

Important Bast Fiber Crops

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Midas

MARGINAL LANDS, INDUSTRIAL CROPS
AND INNOVATIVE BIO-BASED VALUE CHAINS



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Bast Fibre Crops



Flax

Linum usitatissimum L.

- Annual crop
- Seed oil and bast fibre
- Main uses: textiles, composites, paper
- Grown in temperate regions



Hemp

Cannabis sativa L.

- Annual crop
- Multipurpose crop (fibre, seeds, biomass)
- Main uses: textiles, construction materials, biocomposites, hempcrete
- Adapted to temperate and warm climates



Kenaf

Hibiscus cannabius L.

- Annual crop
- Fast-growing
- Main uses: paper and pulp, building materials, textiles, composites
- Adapted to warm and subtropical climates



Ramie

Boehmeria nivea L.

- Perennial crop
- High-quality, long and strong fibre
- Main uses: textiles, specialty fabrics, composites
- Adapted to warm and humid climates



Nettle

Urtica dioica L.

- Perennial crop
- Local and low-input option
- Main uses: textiles, composites, insulation materials
- Adapted to temperate regions



Jute

Corchorus spp.

- Annual crop
- Important global fibre crop
- Main uses: sacks, ropes, textiles, geotextiles and composites
- Adapted to tropical and subtropical climates



Annual crops

Flax, hemp, kenaf, jute



Perennial crops

Ramie, nettle



Main uses

Textiles, paper and pulp, building materials, composites, ropes and sacks, insulation, cat litter, oil and other industrial applications

Source: 4FCROPS, Crops2Industry, FIBRA & MAGIC projects & www.fibrecrops.nl.



The importance of Bast Fibre Crops



Bast Fibre Crops studied in MAGIC



www.magic-h2020.eu

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Marginal Lands for Growing Industrial Crops

Turning a burden into an opportunity

Magic

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MAGIC-MAPS
Characterises and analyses current and future marginal land in Europe.
Visit MAGIC MAPS →

MAGIC-CROPS
Provides a description of 37 industrial crops suitable for growing on marginal land in Europe.
Visit MAGIC CROPS →

MAGIC-DSS
Provides users with guidelines for industrial crops growing under marginal conditions in Europe.
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Bio2Match Tool
Collects information on conversion technologies for various biomass crops growing on marginal land in Europe.
Visit Bio2Match Tool →

MAGIC project website: www.magic-h2020.eu

Bast fibre crops studied in MAGIC



Hemp



Flax



Kenaf



Nettle



In the MAGIC project, four bast fibre crops were identified as promising crops for marginal lands facing natural constraints: **hemp**, **flax**, **kenaf** and **nettle**.

Industrial hemp

(*Cannabis sativa* L.)



Contents

In the following slides, we present key information on industrial hemp, covering:



