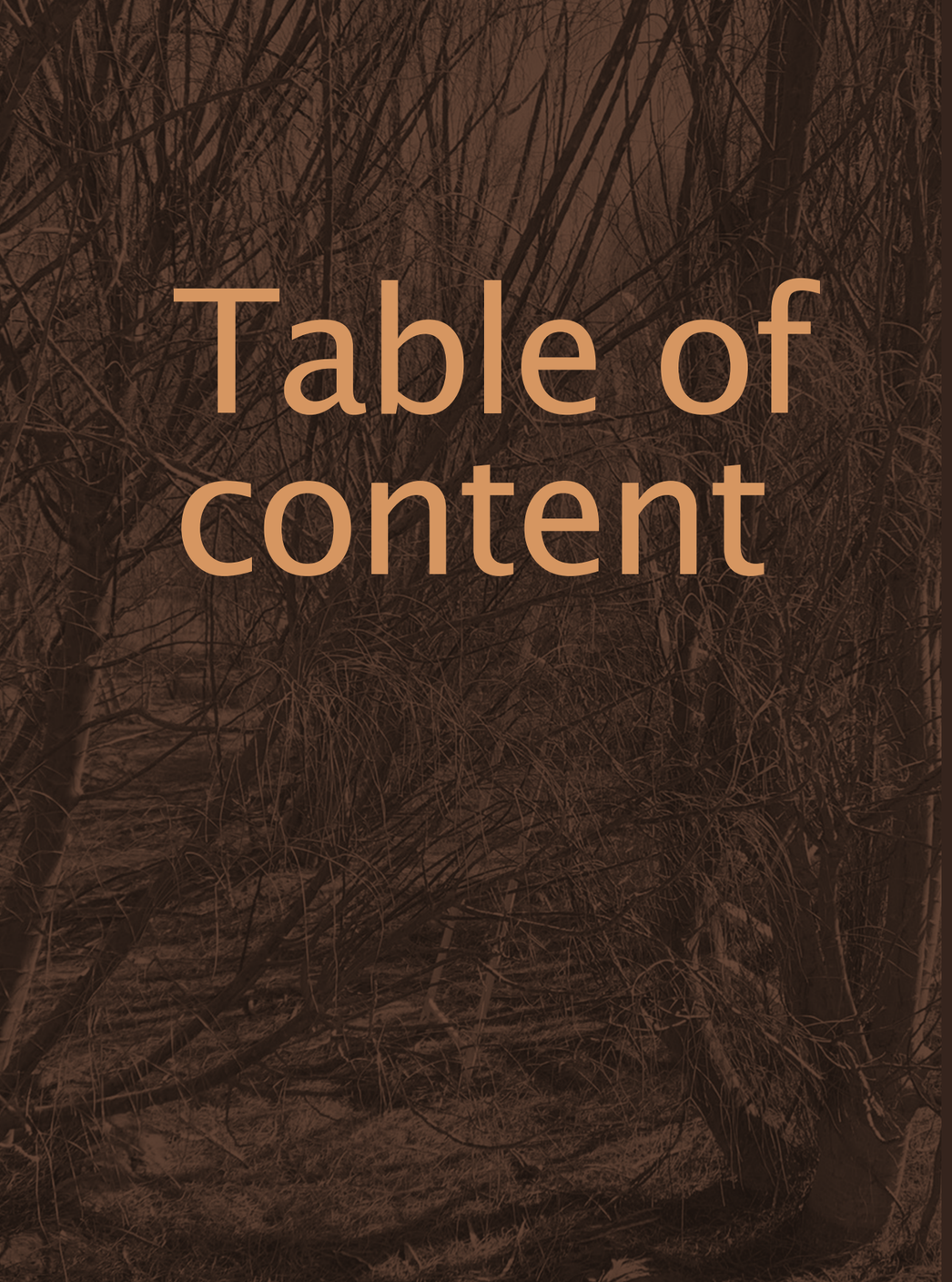
Moringa Peregrina fundamentals

APTC TRAINING BOOKLET 2023

APEX
Agriculture • Performance • Expertise



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Introduction

Introduction

Context

- Part of AlUla heritage, the Bān tree *Moringa peregrina* is a natural asset for the region and its communities
- ALULA PEREGRINA TRADING COMPANY (APTC) was created by the RCU with the objective to set up the first AlUla supply chain to cater for local and international cosmetics markets by nurturing the roots of the Desert of Arabia into exceptional ingredients

Objectives

- Capacity building is a fundamental part of the Strategic pillars for the development of AlUla Peregrina sector
- This book is designed to provide farmers with :
  1. Basic information on Peregrina and its integration in farm systems;
  2. Guidelines for those willing to work with APTC.

Expected learning outcomes

- Knowledge of the cultural and economical value of *Moringa peregrina*
- State of the art in Peregrina cultivation and need for co-learning
- Understanding of APTC's ambition
- Knowledge and mastery of APTC's standards & quality requirements
- Awareness of the need for sustainability at different levels: management of resources, conservation of biodiversity, preservation of the environment

The Peregrina story

1. The *Moringa peregrina* tree
2. The tree in AlUla
3. Cultivating the tree – Review of current knowledge

Arabic Moringa, Bān tree

Native range distributed throughout Northeast Africa to the **Arabian Peninsula**. Peregrina trees are only found in this geographical zone.

An oil, known as bān oil, is **obtained from the seeds**.

Seeds and oil were likely **traded along the antique Incense route,** going back to Antiquity and Pre-Islamic times.
It is referred to as the most precious oil in old Egyptian texts, the Bible and ancient Greek and Roman texts.

In Saudi Arabia today, the tree is mostly found in **Hijaz region**, renowned for producing the best bān oil.

Peregrina in Antiquity and early Islamic times

Peregrina before islamic times

- Proof was found of the **antique use of Peregrina oil** in ancient texts and archeology, **back to Pharaonic Egypt, through the Hellenistic and Roman periods.**

  Greek sources mention it as "**acorn for perfume and unguent**".

  Scholars of the time mentioned Bān oil as **coming from the Arabian countries** and the Levant.

- In the Roman empire, the **oil was used as a scent booster** in the most sought-after perfumes such as "royal perfume", and also **prescribed for skin problems**.

- Precious **unguent containers in Egypt** revealed the presence of bān oil in their content.

