the dye will bind to the mordant.

As we shall see, very few dyes bind effectively to the fibres without using a mordant.

The type of mordant, quantity used, quality or mordanting method used with the same dye can result in different colours.

Although there are several types of mordants, in this handbook, we will mention and use only the most commonly used, as it is widely available and quite effective: potassium alum.

Potassium alum

Potassium aluminium sulphate ($KAl(SO_4)_2$) is a white powder that resembles sugar. It is almost always used in combination with tartaric acid for wool. It is the most universal metal mordant.

Assistants and colour modifiers

Colour assistants and modifiers are substances used in the dyeing process to increase the effectiveness of the mordant, modify the pH of the bath (usually with the aim of altering the tone of the dye) or carry out a post-dyeing colour change.

Tartaric acid

Tartaric acid ($KC_4H_5O_6$) is a white powder almost always used with potassium alum when mordanting wool. Its low pH helps preserve the wool's natural characteristics during the mordanting process. It also makes the colour uniform. Recent analyses show that its use with the mordant increases the amount of dye fixed in the wool.

Cream of tartar fulfils the same function.

Sodium carbonate

Sodium carbonate (Na_2CO_3) is an alkaline substance used in dyeing to raise pH levels, scour cellulose fibres, and aid in mordanting cellulose fibres (in tandem with potassium alum). It is also known as washing soda.

Iron sulphate

Iron sulphate (FeSO4) is a pale green crystalline powder generally used at the end of the dyeing process or on top of the mordant to darken colours. An excess of iron sulphate, as it is naturally corrosive, will make the wool harsh and brittle.

Citric acid

Citric acid ($C_6H_8O_7$) is a weak organic acid present in citrus fruits. Commonly used as an acidulant and preservative, it is usually used in dyeing to lower pH levels.

Calcium carbonate

Calcium carbonate (CaCO2) is an alkaline substance in the form of a fine white powder traditionally used in dyeing to raise pH levels.

Tannins

Tannins are polyphenolic substances of plant origin that can be used as mordants or mordanting assistants in dyeing. These compounds exist in many natural elements, such as gallnuts, pomegranate peel, myrobalan nuts and others.

Depending on the type of tannin we use, it may have no impact on the final colour of the textile, or it may add a yellow or brownish/reddish colour. We should therefore take this factor into account when choosing the tannins to use.

Gallic tannins

This group of tannins does not add colour to the fabric. Some of the best-known sources of this type of tannin are gallium nuts and sumac.

Ellagic tannins

This group of tannins adds a yellowish hue to the fabric. Some sources of this type of tannin are myrobalan, pomegranate peel and henna.

Condensed tannins

This group of tannins adds a brown or reddish colour to the fabric. Some sources of this type of tannin are walnut husks, black tea, cutch and quebracho.

Dye fastness

Dye fastness refers to the resistance of a dyed material to fading or bleeding under various conditions, such as exposure to light, washing or rubbing.

Light is one of the most damaging elements, as, with time, the oxygen in the air combined with the action of light can oxidise and partially destroy the dye-fibre bond, resulting in a gradual fading of the colour.

One of our main objectives in natural dyeing is to achieve maximum colour stability over time.

This stability depends on several factors, such as the choice of dye material to be used and the procedures used throughout all stages of the process, from the preparation of the fibres to the end of the dyeing process.

Each dye naturally has its own level of fastness, which is directly related to the size of the dye molecule. For example, the stability of the pink obtained from cochineal is due to the large size of the dye molecule.

Although we can obtain colour from many natural materials and even encourage experimentation, not many dyes have always been considered 'great dyes', this reputation being directly related to the intensity and durability of their colour. Madder, weld, cochineal, walnut husks, and indigo stand out as some of the most stable dyes and have been widely used for thousands of years for this reason.

Testing for dye fastness

At certain times in our practice, for example, when we experiment with new procedures or new colouring materials, we should test the stability of the resulting colours by checking how they behave under the action of light.

To do this, we can make a display of the dye samples on cardboard, covering half of every sample with another piece of cardboard and exposing them to direct light for at least 3 or 4 weeks.

After this period of time, we can compare and check the degree of colour fastness of each sample by uncovering the half protected from the light.

- Colour fastness tests example. For each sample, the photo on the right shows how the dye resisted being exposed to direct sunlight for several weeks.

Wool as a textile fibre

Wool is a natural textile fibre obtained from sheep's fleece. Known for its softness and warmth, wool has other unique properties that set it apart from other fibres: It is naturally elastic, wrinkle-resistant, and offers excellent thermal regulation, keeping you warm in cold weather and allowing you to breathe in warmer climates. It is also naturally fire-resistant and has a high moisture absorption capacity, retaining up to 30% of its weight in water without feeling wet.

In natural dyeing, wool is one of the fibres that best absorbs and retains colours, due to its scaly structure and the fact that it reacts well to mordants that help intensify and fix colours, resulting in vivid, long-lasting shades.

For these reasons, wool is one of the most rewarding fibres to work with and educate in natural dyeing.

Stages of the dyeing process

In this chapter we want to show you an overview of the different steps involved in the dyeing process.

1 Weighing the textile fibres

The first step will be to weigh the dry textile fibres and register their weight, so that we can calculate the exact quantities of mordant, assistants and colouring matter to use in the dyeing procedure.

2 Fibre preparation

To obtain good results, fibres must be thoroughly scoured, which is essential to eliminate any dirt and residues that could prevent the absorption of the mordant and the dye

3 Mordanting

For better results, the fibres should be mordanted before dyeing. They can be dyed straight away or stored for later use without needing to be mordanted again. Before adding the fibres to the mordant bath, they should always be previously wetted to absorb the mordant evenly.

4 Preparing the dye bath (Dye extraction)

Before proceeding to fibre dyeing, the dye bath must be prepared by extracting the dye from the material containing it. This extraction is almost always done by decoction, boiling the material in water. Depending on the dye in question, it can also be done by maceration or fermentation.

5 Dyeing

At this stage of the process, we will immerse the previously mordanted textile fibres in the dye bath so that they absorb the dye.

Other processes, such as colour changes, can be carried out simultaneously or after dyeing.