Origin and area of cultivation



Its importance as a multi-purpose crop



Soil and climate preferences



Cultivation protocol

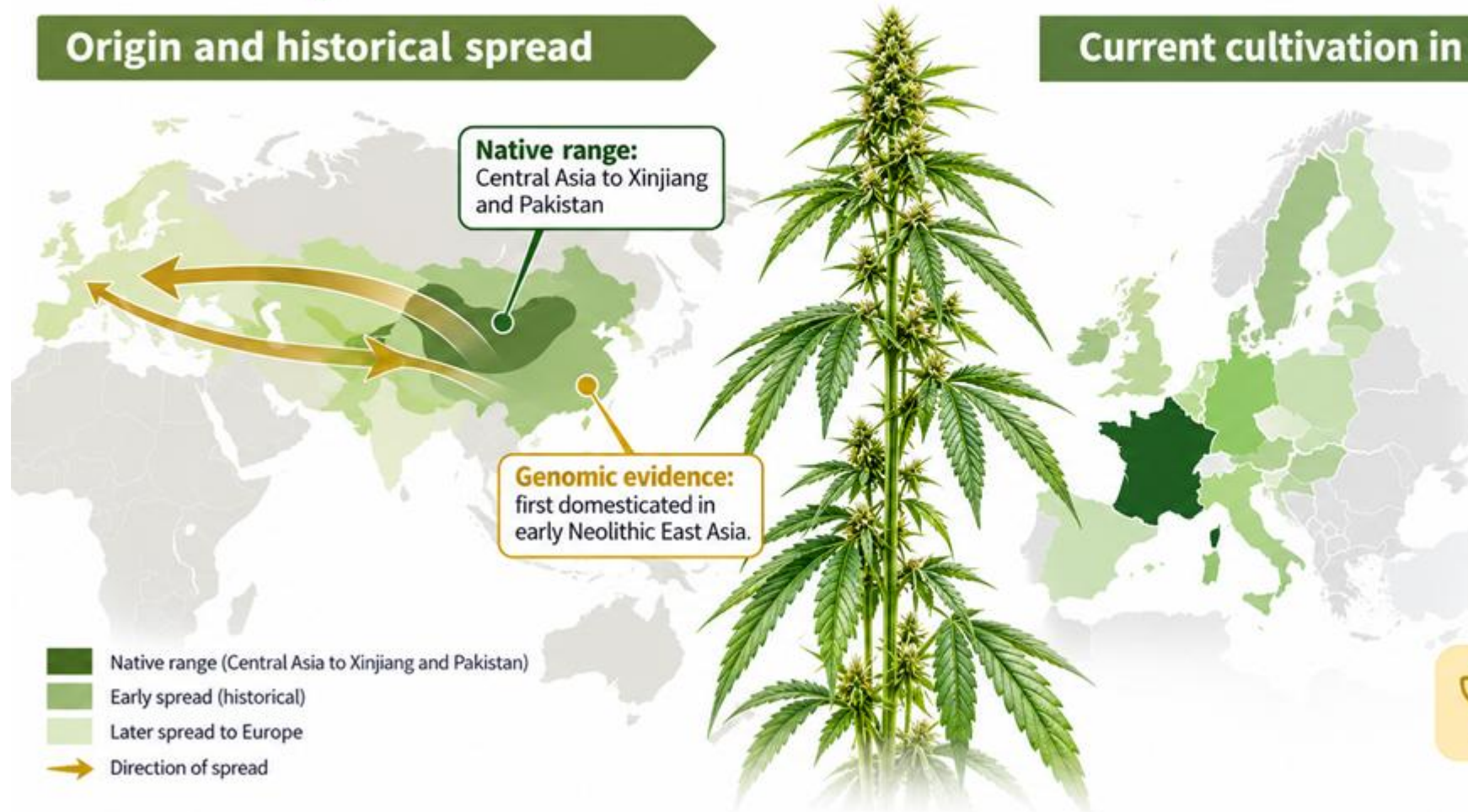


Uses



Hemp: from Asian origin to European cultivation

Origin and historical spread



Current cultivation in Europe (2023)

 **EU hemp area (2023)**
28,830 ha

 **France**
19,410 ha

 **Germany**
2,900 ha

 **Netherlands**
1,976 ha

 **France is the leading EU producer.**

Hemp A multipurpose crop

Seeds, fibre, shives, leaves and roots for high-value products

Seeds Food, feed and bio-based products

- Dehulled seeds (food) – protein, oil, fibre
- Hemp oil – food, nutraceuticals, cosmetics
- Protein-rich cake/meal – animal feed, aquaculture
- Ingredient for functional foods



Leaves Bioactive compounds and green biomass

- Animal feed (fresh/dried)
- Pharmaceutical and nutraceutical compounds (e.g. cannabinoids, terpenes, polyphenols)
- Essential oils and cosmetics
- Biopesticides and other bio-based products



Roots Soil and environmental services

- Soil structure improvement and carbon sequestration
- Phytoremediation (uptake of contaminants)
- Source of bioactive compounds
- Contribution to soil health and ecosystem services



Flower High-value compounds

- Pharmaceuticals (THC, CBD and other cannabinoids)
- Nutraceuticals and cosmetics
- Essential oils and flavourings
- Other specialised applications



Fibre Renewable materials

- Textiles (clothing, technical textiles, geotextiles)
- Biocomposites (e.g. automotive, construction)
- Pulp and paper (packaging, specialty papers)
- Insulation materials
- Other industrial applications



Shives Bio-based and construction products

- Animal bedding (horse, small animals)
- Garden mulch and soil amendment
- Construction materials (hempcrete, blocks, panels)
- Bioenergy (pellets, briquettes)
- Other bio-based products



Multiple products
from the same crop



Supports circular
bioeconomy



Carbon sequestration
and environmental benefits



Grown on marginal lands
with low ILUC risk



Diverse markets in food,
materials and energy

Source: MAGIC project
(www.magic-h2020.eu)

Industrial hemp (*Cannabis sativa* L.); how and where to grow it

1 Where it grows best

- Temperate to warm-temperate regions
- Full sun and a frost-free growing period
- Well-drained loam or silt-loam soils
- Best performance around pH 6.0–7.5
- Avoid waterlogging and severe soil compaction



