File 0 - Plants : introduction

First and foremost, it should be noted that the term « Artemisia » often used by La Maison de l'Artemisia refers to the plant species *Artemisia afra* and *Artemisia annua*. This generic term is not written in italics so as not to confuse it with the genus « *Artemisia* » which comprises several hundred other species.

Distinction between *Artemisia annua and Artemisia afra* :

Artemisia annua is an herbaceous plant that has been used for 2000 years in Traditional Chinese Medicine to prevent and treat intermittent fevers (malaria) and other parasitic diseases. It is an annual pant and must therefore be sown every year in order to be harvested before flowering. This makes it demanding in terms of care.

Artemisia afra is a perennial bush native to South East Africa, used by Traditional Medicine practitioners for centuries to prevent and cure malaria and other parasitic diseases. It is a perennial plant which can be harvested as needed throughout its growth. However, it is difficult to produce viable seeds. This is why it is mainly propagated by layering or cuttings.

Figure 1 : Artemisia afra bush (bottom left), flowering Artemisia annua plant with small yellow blossoms (centre right) and Artemisia annua plants (extreme right and in the background).

Artemisia annua

1. Taxonomy

Artemisia annua L. is a species of the *Asteraceae* family.

It has many local names including sweet wormwood, annual wormwood, sweet Annie, sweet sagewort, annual mugwort in English ; armoise annuelle, absinthe chinoise in French and mohlaswapatla in South Africa [1-2]

Its Chinese name is qinghao (青蒿) [3].

2. Origin and distribution

Artemisia annua is a plant native to the high plateaux of China, where it grows in steppe vegetation (40° north latitude between 1000 and 1500m altitude). It has spread widely throughout the world: North China, Europe, North Africa, North India, North Vietnam, USA, Argentina ...

Over the last thirty years, it has been introduced in East Africa and Madagascar to establish large plantations (Kenya, Madagascar, Ethiopia, Tanzania ...), in Central Africa (Burundi, Cameroon, DRC, Rwanda, Sudan, Uganda ...), in West Africa (Burkina, Gambia, Mali, Nigeria, Senegal, Togo ...) and in South America (Brazil, Peru, Colombia) in a more marginal way. [1,3,4]

3. Botanical description

The morphology of *Artemisia annua* varies enormously from one plant to another.

- **An annual herbaceous plant** forming **bushes** that can exceed 3 metres in height. Potentially biennial [1,4,6].
- Root system consisting of a short taproot and numerous secondary roots [4].

- **Usually** composed of a very hard **single upright fibrous stem**, occasionally several several stems, with **alternating branches** that can reach a level higher than n+4 (quaternary branches) [3,4].
- **Various ports** are possible depending on the type of branching (slender, pyramidal, globular) [4].
- **Stems** are often **ridged** and glabrous (hairless)- rarely smooth and hairy - and can be **red, yellow, brown or green in colour** [4,6,7].
- The main stem and the first branches become lignified with age (become "hard as wood") [3,4].
- When the plant is pruned, the buds at the base of the main stem break open and produce secondary stems [4].
- Alternating branches with petiolate (stalked) leaves from 1.5 to 10 cm long, very indented (bi-pinnate with linear serrated segments) [3,4].
- The leaves have a strong **characteristic aromatic odour** (fresh and bitter) due to the presence of glandular trichomes which secrete a volatile oil [2, 4,8].
- **Alternate green leaves,** generally glabrous (hairless) [7].
- Oval to triangular lamina[1] , deeply cut. Leaf edge generally dentate [7].
- **Inflorescences[2]** (flower clusters) of **green-yellow panicles** appear at the top of the main stem and branches [3,4,8].
- Tiny, **yellow flowers** arranged in capitula[3] (flower-heads) 2-3 mm in diameter in the inflorescences [8].
- Fruits are smooth, ovoid, light-grey **achenes[4]**, 0.5 cm long [3].
- Each fruit contains a single, **very small**, brown, oblong **seed** (less than 1 mm, i.e. 10.000 to 14.000 per gram) [3,4].
- Pollination is mainly by wind, less frequently by insects [4,8].
- Fertilisation mail allogamy (cross fertilization between two distinct plants) [4].
- Plant fertility (number of achenes per inflorescence) is highly variable [4].

Figure 2 : Artemisia annua leaf

[1] Lamina : leaf blade
[2] Inflorescence : cluster of flowers arranged on a stem
[3] Capitulum, pl. Capitula : cluster of small flowers
[4] Achene : Dry one-seeded fruit that does not open to release the seed

4. Ecological requirements

- **Day length and sun**

Artemisia annua is a short day plant which starts to flower (and hence stops its growth) when the day length falls below a critical threshold value: between 11.5 - 13.5 hours, depending on the variety and growing conditions [4].

Hydric stress (excess or shortage of water), high temperatures, the physical impact of water on the plant and the wind can also induce a start of flowering [4].

Upon return of more favorable conditions, if daylight duration is not too short, the plant can stop blossoming and resume growth [4].

It is a heliophilous plant, which likes full sun when sufficiently supplied with water [4].

- **Temperature**

Germination of the seeds: from 7°C [1].

Optimal average growth temperature: 20-25°C [1].

Growth slows during the cold dry season [4].

The total temperature/days above the 10°C threshold must lie between 3500 and 5000°C to ensure good plant growth [1].

- **Water**

Artemisia annua requires significant amounts of water during the initial growth phase (young plants) but resists better to hydric stress thereafter. It requires a minimal rainfall of 600 to 650 mm/year to ensure growth. [9]

- **Soil**

Artemisia annua will grow best in not too heavy soils (i.e. sandy) with a pH between 5.5 et 7.5. It can grow in soil with pH below 5.5 but as a result will produce less biomass. [3]

It requires well drained soil as it doesn't not like waterlogging. [1].

Important: it is always possible to circumvent any adverse local conditions by selecting better suited varieties

5. Phenology

6 stades of development:

1. Seedling / rosette
2. Elongation and stem branching / pre-flowering
3. Formation of flower buds
4. Flowering
5. Fruiting
6. Senescence

There are overlaps of stages 3, 4, 5 and 6 depending on the parts of the plant [4].

Cycle duration varies according to plant variety and growing conditions. For this reason, it is important to identify optimum varieties and growing periods for your site. (See First Trial sheet: Which cultivar and which period?)

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