6 Washing and rinsing

After dyeing, the textiles are washed and rinsed to remove any residue on the surface.

The appropriate procedures for each type of fibre are described in the chapter ‘Finishing dyed textiles’.

7 Drying

The fibres are left to dry in the shade, unless otherwise indicated.


1


2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General notions

Recording and documenting experiences

One of the most important parts of natural dyeing is the production of adequately identified samples and records, from which we can build an archive of our experiments, results and conclusions.

It's important to reserve properly labelled samples to add to our archive whenever we dye. For each experiment, we suggest recording the following information:

- Type of fibre used
- Origin of the dye source (if applicable, place and date of collection)
- Water source
- The material of the container used for dyeing

Preparation and identification of materials

Yarn should always be dyed in skein form so that all the fibres are in contact with the liquid. We need to pay attention to the ties when making skeins so they don't get tight and prevent the dye liquid from circulating. We should always make the ties out of cotton because of its resistance throughout the process.

If the skeins don't all have the same weight, we should identify those with differences (with a different knot, for example). We should always identify the textiles we are dyeing and record the procedures to keep an organised archive of experiences. For instance, we can mark fabrics with a permanent marker.

Quantities and proportions

The recipes indicate the proportion of material (dyeing material, mordants and assistants) necessary concerning the quantity of fibres to be dyed. By default, the recipe indicates 100 g of fibres. If you are working with a different weight, simply calculate the proportion.

In most recipes, the amount of water used is not indicated because it depends on how much fibre is dyed. Please see the instructions under 'Amount of water to use in the dye bath'.

Temperatures

In the recipes chapters, we will indicate the approximate temperature at which decoctions and dyeing should be undertaken. It is especially important not to exceed certain temperatures or heat up to a certain point to guarantee maximum effectiveness.

You should have a thermometer to measure the temperature of the liquids.

→

Amount of water to use in the dye bath

The amount of water used for mordanting and dyeing must be sufficient to allow the fibres to flow freely so that they are evenly exposed to the dye or mordant. They must not be squeezed, as this will result in uneven dyeing.

This is particularly important when dyeing fabrics or garments that tend to crease. Fabrics need even more space to be dyed than skeins of yarn of the same weight.

The containers must be covered during the mordanting and dyeing process. If the liquid is reduced by evaporation, water at the same temperature is added so that the fibres remain entirely immersed.

Water quality

The characteristics of the water you use to create your dye baths are paramount. Its pH, as well as other substances it may contain, will significantly influence the colours obtained. Try to know the characteristics of the water you are using to understand the results you are getting.

Alternatively, you can use rainwater or distilled water.

pH

The dye bath's pH can completely alter the final results of your dyeing. Very frequently, colour modifications are achieved simply by changing the pH of the dye bath.

We must always consider the pH of the water we use (in some regions, the water is more alkaline; in others, it is more acidic), especially if it doesn't come from the public water supply.

You should, therefore, have pH strips at your disposal.

How to introduce fibres into dye or mordant baths

All the fibres that will be inserted in the mordant or dye baths must be wet beforehand. Otherwise, the mordanting and dyeing will not happen evenly or efficiently.

The fibres should be immersed in water for as long as necessary for the water to penetrate them. Thinner and lighter textiles will need less time, while denser or rougher textiles may require several hours.

Before introducing wool into the dye bath, the bath should be left to cool down a little to avoid thermal shock for the fibres.

How to create a range of shades

You can create a range of shades in the same dyeing bath, from the deepest to the lightest. Considering that the first fibres to enter the bath will absorb a good part of the dye, the next ones in the same dye bath will have progressively lighter tones. It should be noted that some plants are more 'generous' than others, i.e. their dye concentration allows for several successive immersions in the same

dye bath, while others run out after 2 or 3 immersions.

How to get darker shades or combine colours (overdyeing)

To obtain darker shades, the immersions can be repeated, overlaying colour on colour, without the need to mordant again. You can also overdye one colour with another to create different colours. For example, overdyeing a material previously dyed with weld (yellow) with indigo (blue) creates a green colour.

How to get lighter shades

To obtain lighter shades, we should use a smaller amount of dye material in proportion to the amount of fibres we are dyeing.

Equipment and materials

For the first experiments with a small quantity of fibres, you can use ordinary kitchen utensils. Still, these should be reserved only for dyeing to avoid contamination.

Here, we will list the essential equipment to have for workshop activities and small dyeing experiences.

Equipment

- **2 burners** for simultaneous use of mordant and dye baths.
- **Stainless steel pots** with a volume of 4 to 6 litres (minimum of 2).
- **Electric kettle**, for heating smaller quantities of water.
- **Electronic scale**, for weighing your materials.
- **Glass or ceramic bowls**, for several uses.
- **Glass jars or plastic pots** with airtight lids, for storing mordants and plants, preparing fermentations and macerations, preserving leftover dyes that can be used again, etc.
- **Mesh strainer**, to remove solid residues.
- **Forks**, long-handled tongs and wooden sticks, to handle the hot fibres when in the pot.
- **Thermometer**, to check the water temperature.
- **pH strips**, to check the solution's pH when necessary.
- **Rubber gloves, mask and protective glasses.**
- **Labels** (adhesive for the jars and paper for the skeins).
- **Notebook**, for writing down recipes and experiments.

Materials

These are some of the consumables used in dyeing procedures specifically for wool that you should have available to work according to the recipes described. More specific materials may be needed depending on the chosen dye or if you start working with different types of fibres.

- Potassium alum
- Tartaric acid
- Iron sulphate
- Calcium hydroxide
- Sodium carbonate
- Citric acid
- Neutral detergent (e.g. dishwashing detergent)
- Cotton yarn to tie the skeins

Safety recommendations

Before moving on to the practical part, we must consider the precautions we must take in the practice of natural dyeing to guarantee our safety throughout all the processes. Although the dyes, mordants, and assistants we use in these procedures are low risk, we must always consider the correct way to store them to avoid accidents, contamination, and unwanted exposure.