2 How to establish the crop

- Sow in spring after the risk of hard frost
- Soil temperature ideally at least 8–10°C
- Shallow sowing depth: about 2–3 cm
- Good seed–soil contact is important
- Early weed control is critical until canopy closure



3 Crop management

- Moderate nutrient demand, especially nitrogen
- Needs moisture for establishment and rapid stem growth
- Dense stands for fibre; wider spacing for seed crops
- Rotations help maintain soil health and reduce disease pressure
- Fast canopy growth can suppress many weeds



4 Main variety groups

- **Fibre types:** tall, slender stems, high bast fibre yield
- **Grain/seed types:** shorter, more branching, seed production
- **Dual-purpose types:** balanced stem and seed production
- Use certified low-THC industrial hemp cultivars according to national rules



5 Key diseases and pests

- Damping-off in seedlings
- Botrytis (grey mould)
- Sclerotinia (white mould)
- Fusarium and root/stem rots
- Powdery mildew
- Possible pests: aphids, flea beetles, caterpillars/borers



Grey mould



Root rots



Aphids

6 Good prevention practices

- Start with healthy certified seed
- Use crop rotation and avoid repeated hemp in the same field
- Avoid poorly drained fields
- Monitor regularly during establishment and flowering
- Promote airflow and avoid excessive crop stress
- Follow local guidance for cultivar choice and plant protection



7 Growth cycle

1. Emergence
(0–2 weeks)



2. Rapid vegetative
growth (2–8 weeks)



3. Flowering
(8–16 weeks)



4. Harvest
(varies by use)



Fibre crops are often harvested earlier; seed crops are harvested later.

Typical uses



Fibre

Textiles, composites,
paper, construction
materials



Seed/oil

Food, animal feed,
cosmetics, oils



Biobased materials

Bioplastics, bioenergy,
building materials
and more

Harvesting is depending on its main purpose for cultivation (fibre, seed or both)

1 Choose the harvest objective



Fibre hemp

Harvest at early flowering to preserve fibre quality.



Seed / grain hemp

Harvest when seeds mature and moisture is lower.



Dual-purpose hemp

Combine a seed harvest first, then collect the remaining stalks.

2 Typical harvest timing



Fibre: usually cut earlier



Seed: harvested later at seed maturity



Dry weather helps harvesting, field drying and retting.

3 Main harvesting systems used in Europe

For fibre



Cut stems with a mower / cutter bar / specialised hemp harvester



Lay stems in swaths



Ret in the field



Turn swaths if needed



Bale and transport

For seed



Use a combine harvester



Raise cutter bar and adjust speed carefully



Harvest seed heads while limiting fibre wrapping



Dry and clean seed after harvest

For dual-purpose crops



Harvest seed first



Cut remaining stalks afterwards



Ret and bale stems for fibre or biomass

4 Machinery examples

Examples shown are illustrative machinery types for hemp cutting and harvesting.



HempFlax HempCut 3000/4500



Clipper 4.3 MMH



Blücher / specialised hemp harvester

5 Key practical tips



Avoid harvesting when stems are too wet.



Prevent fibre wrapping and machine clogging.



Adjust cutting height and forward speed carefully.



Keep windrows even for retting and baling.



Plan logistics for drying, baling and storage.



European practice

In Europe, hemp is commonly harvested either for fibre, for seed, or in a dual-purpose system. Specialised cutting equipment and adapted combines are often used depending on the final market and plant maturity.

Source: adapted from the provided hemp harvesting reference image and general European hemp harvesting practice.



Flax

(*Linum usitatissimum* L.)



Contents

In the following slides, we present key information on flax, covering:



Origin and area of cultivation



Its importance as a multi-purpose crop



Soil and climate preferences



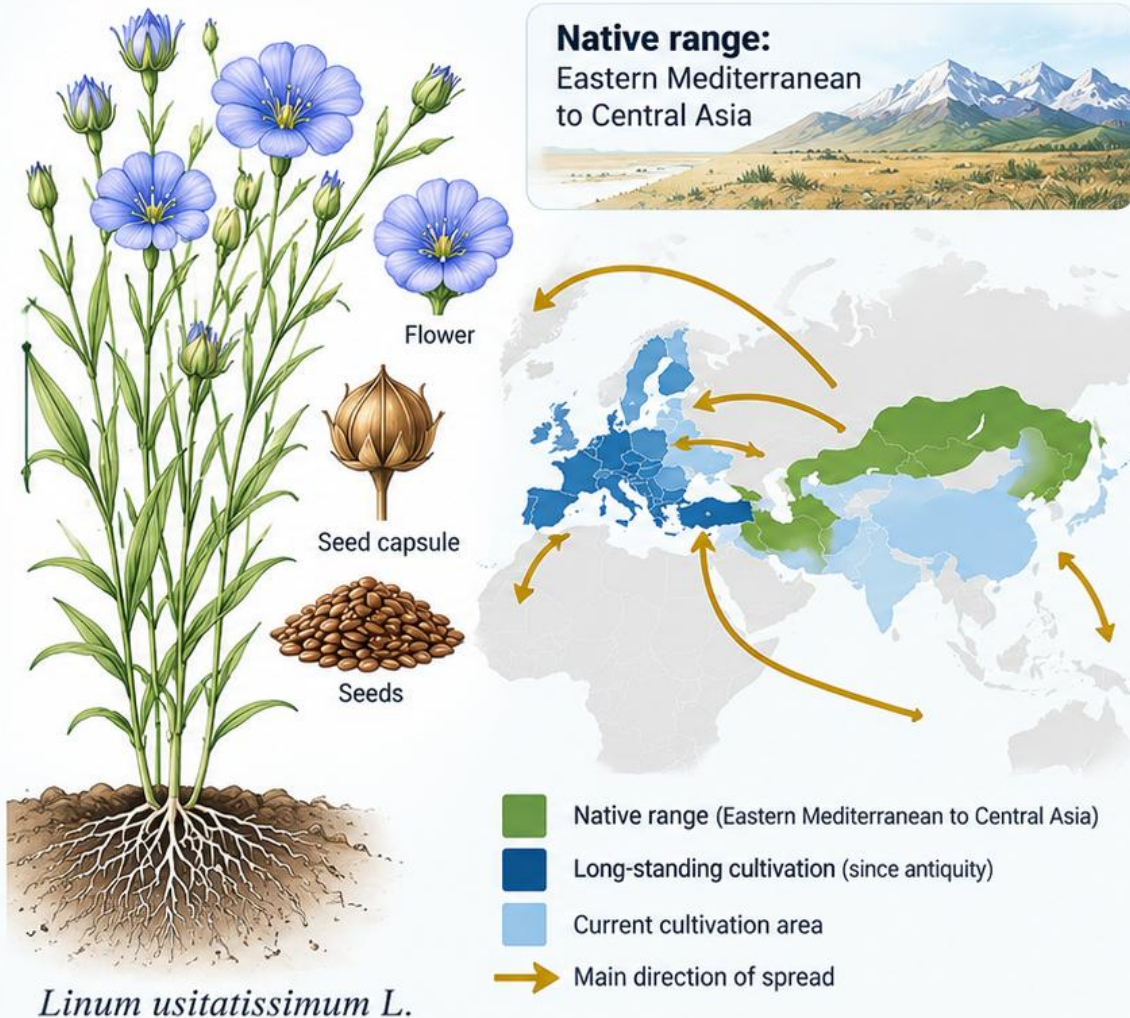
Cultivation protocol



Uses



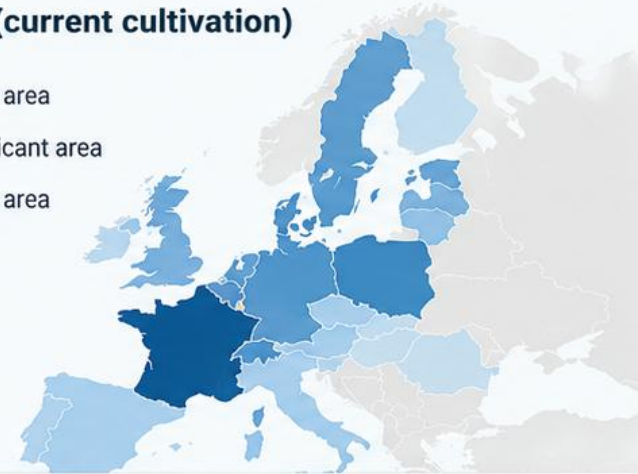
1 Origin and historical spread



2 Cultivation area (main producing regions)

Europe (current cultivation)

- Major area
- Significant area
- Minor area



Main European producers

- France
- Belgium
- Netherlands
- Germany
- Poland



Also cultivated in



North America
(Canada, USA)



Other regions
(Asia, South America, Africa, Australia)
on a smaller scale



Grown in a wide range of temperate and continental climates.

1 Soil and site preferences



Fertile to medium-heavy soils.



Best in **well-structured soils**, especially humus-rich clay soils.



Good **water/air balance** is important.



Avoid crust-forming and waterlogged soils.



Fibre and linseed both perform well under good soil conditions.

2 Climate preferences

Linseed



Avoid high temperatures; long days during the growing period are favourable.