- In Arabia, **the word bān was identified in three south-Arabic inscriptions** dated from the 5th to the 3rd centuries BCE, confirming the correlation between ancient bān and *Moringa peregrina*.

Early islamic period

*In Abbasid times, **Bān oil is part of** the Ghâliya recipe, one of the most expensive complex and **sough-after perfume**.*

*The **Kitāb Al-Aghānī**, "The book of songs" from Abu al-Faraj al-Isfahani (897-967 CE), mentions that **Hakim bin Maymoun**, servant of al-Walid ibn al-Malik ibn Marwan (ca. 674-715), 6th Umayyad Caliph, **used to transport bān oil from the Levant and from Wadi Al-Qurah (the ancient town of Quhr) to Jeddah**.*

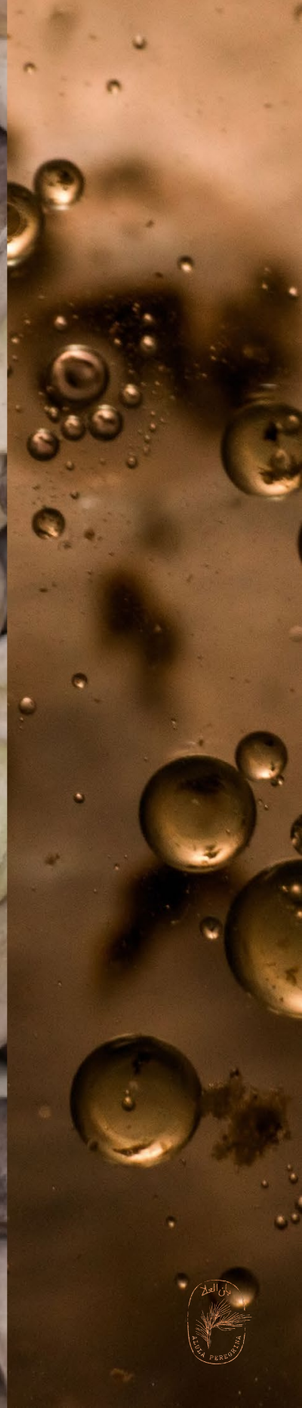
Part of AlUla heritage: Bān oil, a millennium use for perfumes and cosmetics

Many uses

Tree: used for its **ornamental qualities**, often in alignment plantations as hedges or field borders and windshields. It can also be useful for **erosion control and soil improvement.**

Plant parts: leaves, rachis, roots, flowers, fruits, and immature pods can be used for **various purpose**s, e.g. food, medicinal, fodder…

Oil: the edible oil has been used since ancient times for cooking, in traditional medicine and **in cosmetics & perfumery.**
It is still **produced and used locally in AlUla.**



One genus, two species

- *Moringa* is the sole genus of the family Moringaceae.
- Another well-known species used for its seed oil is *Moringa oleifera* (Indian Moringa), a tree native to Pakistan and India, and now introduced in many tropical and **subtropical countries including KSA**.
- The two species *M. peregrina* and *M. oleifera* are prone to hybridisation: they can reproduce together and produce plants with mixed traits.

Did you know? Only the *peregrina* species is native to KSA and AlUla

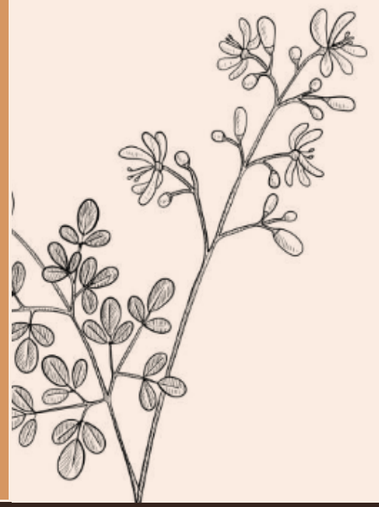
Moringa peregrina

Family: Moringaceae
Genus: *Moringa*
Species: *peregrina*
Common names: Peregrina, Bān and Yusr

Leaf

Inflorescence

Fruit



Moringa oleifera

Family: Moringaceae
Genus: *Moringa*
Species: *oleifera*
Common names: drumstick tree, horse-radish tree

Leaf

Inflorescence

Fruit

Morphological clues for differentiation between the two species

Moringa peregrina

Leaves: fast falling; when visible, leaflets are very small, linear, elliptic or oblanceolate

Seeds: beige, brown or black, globose to ovoid or trigonous, relatively smooth (without ridges);
Ratio almond/shell = 60%/40%

Flowers: white or streaked pink

Interspecies hybrids:

M. oleifera x M. peregrina

Mainly distinguishable from seeds: they can be without ridges but are **always of a pointy shape** like *M. oleifera* seeds.

Leaves can show intermediate traits

Moringa oleifera

Leaves: with 3-5 pairs of pale green, obovate or round leaflets 1-2 cm long

Seeds: brown to black, up to 1 cm in diameter, in a **typical winged seed coat**. When wings are not visible, the seed still has clear **ridges** and a **pointy shape**.
Ratio almond/shell = 45%/55%

Flowers: cream white colour

Local value and production

- In AlUla, the tree is **found in an array of locations** and environmental conditions: wild in the southern wadis, on rocky soils in the mountains, cultivated in valleys or plains in spite of the salted soils or salted water, among date palms in oasis areas, at the edge of the desert…
- Cultivation started about 40 years ago in the region, for the **production of edible oil** (bān ghee). In AlUla, farmers started cultivation from seeds collected in the wild.
- **Local uses** include:

Food source
Ban ghee, Moringa tea, traditional dish

Farm protection
Line plantation of trees used as air deflectors

Animal feed
Bad seeds or press residue (cake) and Peregrina rachis

Source of income
By selling seeds, oil and Peregrina mixed henna

- Use of the oil is **anchored in the ancient Bedouin traditions**, and some families still perform the old process of boiling and skimming the seeds.

Local value and production

- Current **estimates of production** for the sector in AlUla county:

350k
trees

<1k trees/farm
for most farms

90%
cultivated

0.8 - 0.9 kg seeds/tree
average yield for mature trees

>85ha
planted

What we are missing

Precise data about the local production:
planted surfaces, # farms, # trees, yields (per plant & per ha)...