Here are some rules and recommendations that we hope you will follow:

1. The workplace must be well-ventilated and have good extraction of the vapours produced.

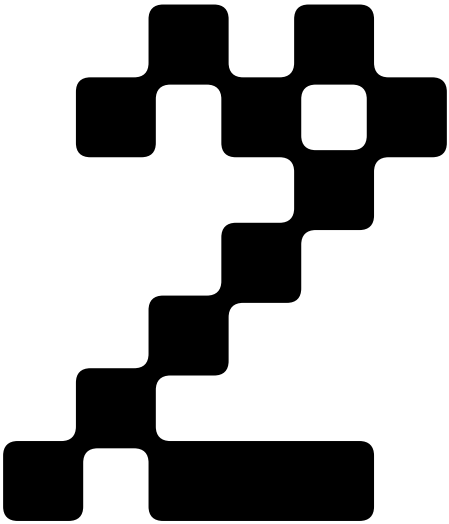
2. The equipment used should be reserved exclusively for dyeing to avoid contamination.

3. The workplace should be away from food preparation areas to avoid contamination and to keep it out of the reach of children and animals.

4. It is recommended to wear a mask (especially when working with fine powders), gloves, an apron and even protective glasses. Some people are more sensitive than others, and we must take all possible precautions.

5. Physical contact, ingestion or accidental inhalation of the chemicals used should be avoided.

6. All chemicals and substances should be stored well, in tightly closed and properly labelled containers (preferably including the chemical formula when possible), out of the reach of children and animals.



Preparing wool for dyeing

Scouring wool

Before proceeding with the mordanting and dyeing processes, it is necessary to scour the wool to eliminate any substances that could interfere with these processes. More specifically, even if it has been processed, wool contains impurities, grease and wax that must be removed at this stage. For the same reason, it is not advisable to dye raw wool, which still contains lanolin and other substances.

Materials

A neutral pH detergent, such as simple dishwashing detergent, has good scouring power and generally doesn't contain ingredients that will subsequently affect the dyeing process. Alkaline soaps should not be used, as they damage the wool fibres.

Choose a container with enough space for the fibres to flow freely.

Procedure

1. Add enough water at around 60 °C to the container to cover the wool and allow it to flow freely.
2. Dissolve a little detergent in the water without creating any foam.
3. Add the wool fibres to the water, immersing it slowly, and leave to soak for around 30 minutes to 1 hour.
4. At the end of the process, rinse the fibres thoroughly with lukewarm water so that the wool does not suffer thermal shock. The rinsing should be repeated as often as necessary to remove all the detergent.

Preparing wool for dyeing

Mordanting wool

We expose the fibres to the mordant during the mordanting process so that the bond between fibre and dye is ensured at the time of dyeing.

Mordanting is a one-off operation, meaning that a textile only needs to be mordanted once, even if it is going to be dyed again.

Once the fibres have been mordanted, they do not change in appearance, texture or colour, which is why they should be labelled if they are not going to be dyed immediately.

Given the focus on wool fibres in this handbook, we have chosen to explain the mordanting process using only the most widely used and accessible mordant, potassium alum, in combination with tartaric acid as an assistant.

As an assistant to alum, tartaric acid helps lower the mordant bath's pH, protecting the wool. It also increases the amount of dye that adheres to the wool and makes the colour more uniform.

Materials

For 100 g of wool, use 15 to 20 g of potassium alum and 4 to 6 g of tartaric acid. If the wool is very fine or delicate, use the lower quantity.

Before mordanting

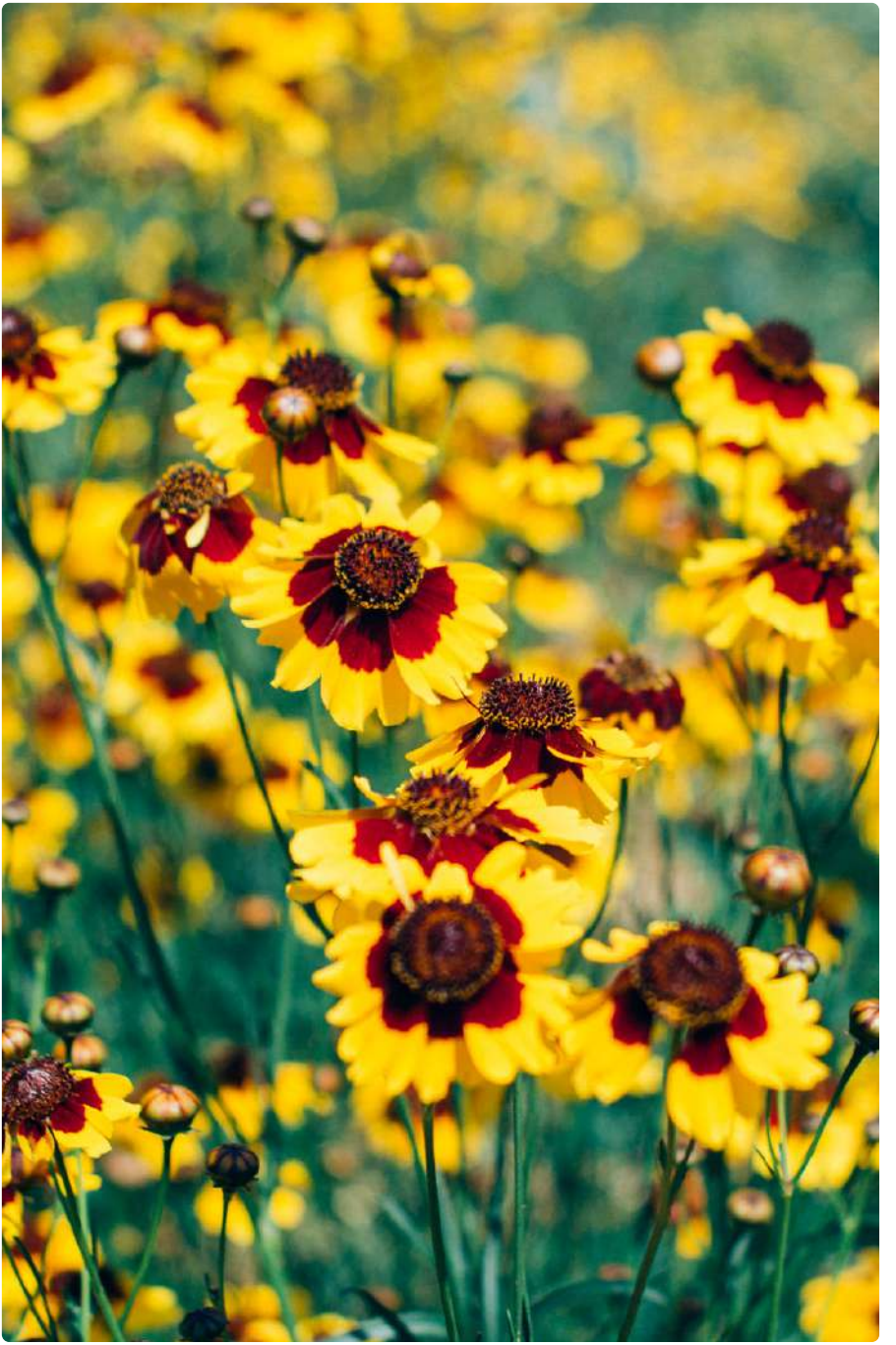
The wool fibres must already have been scoured, according to the instructions. The dry fibre's weight must be considered to determine the amount of alum and tartaric acid to use. The fibres should be introduced wet to the mordant bath.