Fibre flax



Prefers moderate temperatures around **18–20°C** and good **cloud cover** / mild conditions.



Cool temperate conditions favour crop establishment and quality.



3 Sowing



Spring flax

Sown between the end of **February** and the end of **March**.



Winter flax

Sown between mid-September and the end of October.



Row spacing: 8–12 cm



Sowing depth: about 2 cm



Sowing density:

Fibre flax: 110–140 kg seed/ha

Linseed: 50–60 kg seed/ha

4 Harvest



Winter flax



Indicative harvest around **20 July**.



Spring flax



Indicative harvest around **20 August**.



Fibre flax is commonly harvested at the green–yellow maturity stage.



5 Extra practical notes



Choose cultivar type according to **end use:** fibre or seed.



Good field structure supports root growth and even emergence.



Timely sowing is important for yield and quality.



Harvest timing depends on crop type and maturity stage.

Long + short fibre



Textile industry



Medicine (wound dressing)



Paper production



Insulation materials



Biodegradable packaging material and biocomposite production



Car-door panels



Plant pots



Retaining mats



Flax seeds



Food use
(high nutritional value)



Pharmaceutical and
health-care industries



Wooden shives



Can serve as an
energy source



Valuable compounds
with antibacterial activity



Flax fibres are flexible, lustrous and soft, stronger than cotton but less elastic. They absorb humidity and are allergen-free.



Kenaf

(*Hibiscus cannabinus* L.)



Contents



Origin and cultivation area



Description of the crop



Soil and climate preferences



Cultivation protocol,
protection and harvest



Uses and products

Origin and cultivation area of kenaf



Origin



Native origin
(tropical and
eastern Africa)



Warm-season annual bast fibre crop.



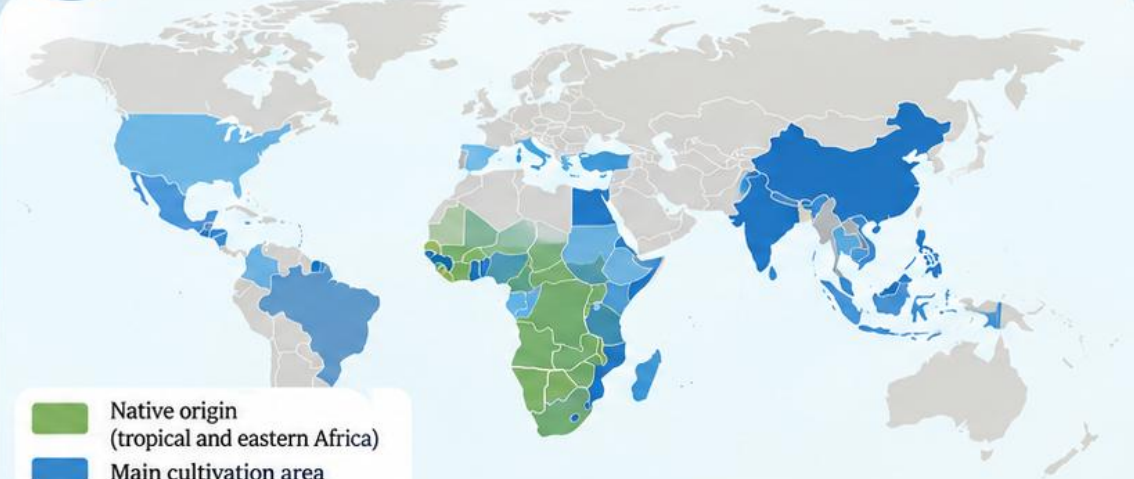
Cultivated for centuries for fibre
(e.g. ropes, sacks, textiles, paper).



Adapted to tropical and
subtropical climates.



Cultivation area



- Native origin
(tropical and eastern Africa)
- Main cultivation area
- Other/smaller cultivation area
(testing or limited production)



Typical cultivation zone

Roughly **30°S to 45°N**

Grows best in tropical and subtropical
regions with warm temperatures and
adequate rainfall.



Main producing regions

- India (largest producer)
- China
- Bangladesh and Southeast Asia
(e.g. Thailand, Vietnam, Indonesia)
- Africa (e.g. Egypt, Sudan, Nigeria and
other tropical African countries)
- Other regions: USA, Central and South
America, Mediterranean and southern Europe
(limited or experimental cultivation)

Source: adapted from FAO EcoCrop and general literature on kenaf (*Hibiscus cannabinus*).

Description of kenaf

(*Hibiscus cannabinus* L.)