A high-value crop with unique seeds

Oil extraction

Peregrina virgin **oil**

Claims/Activities

Light and dry oil with deep hydration action and nourishing properties. Perfume booster and long conservative properties.

Seeds are traditionally harvested for their oil

The **process of pressing yields** the Peregrina virgin oil.

This ingredient holds **precious properties**: in addition to being a good edible oil, it offers **nourishing properties for the skin.**

These properties are of **high interest for the cosmetic market.**

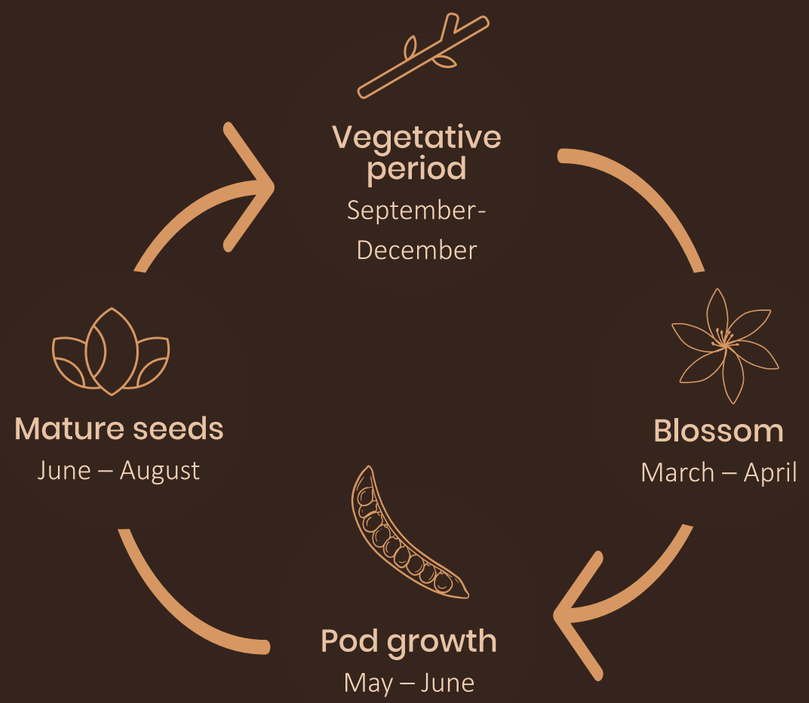
What we need to understand

Oil yields, oil composition and activities could be influenced by environmental conditions and genetic traits

Cultivating the tree: review of current knowledge

Biology

- Tree **adapted to grow in an arid extreme environment** (desert or dry shrubland biome):
  - relies upon very little water
  - grows in direct sunlight
  - resistant to wind
  - can grow on quite poor soils
- However, it is **sensitive to salinity**
- Tree height: 6-10 m
- **Deciduous foliage** - leaflets are visible for a limited period, during the flowering and sometimes until the production of fruits (pods)
- Showy fragrant **flowers** with beautiful **white & pink petals**
- Fruits form long **pods** (immature pods are edible)
- Peregrina will start bearing fruit 2 to 4 years after planting and will reach full maturity (peak productivity) between 7 and 10 years



What we need to understand

Evolution of productivity during tree life

Cultivating the tree: review of current knowledge

Propagation

- **Easy to propagate in nursery** by either:
  - Harvesting seeds in chosen populations and controlled germination;
  - Planting limb cuttings (1-2m long): transplant in pots of appro- priate size to encourage the optimal growth of the root system.
- Production of young plants in nursery for at least 2 years.

Pests & diseases

- Few pests and diseases have been observed in *M. peregrina* plantations. They include: scales and mealybugs, fungal diseases (molds).
- As many pests and diseases can affect other Moringa species, **this subject must be investigated to provide adequate plant protection** and pest management.

What we need to understand

Susceptibility to pests and diseases

Plant needs: on-field observations

The tree is adapted to grow in AlUla's environment and thus requires little inputs or maintenance

Planting

- Can be planted (pricking out) in a range of well-drained soils e.g. silt, loams to loamy clays.
- Ideal planting density is still to be determined.

Fields observations revealed various practices: tree spacing of 2 x 2m, 3 x 4m, 4 x 6m…

Spacing inferior to 3 x 4m may be too dense for optimal plant development.

Pruning

Fields observations revealed it is commonly carried-out after harvest, with 3 main goals:

1. shaping tree to ease harvest
2. promoting branching, flowering and pods production
3. preventing diseases.

However, the effect of pruning on yield and as a prophylactic measure still needs to be clarified and validated.

What we need to understand

Optimal plantation density; Effects of pruning; Implications on yield and seeds quality

Plant needs: on-field observations (2)

Irrigation

Watering young plant is necessary until well established.

Fields observations revealed excessive irrigation in most farms. The common irrigation practice is surface flood irrigation (individual basins).

This has negative consequences: high loss of water through leaching and evaporation, development of diseases linked to high moisture, low efficiency of irrigation (water quantities not aligned on the requirements of the crop).

What we need to understand Water requirements of the plant ; Implications on yield and seeds quality

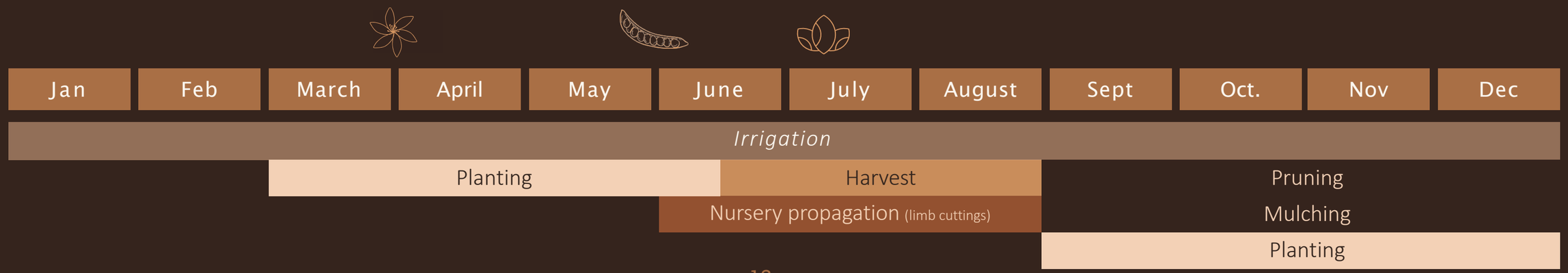
Calendar of the cropping practices observed