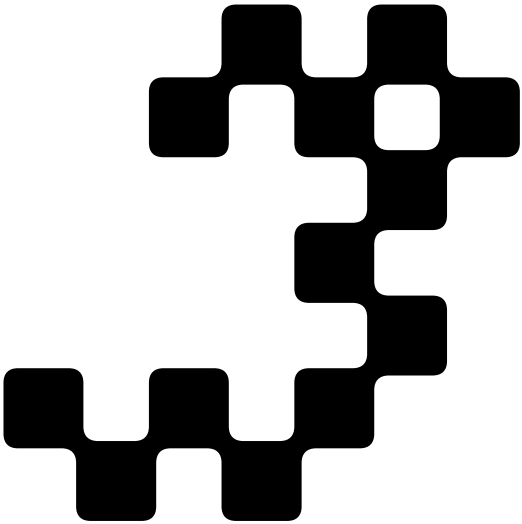
Procedure

1. In a separate container, dissolve the alum and tartaric acid in hot water.
2. Fill a pot with water and bring it to about 40-50°C.
3. Add the previously dissolved alum and tartaric acid to the pot.
4. Add the wool, previously wet with lukewarm water, and gradually heat to 85 °C. Keep it like this for 1 hour. Remove the wool and let the excess water drain off.
5. Rinse with lukewarm water and the fibres are ready to be dyed. They can be used immediately or a few days later.

Note 1
Alternatively, you can mordant the wool without applying continuous heat. To do this, we follow the previous recipe up to step 4, heating to 85 °C, but we turn off the heat source after introducing the fibres and leave it for 24 hours. The longer exposure time to the mordant will compensate for the lower temperature.

Note 2
Once the mordanting process is complete, the bath can be reused to mordant more fibres. We can assume that only 50% of the alum will have been absorbed by the fibres, with the rest remaining in the bath to be reused. So, if you reuse this bath, just add 50% of the required amount of mordant.





Dyeing wool – the recipes

Madder
Rubia tinctorum

Madder is a perennial plant of the Rubiaceae family, native to Mediterranean regions of Europe and Asia, whose roots produce a red dye.

Its roots are harvested after at least three years of growth. After harvesting, they are left to dry, sometimes for years, and this drying process is essential for developing the dye.

There are many varieties of madder, but *Rubia tinctorum* and *Rubia cordifolia* are the most widely cultivated and used commercially.

Parts used
Roots.

Main dyes
Alizarin is the main colouring agent present in the roots of this plant, but it also contains purpurins, pseudopurpurins and others.

Colours obtained
Reds and oranges hues.

Observations
Madder is sensitive to the pH of the bath. Alkaline baths will make the colours red/pink, while acidic baths will produce orange shades.

Recipe for red colour

Preliminary note

The use of alkaline water benefits the results of dyeing with madder. If the available water has an acidic pH (below 7), you can add a little calcium carbonate or sodium carbonate (5 g per 15 litres).

Fibre preparation

Fibres must first be scoured and mordanted according to the instructions. The fibres should be added wet to the bath.

Materials

For 100 g of fibre, 100 g of whole dried madder roots or 50 g of dried powdered roots. Use a pot with enough space for the fibres to flow freely.

Procedure

1. If using whole roots, they should be steeped in warm water the night before or for a few hours. Powdered roots do not need to be steeped.

2. Pour the roots into the water in the pan and heat at 65 °C for 45 minutes to 1 hour. It is important to not exceed this temperature, as it will affect the colour obtained.

3. Let the bath cool down, add the wet wool and heat it again to a maximum of 65 °C, keeping it that way for about 1 hour. Let the fibres cool down in the bath.

4. Wash the fibres in warm water with soap and rinse. In this case, you can use slightly alkaline soap (ideally with a pH no higher than 9.5 to avoid damaging the wool), as alkalinity will enhance the colour.

Weld
Reseda luteola

Weld, or dyer's rocket, is a biennial herbaceous plant of the Resedaceae family cultivated in various regions of Europe and Asia for dyeing. It is historically known for its ability to produce a bright yellow dye, the most stable of all plant-based yellows.

Before the advent of synthetic dyes, it was grown in several European countries for dyeing and over-dyeing with indigo to obtain various shades of green.

Parts used
All the aerial parts: leaves, stems and flowers. It should be harvested in summer when some of the flowers in the lower part of the stem have already set seed, but we can still see some flowers in the upper part.

Main dye
Luteolin.

Colours obtained
Bright and pale yellows, greens.

Recipe for bright yellow colour

Fibre preparation

Fibres must first be scoured and mordanted according to the instructions. The fibres should be added wet to the bath.

Materials

For 100 g of fibre, 100 g of dried leaves, flowers and stems cut into small pieces, and 1 g/L of calcium hydroxide. Use a pot with enough space for the fibres to flow freely.