1 Crop type and classification



- Annual spring, self-thinning bast fibre crop
- Dicotyledonous angiosperm, family Malvaceae

2 Stem



- Round, sometimes thorny; colour ranges from pure green to deep burgundy
- Provides both long bast fibres and short core fibres

3 Flowers



- 7.5–10 cm diameter, 5 petals
- Flower colour ranges from light cream to dark purple

4 Seed



- Small and black

Varietal groups



Early



Late:

flowering starts when day length is below 12.5 hours

Main plant parts



Seedling



Leaves



Mature plant



Flower bud



Flower



Capsule / fruit



Opened capsule



Seed

Kenaf: Soil and climate preferences

Hibiscus cannabinus L.



Deep root system

Tap root system penetrates several meters deep, helping the crop access water and nutrients.



Warm climate and long season

Best conditions are high temperature, a long growing season and abundant soil moisture.



Soil type

Prefers heavier, well-drained, fertile soils with good moisture-holding capacity.



Rainfall or irrigation

Annual rainfall or irrigation requirement is about 500–650 mm, equivalent to approximately 125 mm per month.



Returns nutrients to the soil

Crop residues and leaves return significant quantities of nitrogen, calcium, magnesium, phosphate and potassium to the soil.

Source: adapted from MIDAS project material.

Kenaf cultivation protocol

Hibiscus cannabinus L.



1 Seedbed preparation



Seeds require good **seed-soil contact** for germination, so a fine, firm, well-prepared seedbed is needed.



2 Sowing



- Sowing depth: **2.5 cm.**
- Ensure good seed-soil contact.



Emergence

3 Temperature & timing



- Minimum ground temperature: **15°C.**
- In southern Mediterranean countries, kenaf can be planted in spring (**April to May**).

4 Early growth advantage



- In warm climates kenaf emerges and **grows rapidly**, helping it compete effectively with weeds.



Crop development (typical progression)



Emergence

Seedlings emerge quickly in warm conditions.



Rapid growth

Fast vegetative growth helps suppress weeds.



Flowering

Flowering stage (for high fibre quality).



Crop spacing

Maintain adequate plant spacing for good stand and fibre yield.

Kenaf crop protection and harvest

Hibiscus cannabinus L.



Nematodes: key issue and management



Nematodes can be a major constraint

Root-penetrating nematodes can reduce root growth and crop performance in kenaf.



Nematode damage on kenaf roots

Two main solutions for nematodes:

1



Combination of crop rotation and chemical control

2



Variety SF 459 is reported as nematode resistant.



Harvest options



Harvest as green material

During flowering
(for high fibre quality).



Harvest as dry material

During winter.



Harvesters that can be used:



Sugarcane type



Forage type combined with baling equipment



Jute/reed type



Combined harvesting when stems and seeds are harvested at the same time

Source: adapted from MIDAS project material.

Main uses of kenaf

Hibiscus cannabinus L.



1. Paper and pulp

Can be pulped to make a range of paper and pulps.



2. Fibre-based uses

Kenaf fibres are used for fabrics, building materials (particleboards, low-density panels), wallpaper backing, furniture underlays, bedding material, poultry and cat litter, and oil absorbent.



Fabrics



Building materials
(particleboards, panels)



Wallpaper backing



Furniture underlays
& bedding material



Poultry and cat litter



Oil absorbent



3. Whole plant and seeds



Whole plant

Whole plant has high protein and good digestibility and may be pelletized for multiple industrial or feed uses.



Seeds

Seeds contain about 20–25% oil which is rich in polyunsaturated fatty acids.



Source: adapted from MIDAS project material.



Nettle

(*Urtica dioica* L.)



Contents



Crop description



Origin



Soil and climate preferences



Crop establishment



Harvest



Main uses



Nettle (*Urtica dioica* L.)

Crop description



Field stand



Botanical features

At a glance

- Perennial bast fibre crop
- 1.2–1.8 m tall stems
- Soft, silky grey-white fibre
- Experimental cultivation in Europe

1



Crop type

Dioecious, wind-pollinated perennial. Male and female flowers occur on separate plants; flowers are small, green and grouped in long racemes.

2



Stems and leaves

Straight, usually unbranched, four-sided stems up to 1.8 m; opposite serrated leaves and stems covered with stinging hairs.

3



Cultivation status

Common in wild conditions across Europe, Asia and North America. Commercial cultivation is limited; European work has mainly used experimental plots.

4



Growing requirements

High water demand, especially during intensive growth. Prefers evenly distributed precipitation and benefits from nitrogen-rich, well-managed soils.

5



Establishment and harvest

Vegetative multiplication is preferred: rhizomes or clone seedlings planted in April–May, often at 50 × 50 cm. Harvest usually at flowering, mid-August to early September.