- **Planting** in field is generally carried-out all year round except in the coldest and warmest months
- **Nursery** propagation of limb cuttings from June to August
- **Harvest** mostly around July, from June to August
- **Pruning** and mulching from the end of August until December
- **Irrigation** generally conducted all year round, but some farmers avoid the end of the flowering period

What we are missing

Best timing for each field activity, in order to define a relevant technical itinerary* to maximise yields and seeds quality

**reasoning leading to the application of techniques in order to obtain a production corresponding to given constraints, and physical and social-economical objectives (climate/quality of the environment, yield/costs...)*



Key takeaway

1. *Moringa peregrina* is an **extremophile tree adapted to the local, arid conditions of AlUla.**
2. Endowed with a long history, it is a **key component of the cultural heritage of AlUla.**
3. The **seeds bear many remarkable, scientifically proven properties**: the ingredients extracted from the seeds are of precious value, particularly in the cosmetic industry.
4. This brings an **opportunity to develop Peregrina cultivation** at the base of a new, high-value supply chain.
5. The **cultivated resources available locally** will allow to support a strong supply chain without endangering wild biodiversity.
6. As a naturally adapted tree, once installed in cultivation **the tree does not require sophisticated farming technologies** and little work is required.
7. Peregrina is a **high-value crop** which can generate important **economic benefits for the farmers selling their seeds**, however **the components of yield and quality need further investigation** to be completely understood.

Continuous **gathering of knowledge on Peregrina** cropping in **collaboration with farmers** will

I. Maximise on-farm Peregrina seeds quantities and quality,
II. help building-up a **strong and sustainable value-chain**,
III. ensure **stable revenues for farmers**, and
IV. establish the **local Peregrina economy**, with benefits for AlUla and its communities.

Our approach: learn together to improve practices, optimise yields & quality and maximise farmers revenue

AlUla Peregrina trading company

1. APTC vision and ambition
2. Working with APTC
3. Quality requirements

Presentation of APTC

A vision

- Reviving an **ancestral** product through **sustainable agriculture** in AlUla.
- Developing Peregrina farming for the production of **superior quality oil and derived cosmetics products.**
- Building the most exclusive and in- clusive value chain of AlUla, with **be- nefits to the local economy and to the women** and men through com- munity development.

A company: AlUla Peregrina trading (APTC)

- 100% created & owned by RCU with the support of AFALULA
- **Mission**: Establishing the Peregrina excep- tional **ingredients supply chain** to cater for the international cosmetic market and pre- mium hotels and spas.
- Creation of a **brand: AlUla Peregrina™**, with the name Peregrina protected in the countries where the species is naturally oc- curring or cultivated.
- An **operational set up** with the Peregrina Center Laboratory complying with interna- tional norms and standards (ISO 9001).

Presentation of APTC (2)

APTC current status

- **APTC collaborates with farms distributed in all areas** of AlUla county.
- The number of farmers selling their seeds to APTC is **in constant increase.**
- APTC targets Peregrina **farmers willing to continuously improve their practices** and follow APTC quality requirements, and thus does not collaborate with all the Peregrina producers in the county.

Opportunities on the international cosmetic market

An opportunity…

- *Moringa peregrina* luxurious oil and extraction by-products can be used to create a wide array of **beauty products**
- These exceptional ingredients are of potential interest to **international distributors and brands in the cosmetic industry**
- Reaching these high-end, high-value markets through partnerships and commercialisation will allow **international visibility and recognition of AlUla and its products**
- In parallel, ready-to-use products and formulas designed for the hospitality sector (hotels, spas) can be produced locally and **bring further value to the local economy**

Putting the desert of Arabia on the map of exceptional ingredients

Clinical tests performed on seeds, oil & by-products → Characterisation of activities → Cosmetic patents deployment in targeted countries

Singularity of *Moringa peregrina vs. Moringa oleifera*:

- higher quality of the genetic heritage of AlUla *Moringa peregrina*
- remarkable and characteristic oil profile: a specific signature for Peregrina
- specific properties

Opportunities on the international cosmetic market

...and responsabilities

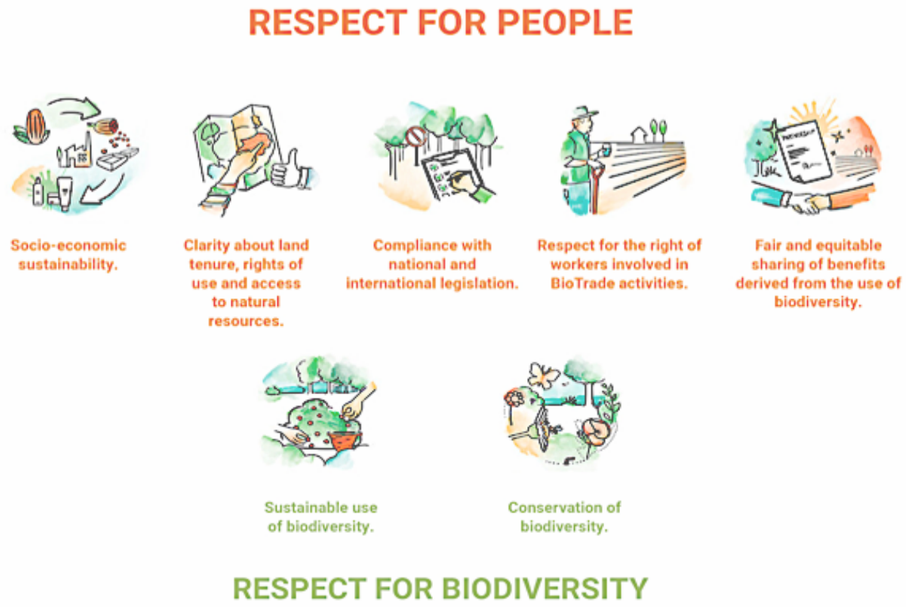
- High-end markets only accept products corresponding to the highest **standards**
- **Products** must meet with strict **quality requirements**, which necessitates a full **traceability** all along the supply chain, complete **control over sourcing** of raw materials (seeds), processing and **quality control.**
- The **production** of Peregrina seeds must follow principles guaranteeing **sustainability at the social and environmental levels**: APTC's aim is to first reach a 100% **responsible and ethical sourcing**, and will later pursue the objective of organic certification
- Acknowledgment of the above is confirmed through **certification**, delivered by independent accredited bodies such as **UEBT and ECOCERT**, who assess compliance to defined principles and practices through different indicators

The UEBT standard – Sourcing with respect

UEBT SOURCING WITH RESPECT®

Ethical BioTrade

7 principles for a **responsible and ethical sourcing** covering social, environmental and economic issues.