Procedure

1. Place the weld in cold water in the pot and heat slowly to 75 °C. Keep for 1 hour.
2. Leave the bath to cool, add the wet fibres and heat again to a maximum of 65-70 °C for another hour, stirring gently occasionally.
3. Remove the textiles briefly, add the calcium hydroxide to the bath and dissolve well.
4. Soak the fibres in this alkaline solution until the colour becomes more intense. There is no need to reheat.
5. Wash in warm water with neutral detergent and rinse.

Notes
The fibres can also be alkalised in a separate container with clean water if you want to reuse the bath for other dye baths without the calcium hydroxide interfering.

Dyer's coreopsis
Coreopsis tinctoria

Dyer's coreopsis is an annual herbaceous plant from the Asteraceae family, valued for its beauty and dyeing properties.

Usually sown in spring, it flowers during the summer, when the flower heads are harvested for natural dyeing.

Parts used
The flower heads.

Main dyes
Several flavonoids, such as luteolin, quercetin and morin.

Colours obtained
Yellows, oranges, ochres.

Observations
Using the same recipe, we can dye with other varieties of coreopsis, obtaining slightly different results. For example, *Coreopsis grandiflora* generally produces brighter, more intense yellows than *Coreopsis tinctoria*, which gives us more burnt yellows.

Similarly, the same flower picked at different times of the year will produce other colours.

Recipe for yellowish tones

Fibre preparation

Fibres must first be scoured and mordanted according to the instructions. The fibres should be added wet to the bath.

Materials

For 100 g of fibre, 100 g of dried flowers or 200 g of fresh flowers. Use a pot with enough space for the fibres to flow freely.

Procedure

1. The flowers can simply be placed in cold water and brought to a boil for 1 hour (≈85 °C). Alternatively, before boiling, they can be left to steep in water for a day to maximise extraction.
2. Allow the bath to cool down; add the wet fibres and heat to 65-70 °C for 1 hour.
3. Let the fibres cool in the bath, if possible.
4. Wash in warm water with a neutral pH detergent and rinse.

Calendula
Calendula officinalis

Calendula is an annual herbaceous plant from the Asteraceae family, native to the Mediterranean region. It is widely cultivated for its ornamental flowers and medicinal properties, being easy to grow and adaptable to various soil and climate conditions.

Plant parts used
Flower heads and stems.

Main dyes
Several flavonoids.

Colours obtained
Yellows.

Recipe for yellow colour

Fibre preparation

Fibres must first be scoured and mordanted according to the instructions. The fibres should be added wet to the bath

Materials

For 100 g of fibre, 100 g of dried flowers or 200 g of fresh flowers. Use a pot with enough space for the fibres to flow freely.

Procedure

1. Boil the flowers for 1 hour (≈85 °C) in enough water to cover the textiles and allow them to flow freely.
2. Allow the bath to cool. Add the wet fibres and heat to 65-70 °C for 1 hour.
3. Wash in warm water with a neutral pH detergent and rinse.

Onion
Allium cepa

Onion is a biennial herbaceous plant of the Amarilidaceae family, commonly cultivated for food purposes. In addition to its culinary function, the onion has medicinal and dyeing properties.

Plant parts used
The thin, colourful skin that surrounds the bulb of all varieties.

Main dyes
Quercetin.

Colours obtained
Various shades of yellow.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Recipe for yellow-orange colour

Fibre preparation

Fibres must first be scoured and mordanted according to the instructions. The fibres should be added wet to the bath.

Materiais

For 100 g of fibre, use 100 g of onion peels (only the outer peels). You can also increase the proportion of 500 g of peels for 300 g of fibres to obtain deeper tones. Use a pot with enough space for the fibres to flow freely.

Procedure

1. Heat enough water in a pot to cover the fibres to be dyed.
2. Add the peels and boil for 1 hour (80-85 °C).
3. Let the bath cool down, add the wet fibres and heat to 65-70 °C, maintaining for 1 hour. Stir from time to time.
4. Wash in warm water with a neutral pH detergent and rinse.

Walnut
Juglans regia

Walnut is a large tree belonging to the Juglandaceae family, highly valued both for the production of edible nuts and for its wood.

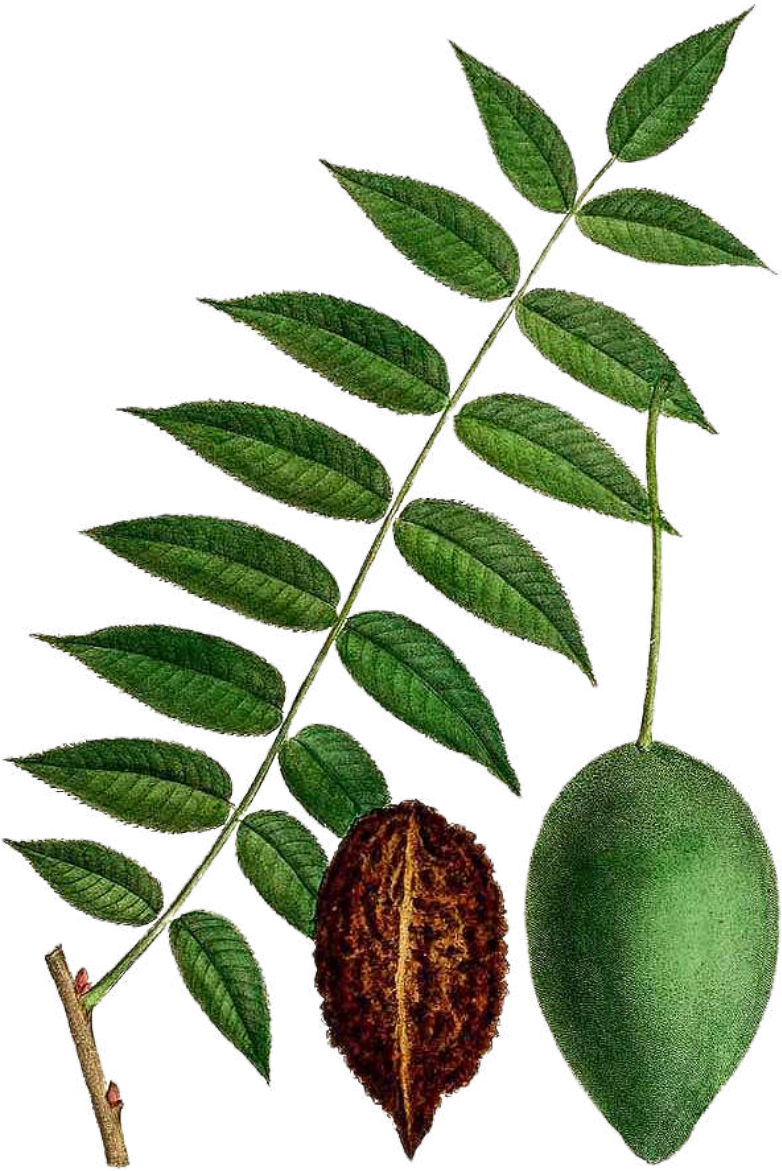
The dye is obtained mainly from the green husks surrounding the nuts, which were historically used to produce browns and blacks because they also contain tannins.