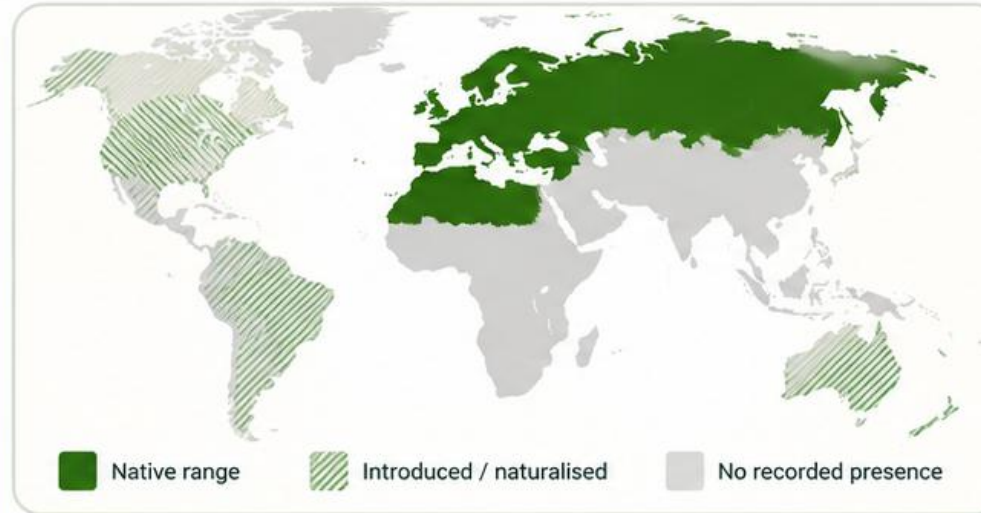
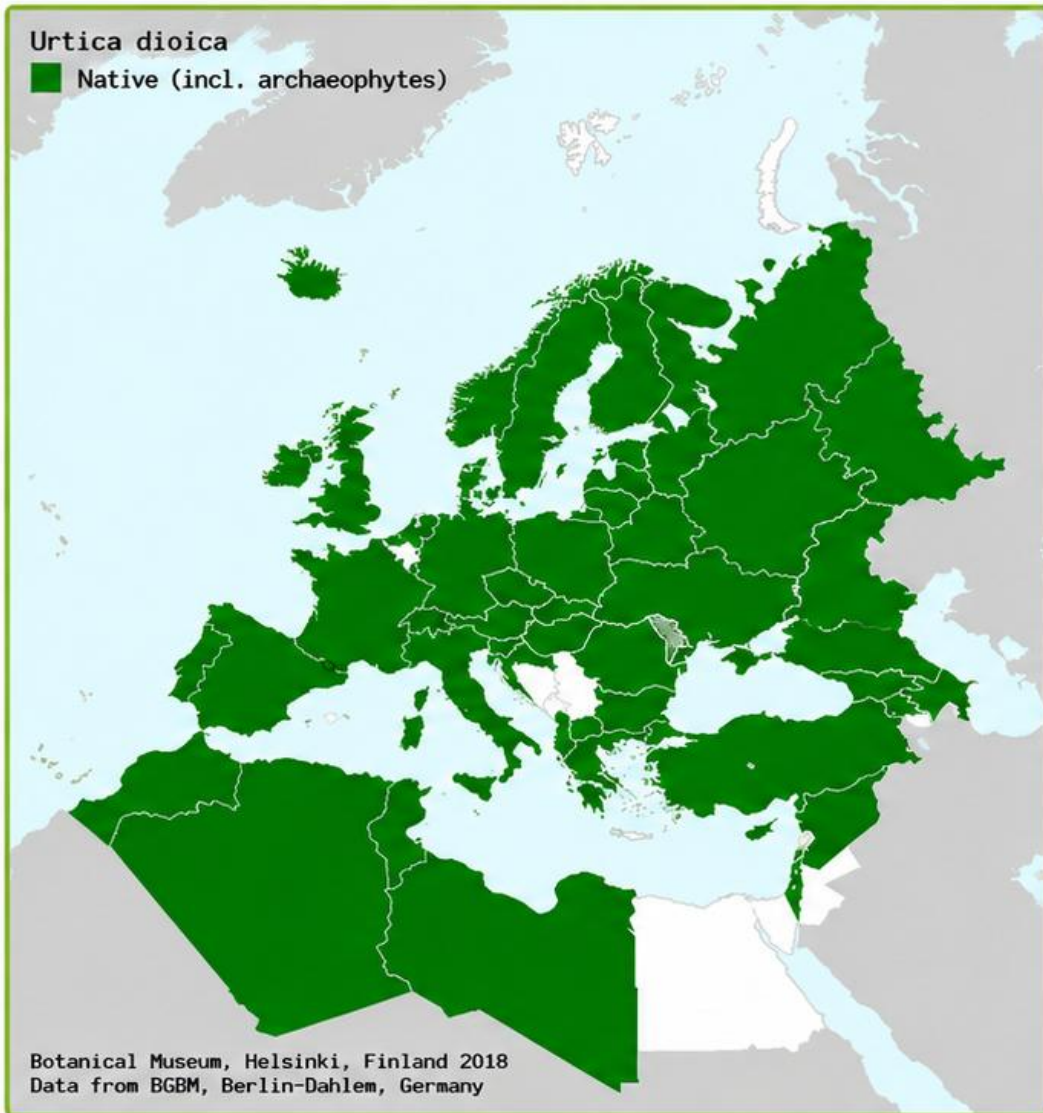
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Fibre and uses