What we have today

Responsibly Sourced
status for Peregrina oil production

What we want for tomorrow

Ethically Sourced status

The Cosmos standard – Natural ingredients for cosmetics

What we have today

COSMOS Approved status for raw material, a guarantee to distributors, brands and consumers of natural cosmetics that you can trust

What we want for tomorrow

COSMOS Organic status

Beauty care products containing ingredients from natural origin and from **plants cropped with respect to organic agriculture**, a holistic production management system based on environmental **sustainability principles**.

A chance to learn and grow with APTC (1)

Easy crop

- Peregrina tree is a native plant with minimal needs for its cultivation:
  - Consumes **less water** than other fruit crops (e.g. palm trees, citrus)
  - No dangerous or time-consuming interventions (e.g. for pollination or harvest)
  - Minimal maintenance.

With economic advantages…

- Due to the singular ingredients derived from its seeds, Peregrina is a **high-value and financially efficient crop** (trees generate fast revenues after only a few years)

- Collaboration with APTC guarantees:
  - **Selling your harvest every year**: agreements with APTC to buy all the volumes of good quality seeds
  - **Fair prices**: purchase price is better than what other buyers may offer, and farmers receive a bonus if the seeds are properly sorted

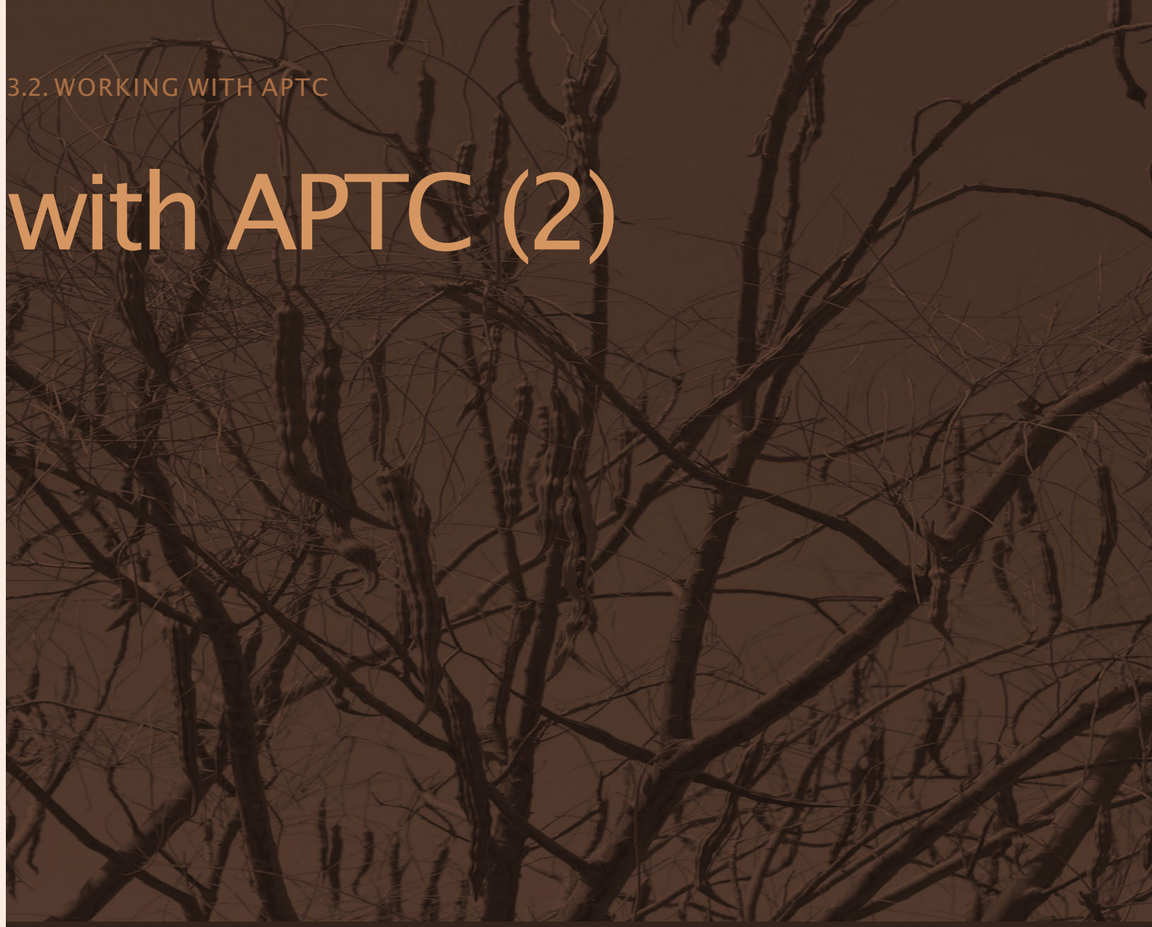
- APTC promotes **the implementation in farms of a set of principles**, regulations and technical recommendations **recognised at the national and international levels**, thereby **generating even more value to the farms** applying these measures and to their production

- Prices will improve in the future with the improvement of the whole value chain

A chance to learn and grow with APTC (2)

...And social benefits

- **Contact point** available at APTC for farmers support
- Training provided by APTC to build-up farmers capacity
- The principles implemented in farms under APTC's guidance address human health care, environment protection and overall sustainability of production, which will improve current and future livelihood conditions for farmers, workers and their families.
- In the future, additional support to farmers will be available through the RCU Farmers Service Centre and Farmers' Hubs (e.g. technical training and advice to improve practices and production), in cooperation with APTC.