Parts used
The husks that surround the nuts, harvested in September when they start to turn brown and come off easily (those that are blackened or fallen by the tree are also good). The leaves from July to August.

Main dyes
Juglone and tannins.

Colours obtained
Brown, grey, black.

Observations
The colours obtained from walnut husks are extremely stable. As they contain natural mordants (tannins), it is not necessary to mordant the wool.



Procedure for extracting the dye by steeping and fermenting the husks

Materials

The green husks that surround the nut. The quantity needed varies according to the amount of extract you want to make.

Procedure

1. Crush the husks with a hammer.
2. Place the crushed husks covered with water in a large jar or tub and cover.
3. Leave to steep until fermentation. After a week, they can be used, although they can be kept for years if they are always covered in water.

Notes
The longer the steeping, the more intense the quality and intensity of the dye bath. The colour varies from brownish green to dark brown, almost black, depending on the time of harvest and the length of fermentation.

Recipe for brown (decoction)

Preliminary note

To change the colour from beige to dark brown, increase or decrease the amount of extract you put in the bath.

Fibre preparation

Fibres must first be scoured according to the instructions, but no mordanting is required to dye with walnut husks.The fibres should be placed wet in the bath.

Materials

For 100 g of fibres, a quantity of extract equivalent to half the total volume of liquid needed to generously cover the fibres is taken from the container. Use a pot with enough space for the fibres to flow freely.

Procedure

1. Place the extract and fermented husks in a pot, adding enough water to cover the fibres. Boil for 1 hour, bringing up to 90-95 °C and then lowering to 80-85 °C.
2. Strain the dye bath to remove the husks.
3. Allow the bath to cool, add the wet fibres and heat again (≈65-70 °C) for 1 hour or more, depending on the desired shade.
4. Wash with warm water and neutral detergent and rinse.

Recipe for brown (without applied heat)

Fibre preparation

Fibres must first be scoured according to the instructions, but no mordanting is required to dye with walnut husks. The fibres should be placed wet in the bath.

Materials

All or part of the fermentation liquid (see fermentation extraction procedure) is used, depending on the amount of fibres to be dyed. Use a pot with enough space for the fibres to flow freely.

Procedure

1. Add the fermentation liquid and the fibres to be dyed to a pot, adding water if necessary.
2. Leave to steep for 1 to 3 days, depending on the colour you want, stirring occasionally.
3. Remove the fibres and drain well.
4. Dry before rinsing to complete setting the dye to the fibres.
5. Rinse in cold water and dry again.

Recipe for dark brown to black

Dark brown and black tones are obtained by carrying out the ‘brown colour (decoction)’ procedure and adding 3g iron sulphate to the dye bath. To reuse the brown bath for other dye baths, you can soak the textiles in the iron sulphate solution in a separate container.

Recipe for dyeing with walnut tree leaves (colour varies)

Preliminary note

Leaves harvested before fruit setting are higher in colouring matter.

Fibre preparation

The fibres must first be scoured and mordanted according to the instructions. Unlike husks, when dyeing with leaves, the fibres must be mordanted. The fibres must be introduced wet into the bath.

Materials

For 100 g of fibre, 100 g of chopped fresh walnut leaves or 70 g of dried leaves powdered. Use a pot with enough space for the fibres to flow freely.

Procedure

1. Boil the walnut leaves gently for 1 hour (80-85 °C) in enough water to cover the textiles to be dyed.
2. Strain the bath, removing the leaves.
3. Allow the bath to cool, add the wet fibres and then heat again for 1 to 2 hours (65-70 °C).
4. Wash in warm water with neutral detergent and rinse.

Woad
Isatis tinctoria

Woad is a biennial plant from the Brassica family, native to Europe and Asia. This plant has great historical importance, having been cultivated on a large scale throughout Europe to produce the blue pigment (indigo) extracted from its leaves. For this reason, it played an important economic and cultural role until it was replaced by indigo from India.

Parts used
Leaves harvested in September-October.

Main dyes
Indigo and a few flavonoids (only relevant for the procedure with fresh leaves described in this manual).

Colours obtained
Greenish blues and bluish greens, resulting from the mixture of the blue of indigo and the yellow of flavonoids.

Observations
This handbook only includes the procedure for dyeing with fresh leaves, as it is simple and rewarding to do when you have access to fresh plants, resulting in light greenish blues.

Historically, the indigo pigment was extracted from woad by fermentation. Then, a dye vat was created, and the procedure was radically different from the ones described in this manual. The colours produced from this dyeing process were the dark blues associated with indigo.

Recipe for dyeing with fresh woad leaves

Preliminary note

The procedure described in this handbook is dedicated to dyeing using fresh leaves, which is only possible when we have direct access to the living plant and only applies to wool. This method cannot be used with indigo pigment.

Fibre preparation

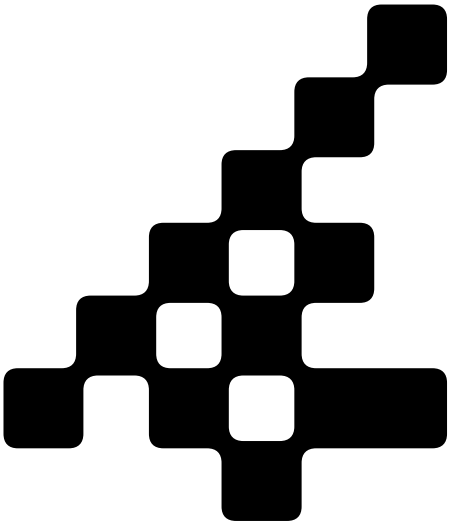
Wool fibres must first be washed according to the instructions. This process does not require mordanting. The fibres should be put into the bath wet.