Dry stems can yield soft, silky, grey-white fibre suitable for cottonized fibre routes. Nettle also has food, feed, medicinal and ecological value.

Nettle (*Urtica dioica* L.)



Native range

Native to Europe, extending eastwards through temperate Asia to Siberia and western China, and also to north-western Africa.



Europe is a core native area

Widespread across most of Europe, including the Mediterranean region and northern Europe (present in Greece).



Temperate species

Occurs mainly in temperate regions, typically in moist, nutrient-rich soils. It is a perennial, rhizomatous species.



Widely distributed beyond its native range

Introduced and naturalised in many other temperate regions worldwide, including much of North America, parts of South America, Australia and New Zealand.



A widespread Eurasian–North African native species,
now naturalised in many temperate regions worldwide.

Nettle (*Urtica dioica* L.)

Soil and climate preferences



Moist, fertile stand



Water-stress risk

Core message

Nettle performs best where water is reliable and soils are nitrogen-rich.

What nettle prefers

1



Climate

Temperate species; commercial fibre work is mainly from European experimental plots.

2



Water

High water demand, especially during intensive growth; rainfall should be evenly distributed.

3



Soil fertility

Nitrophilic crop: prefers nitrogen-rich, well-managed soils and benefits from N supply.

4



Site risk

Avoid dry, windy sites; plants are sensitive to drying winds and water deficiency.

Establishment

Deep-rooted forecrops can reduce weeds; N-enriching forecrops such as lupine or vegetables are recommended. Vegetative planting is commonly used in April–May.

Takeaway: Select moist, fertile, nitrogen-rich sites with reliable water availability; manage weeds carefully during establishment.

Nettle (*Urtica dioica* L.)

Crop establishment

By seed



-  Approx. 1000 seeds/m
-  Row spacing: 20 cm
-  Sowing depth: less than 1 cm
-  Establishment is often heterogeneous in the first year
-  Usually results in lower fibre content and quality

By vegetative propagation (seedlings)



-  Row spacing: 60–75 cm
-  Within-row spacing: 50–60 cm
-  More uniform establishment
-  Most effective establishment method



Seedling establishment is the most effective method.

Nettle (*Urtica dioica* L.)

Harvest



Harvesting time depends strongly on the **end use**.



For fibre, nettle is harvested between **late summer and early autumn**.



Mechanical harvesting can be used (e.g. hemp processing – scutching drums and short fibre processing units).



After harvesting, **leaves are removed** and **straight, long stems** are collected for fibre production.



Stems should be dried to about **15% moisture content**.



Fibre can be extracted from dry stems by **decortication**.



The **formic acid content** makes the retting process **more difficult**.



Harvesting strategy depends on the **intended end use** (e.g. fibre, medicinal leaves or seeds).

From plant to fibre – main steps

1 Cut / harvest



2 Remove leaves



3 Dry stems



4 Fibre extraction (decortication)



Nettle (*Urtica dioica* L.)

Main uses

Nettle fibre



Ropes



Paper and pulp



Biocomposites



Textile blends with cotton, bamboo, flax and other natural fibres



Animal bedding material



Bioenergy

Leaves and seeds



Cosmetics: creams, masks, tonic, shampoo, soaps, skin lotions



Green permanent dye



Traditional medicinal and nutraceutical uses



Food products: salads, pies, tea



Forage crop for poultry, cattle, horses and pigs



Can enhance yolk yellowness in poultry feed

Whole plant



The whole plant can be exploited and value-added products can be produced.

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AND INNOVATIVE BIO-BASED VALUE CHAINS



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Thank you



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