Engaging in Peregrina farming with APTC: a winning commitment for farmers with market guarantee

Standard action #1: Preservation of *Moringa peregrina*

***Moringa oleifera* (Indian Moringa) trees and hybrids** between the species *peregrina* and *oleifera* were observed in some farms

- can lead to the **disappearance of Arabic Moringa trees**
- can cause a **decrease in quality** of the AlUla Peregrina oil

Protection of the local living heritage through preservation of ***Moringa peregrina*** trees is the **first compulsory step to work with APTC**

Indian Moringa trees must be **removed and destroyed**
(by completely pulling out the plant will all roots)

Do not import Indian Moringa trees, seeds and oil in AlUla

Do not plant Indian Moringa trees in AlUla

Standard action #2: Insuring traceability (1)

WHY? In the event of any issue (e.g. oil quality), the origin of seeds can be traced back and linked to all factors susceptible to affect production (environmental conditions, farm operations…). **This capacity to trace the origin or development of something is traceability.**

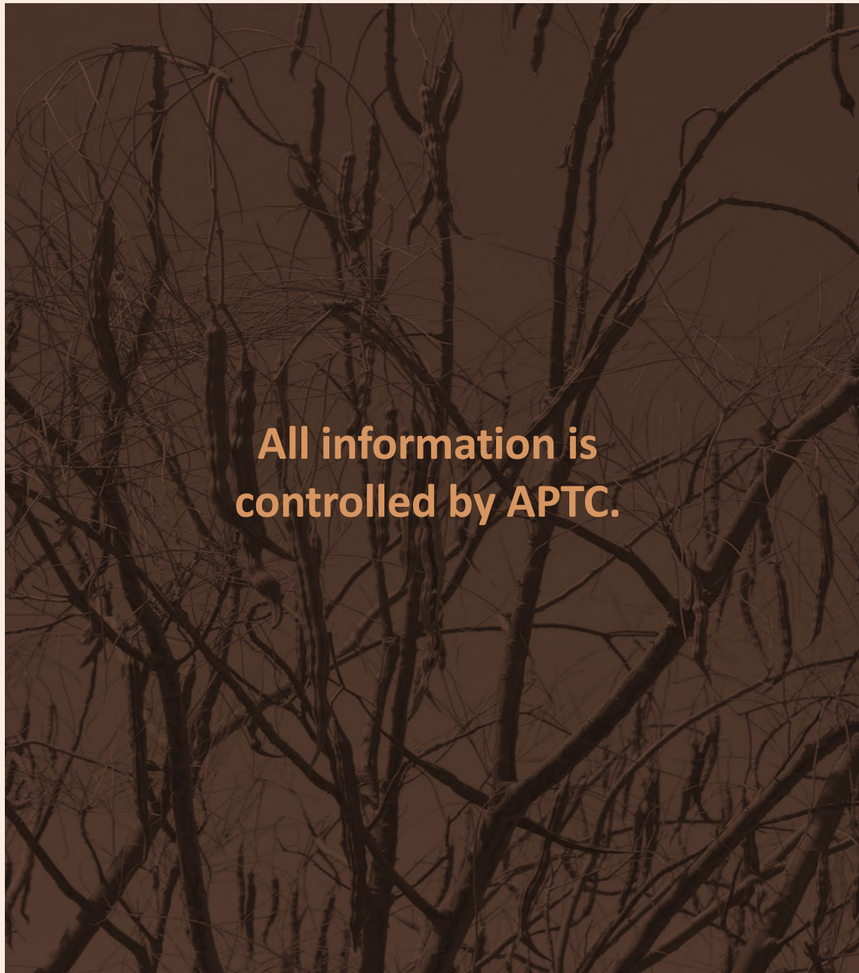
HOW? Each seeds lot is identified and linked to a production area, and all operations are recorded to enable traceability.

1. Farmer and plots identification

- Each farmer is assigned a **specific code**.
- Each farmer divides its plantation in **plots** of land with individual **reference numbers** received from APTC: the surface of one plot cannot exceed 1,000 m².
- **Plot** signs are provided by APTC. Immediately inform APTC if a sign is lost or damaged, to receive a replacement.
- The **field registry** contains all information about each plot: plot code, location (GPS coordinates and mapping), owner, name of the technician or administrator, planted area, species name, planting year.

2. Seeds lots identification

- **Pre-coded standard bags** are provided to farmers for the harvest.
- To **each plot** correspond one or several coded bags.
- Farmers provide **for each lot of seeds**:
  - Harvest date
  - Mass of dry seeds
  - Name of the carrier
  - Sale date.
- **Record the information** in the logbook, with for each plot:
  - Harvest date
  - Number of bags & mass of each bag
  - Name of the carrier
  - Sale date.



Standard action #2: Insuring traceability (2)

3. Farm registry

In a **logbook** for each year, farmers must **keep track of all operations** conducted on each individual land management unit (coded plot), as well as any incident

Inputs: records of any use of inputs (fertilization, crop protection products,)
- Date
- Amount or dose applied
- Name of the products
- Name of the operator
- Origin of the product
- Aim of the operation

Irrigation: dated records of all waterings with times and volumes

Other operations: crop maintenance (pruning, removal of dead trees), mulching, new crops on plot, etc.
- Date
- Detailed description of the operation
- Aim of the operation
- Name of the operator

Incidents: date, nature (detailed description), consequences (if visible)

All information is controlled by APTC.

Standard action #3: Obtaining the best seeds (1)

Harvesting

- **When:** usually between July and August
- Pods must be allowed to mature before harvesting: they are **collected when the tip starts drying** whilst the remaining part is still green.
- The **appearance of the pods should be checked regularly**, as they grow over time
- All seeds should still be inside the pod
- **Symptomatic pods** (potentially contaminated) must be **removed** from trees and destroyed, e.g., pods parasitized by mealybugs or mould.
- **Do not harvest pods or seeds that were already fallen to the ground**.
- **Harvest each plot separately**, one after the other over the course of 1 to 3 weeks, with clear identification of which plot pods are collected from.
- Start sorting immediately after a whole plot is harvested. Once dry, seeds turn brown and the immature, initially green seeds become difficult to identify.