Materials

Freshly picked woad leaves.

Procedure

1. Wash the freshly picked leaves thoroughly in cold water to remove dirt.
2. Place the leaves in a blender and add enough cold water to submerge the fibres we will dye. Chop the leaves together with the water.
3. Strain the liquid using a cotton cloth to remove the leaves residue. The liquid can be poured into a bowl, as it won't be necessary to heat the bath.
4. Place the previously wet wool fibres in the liquid and move them around for a few minutes to ensure even exposure to the dye.
5. Remove the fibres from the liquid and place them in a bowl of clean water or under running water. The dye will oxidise and slowly reveal its bluish-green colour.



Finishing dyed textiles

At the end of the dyeing process, the textiles should be washed thoroughly in order to remove the dye that is not really set on the fibres and thus increase the stability of the colour.

The detergent used for washing should be pH neutral to avoid making accidental colour changes.

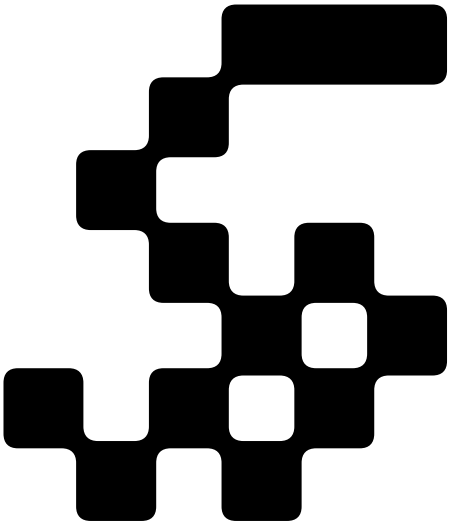
Wool dyed using a mordant

Fibres dyed with the use of a mordant can be washed in hot water that does not exceed 60-70 °C with a neutral pH detergent for 10 minutes. After washing, rinse thoroughly and allow the textiles to air dry out of direct sunlight.

Wool dyed without the use of mordant

Fibres dyed without the use of a mordant should be washed with a neutral pH detergent in lukewarm water (do not heat or boil).

After washing, rinse thoroughly and allow the textiles to air dry out of direct sunlight.



Growing natural dyeing plants

Growing dye plants

Growing our own dye plants allows us to involve the community in which we will work within the entire production and dyeing process, from seed to dyed textiles.

It also allows us to promote a farm-to-cloth approach, reinforcing the idea of environmental education through the connection between the soil, the creation process and the final product.

For these reasons, we've decided to include some advice on how to grow some dye plants here to make it feasible for you to produce some of these materials in your communities.

Which dye plants should I grow?

To begin with, we advise you to choose a mix of species that are easy to grow and maintain in practically any climate, along with some historically important species in the practice of natural dyeing.

In the category of easy-to-grow species, we recommend starting with coreopsis, calendulas, marigolds or even Dyer's chamomile. All of these flowers are extremely easy to germinate and grow and produce excellent results in dyeing. It's not necessary to grow all of these species, as they all produce results in the field of yellows and oranges.

In the field of historically significant plants, we recommend growing madder (red), weld (yellow) and woad (blue).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How to germinate dye plant seeds

The following tips are intended to make seeding easier for beginners and those who know little or nothing about it. They're for those with limited conditions to understand that it's perfectly possible to germinate and have plants in pots or planting bags. If you have land and a farm, they can also be useful, of course.

Before we give you specific advice for each species listed above, here is some general advice on seeds and germination.

1 Make sure the seeds are fresh and have some guarantee of quality

A seed is a reserve of life, but that reserve doesn't last forever. The longevity of a seed can vary enormously, depending not only on the conditions in which it is stored but also on the species itself.

When buying seeds, try to find out when the seeds were harvested, what species/variety they are and whether the seller has experience with that plant, in this case, in dyeing.

2 All seeds have their particularities

Seeds of different species have different requirements to germinate. Don't forget that the seed is a device waiting for the ideal conditions to become life with a guarantee that it has a future.

Our role is to realise what it needs and provide it. Before burying seeds in the ground, research the plant and its needs: not only do you need to get it to germinate, but you also need to ensure that it grows well during the first few weeks of its life, which are the most critical.

3 Seeding seasons

In the north of Portugal, sowing/planting is very concentrated in spring. We don't sow at other times of the year, even for those species that allow it. We only start from mid-March, using a greenhouse for germination.

Temperature is a crucial factor; if temperatures are too low, the plants won't germinate or grow as quickly.

4 Germination medium

The germination medium is the 'soil' you'll use to sow your little plants. We strongly advise buying a special soil from any gardening shop.

5 Seeding containers

We always prefer to germinate the dye plants in trays/containers and then plant them in the desired location with the necessary layout and spacing.

→

You can use small pots or other plastic containers if they have holes in the bottom for draining excess water. If you're buying seeding trays, choose one with large cells and made from high-quality plastic so that they last for many years. Use trays with large holes so the plant has more room to grow before planting.

On a small scale, and in the case of these species we are describing here, it isn't a good idea to sow directly into the soil because the success rate will be lower.

Moisture

An essential condition for germination is to expose the seed to the moisture that will break its dormancy.

You need to keep the soil moist but not too wet (too much moisture can cause fungus to grow, and without moisture, there is no germination).

What always works well for us is to immerse the tray (already filled with soil) in a container of water until the soil is completely wet without being waterlogged. If it gets waterlogged, press down on the soil to expel the excess water. This is also how we water the trays during this phase.

A common mistake is sowing the seeds and then giving them a quick watering, which doesn't leave the soil evenly moist.

Depth

Pay attention to how deep you bury the seed. This should be proportional to its size.

If the seed is too much on the surface, it may not germinate because it is not enveloped by moisture. If it does germinate, it will become poorly rooted, and the plant will tend to topple over. If you bury it too deep, it may not reach the surface. Use common sense and think of it like a seed that needs to be able to take root well and emerge on the surface.

Between germination and planting

The period between germination and planting is the most critical. With proper attention, it's not difficult to get seeds to germinate, but it can be tricky to get them to grow well until they reach planting day. It is during this period that they are at their most fragile.

It's good to keep them in a place protected from wind, too cold or too hot. You also need to ensure they get plenty of light; otherwise, they can end up being too tall and thin-stemmed (not very robust).

It varies a lot, as some plants grow faster than others, and the weather conditions significantly influence them. Still, we usually plant them out after about a month and a half.

Solutions for those who want to grow but don't have the land

If you don't have any land available but still want to grow dyeing plants, you can explore other alternatives. A small balcony is enough to grow many things. Many species do well in large pots and planters. You can also try growing bags, which usually give excellent results.

How to germinate and grow madder
(Rubia tinctorum)

When to germinate
Spring (March-April).

How to germinate
Madder seeds are small berries that appear at the height of summer and turn into small black stones when they dry out. The seed coat (outer layer) is quite hard, so to facilitate and speed up germination, you can soak them in warm water the day before sowing to soften the outer layer.

Use a well-moistened soil, bury the seed to an acceptable depth, and wait.

Madder takes a little longer to germinate than the others. The first plants should start to appear after about 1 ½ - 2 weeks.

How to grow
Madder should be planted in raised beds, with deep sides to contain the expansion of the roots. Otherwise, it will be difficult to harvest them when the time comes. It should not be planted directly in the ground. It is a plant that likes alkaline soils and humidity.

From the second year of cultivation, it will start to produce seeds in the form of small black berries during the summer. We must be careful when harvesting and allow the seed to dry to guarantee crops in the following years.

When to harvest
Madder's roots should be harvested after three years of growth, in autumn (September-October). The plant and roots will be completely pulled out of the ground. The roots should dry for a few years to develop the colouring.

1 Madder seeds
2 Madder plant, ready to be planted in the soil
3 Madder roots, newly harvested

1

2

3

How to germinate and grow weld
(Reseda luteola)

When to germinate
Spring (March-April).

How to germinate
Weld seeds are smaller than the head of a pin. They don't need to be soaked before sowing, but they have one crucial specificity: they need light to germinate. Therefore, these seeds are not buried. Spread them on the surface of the already damp soil and then press down on the surface to envelop them in moisture.

After a week, they should start to germinate, but they may take longer.

As the seeds are tiny, they are more or less sprinkled on the substrate and, as a result, germinate more than we need. Because of this, you can prick out the extra ones and put them in other pots/trays if you don't want to waste them.

Like woad, weld is a plant with an upright root system. To give the root room to grow, it's best to use trays with large/high cells.

How to grow
Weld is a relatively easy plant to grow; you just need to keep it adequately watered. It prefers alkaline soils.

When to harvest
Apart from a few rare regional species, most varieties of weld are biennial. For this reason, we can only harvest the material for natural dyeing (the flowers and leaves) in the second year, when the plant produces seed. This is usually around summer.

1 Weld seeds
2 Weld plants germinating
3 Dried weld, ready to be used for dyeing

1

2

3

How to germinate and grow Dyer's coreopsis *(Coreopsis tinctoria)* and other similar flowers

Preliminary note

You can use these tips to produce other flowers that grow at the same time, such as calendulas and marigolds.

When to germinate

Spring (March-April).

How to germinate

Coreopsis seeds are easy to germinate and ideal for those who just want to throw the seeds in the ground and not think about it again until it's time to pick the flowers.

Just follow the exact instructions for Weld, but these seeds can be buried deeper. They germinate very quickly, will grow well until planting and will give you lots of joy.

How to grow

When they're big enough, just plant them in a spot of your choice (soil or pot) and keep them properly watered.

When to harvest

Coreopsis start flowering in summer. You can harvest the flower heads as soon as they are at the peak of their maturity before they go to seed. If you keep picking the flowers, the plant will continue to produce more. If we allow the flowers to develop seed, the plant will die. If we keep harvesting, we can keep producing flowers until autumn.

1 Coreopsis seeds
2 Little coreopsis plants germinating
3 Coreopsis flower heads to be used in dyeing;dyeing

1

2

3

How to germinate and grow woad *(Isatis tinctoria)*

When to germinate
Spring (March-April).

How to germinate
Woad is not difficult to germinate. If the seeds are good and you give them a little help, they'll sprout in less than a week.

If you want to speed up germination, you can do the following: the woad seed is inside that husk shaped like a bluish leaf; before sowing, open the husk by tearing it in half and taking out the seed, which is oval, yellow/orange in colour, and tiny. By sowing only the seed, germination is much quicker and hassle-free.

Then, place them in the germination tray cell, pressing down a little with a finger to ensure that the seed is well enveloped by the moist substrate.

How to grow
Woad likes well-fertilised, moist soil and places with moderate temperatures. It may appreciate being sheltered from the sun if we're in a particularly hot climate.

It is a biennial plant, so it will produce seeds in April-May following the year of sowing. We should collect these seeds to continue growing them in subsequent years.

When to harvest
Its leaves can be cut off in autumn (September-October), leaving the plant in the ground until it produces seed the following year.

1 Woad seeds
2 Woad seeds
3 Woad seeds germinating
4 Woad plants, ready to be planted

1

2

3

4

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Textile production relies on agricultural-based raw materials production and is one of the most polluting industries, significantly contributing to climate change. The fight against climate change can only happen with the transition to more sustainable and carbon-neutral or positive productions.

CommunityCloth, a groundbreaking initiative aimed at building capacity in urban communities will create essential tools to promote new training models and provide knowledge for the development of community-driven farm-to-cloth productions.

Textile productions based on low impact agroecological practices, greatly complement food production by allowing diverse outputs, crop rotation, introducing new species, and producing fertilisers. Therefore, the project will explore productions complementary to food in urban farms using natural dyeing and small scale wool processing as examples.

By establishing a network of educators, CommunityCloth seeks to implement cost-effective learning programmes to support urban transition practices, foster communal farms, and create new job opportunities.

Community Cloth

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