Standard action #3: Obtaining the best seeds (2)

Sorting

- In a dedicated area adjacent to the plot, remove seeds from pods
- Seeds are **sorted by visual control:**

Discard

- Broken, light-weighted, green or mouldy seeds;
- Seeds identified as coming from Indian Moringa

Keep

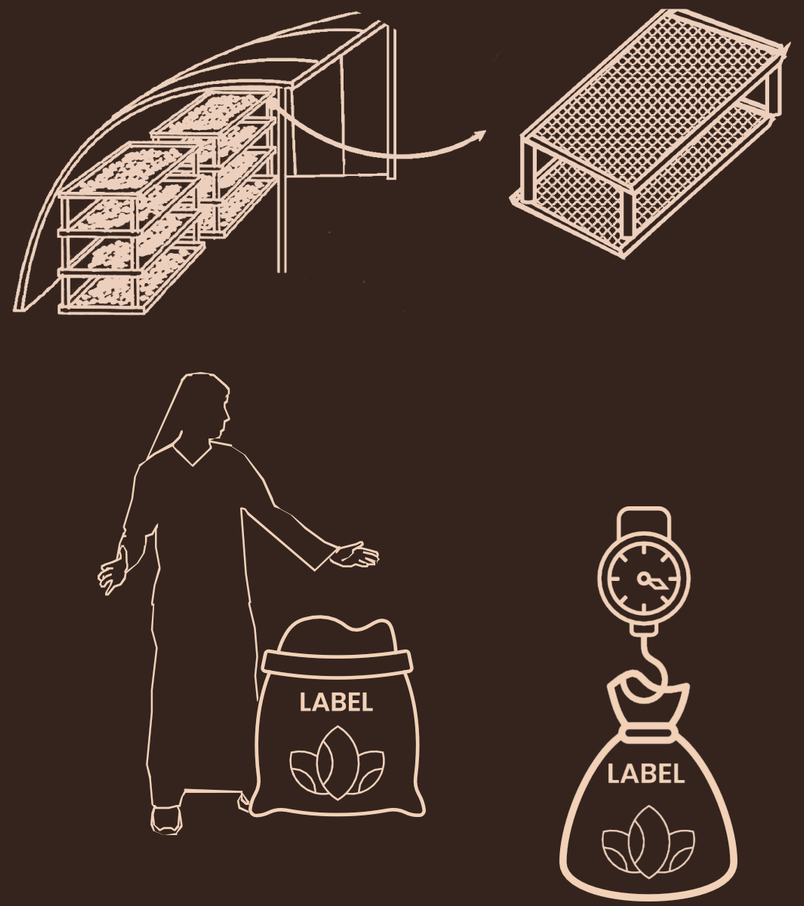
- All other seeds in good condition
- Beige to black
- Round to oblong

- Good seeds are immediately **placed in the encoded bag** provided by APTC

Standard action #3: Obtaining the best seeds (3)

Drying & on-farm storage

- Place the seeds collected from a same plot in a **shaded drying unit**:
  - Open wooden shelves placed at least 10 cm above the ground
  - Homogeneous shade (to prevent negative effects from UV rays on oil quality)
  - **Do not place seeds on the ground** (even with a plastic protection)
  - Label the shelves with the plot code.
- **Let seeds dry** during a minimum of 24 hours and up to 4 days, until they lose enough humid mass.
- **Check the seeds every day**, be careful to avoid all possible contaminations during the process.
- **Place the dry seeds into the encoded bags** associated to the correct plot (check that bags are clean)
- **Weigh each bag** and write the weight on the bag and in the logbook.
- Store bags in a dry and clean room until selling date.
- Do not transport seed bags together with animals, fertilizers, or agrochemicals.



Standard action #3: Obtaining the best seeds (4)

The quality of harvesting, sorting and drying procedures are critical to guarantee the quality of the oil

Contact of seeds with the **ground** is a major factor of **contamination**:

- **soil fungi** such as black mould/seed rot **can infect seeds** that are on the ground
- these fungi **can be human pathogens** (they can cause diseases)
- the **contamination will persist in the oil** after pressing and spoil the whole batch

Do not harvest pods or seeds that were already fallen to the ground

Discard visibly mouldy pods and seeds

Do not place seeds on the ground for drying

Guidelines on Good Agricultural Practices (GAP) (1)

WHY? A farm management that addresses environmental, economic and social sustainability of on-farm processes, and results in safe and quality agricultural products while achieving economic viability and social stability

HOW? Application of available knowledge to implement **safe and sustainable practices** in farming systems.

From the following principles and guidelines, some measures are compulsory and must be implemented to work with APTC ("do it now" inserts). Implementation of other practices is part of the continuous improvement of Peregrina farming systems, with the support of extension services.

Soil: know your soils and protect them

- Gather knowledge of the nature, properties, distribution, and potential uses of soils of the farm.
- Know the history of the field for establishment:
  - ***Avoid saline soils***
  - ***Check on possible contamination sources from neighbouring activities***
- Avoid intensive use of mechanical soil tillage.
- Maintain or improve soil organic matter and soil structure.
- Maintain soil cover to minimize erosion loss by wind and/or water

Guidelines on Good Agricultural Practices (GAP) (2)

Water: manage the resource sustainably

- Adopt techniques to monitor crop and soil water status:
  - ***Assess availability of non-saline irrigation water***
  - ***Do not use contaminated or saline water for irrigation***

- Use efficient irrigation methods and technologies to avoid unproductive water losses, adopt water-saving measures and recycling where possible:
  - ***Underground or drip irrigation with buried pipes, rather than surface basin irrigation to optimise water intake by the plant and limit losses***
  - ***Irrigate in the morning or in the evening to prevent evaporation***

- Monitor water status and irrigation volumes to prevent excessive ex- traction from water tables:
  - ***Installation of measuring devices (water-metres)***

- Build-up soil structure and increase soil organic matter levels to maxi- mise infiltration, moisture retention and root penetration

Guidelines on Good Agricultural Practices (GAP) (3)

Crop protection

- Regular **monitoring and assessment of the status of pests and diseases** at the farm level; apply forecasting techniques where available.

- Adapt practices to prevent occurrence of pests and diseases:
  - adopt relevant irrigation techniques to avoid excessive moisture and discourage the development of moulds and other diseases

Do it now

Do not use agrochemicals unless advised to do so by experts, considering all possible methods and alternatives (see Appendix)

- Consult a technician for recommendations relevant to your crop and the type of pest or disease affecting it

When treatment is indispensable, use products securely and according to legal requirements and label, e.g. registered crops, rates, timings, re-entry & pre-harvest intervals…

Store products securely and according to legal requirements: dedicated, isolated & clearly identified room, locked and ventilated.

Ensure that products are only handled and applied by specially trained and knowledgeable persons, using equipment complying with established safety and maintenance standards (see Appendix).

Guidelines on Good Agricultural Practices (GAP) (4)

Energy & waste management

- Establish **input-output plans** for farm energy and all inputs so as to ensure efficient use and safe disposal:
  - *Dedicate specific areas, rooms and/or containers for waste disposal*
- **Fields should be free of trash**, papers, plastics and empty containers.
- **Identify and recycle** most organic wastes and inorganic materials, where possible.
  - *Green waste (e.g. pruning residues) can be used as mulch*
- Minimize non-usable wastes and **dispose of all waste responsibly**
  - *Check RCU policy for waste collection, especially for agrochemicals*
- Adopt **energy saving practices** in building design, machinery sizing, maintenance and use.
- Investigate **alternative energy sources to fossil fuels** (wind, solar, biofuels), and adopt them where feasible.
- **Maintain accurate records** of energy use, and of products storage and disposal.

Do it now

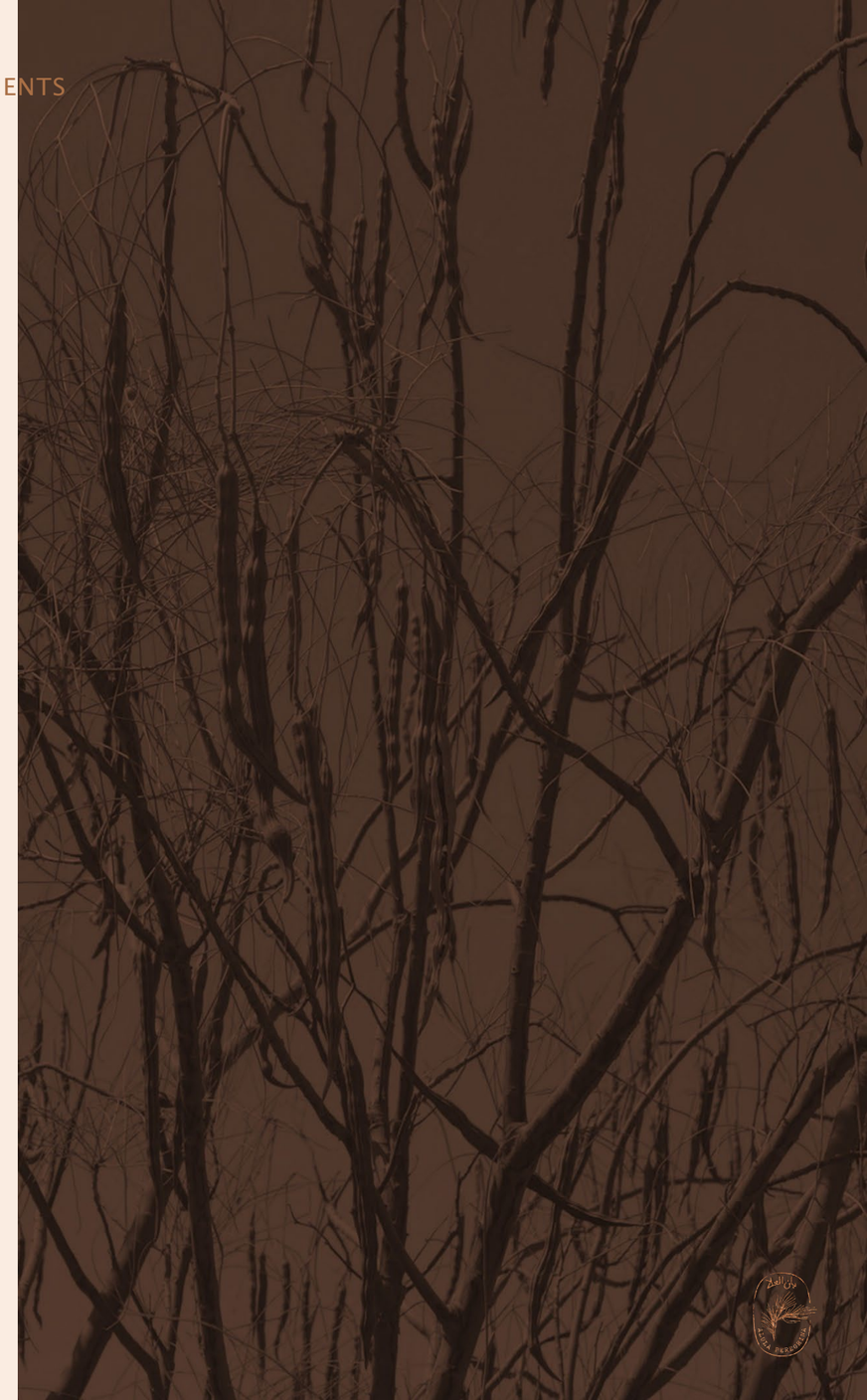
Store empty containers & packaging of fertilizers and agrochemicals **securely** in a dedicated, isolated & clearly identified room; never reuse them (see Appendix)

Guidelines on Good Agricultural Practices (GAP) (5)

Prevention of environmental pollution

- Avoid contamination of soil and water with production inputs by **adapting quantities, application methods and timing** to the agronomic and environmental requirements. (see Appendix)

- Adopt practices **preventing erosion and leaching**
- **Minimize runoff of water** and associated contaminants:
  - *Targeted irrigation*
- Adequately **handle waste** (see Appendix)
  - *Do not burn waste, including green waste (e.g. pruning residues)*
  - *Be especially careful with disposal of agrochemicals*
- Establish **emergency action procedures** to minimize the risk of pollution from accidents.



Guidelines on Good Agricultural Practices (GAP) (6)

Human welfare, health & safety

- Establish and adhere **to safe work procedures** with acceptable working hours and allowance for rest periods.
- Instruct workers in **the safe and efficient use of tools and machinery**, and regarding hygiene and first aid.
- Ensure **clean tools and machinery** for operations
- Buy inputs and other services from local merchants if possible.

Do it now

All workers must be legally entitled to work in KSA and registered in the national social security system

Make available to employees: adequate, functional and clean facilities (e.g. lavatories, lunch and break areas); potable water for drinking and personal hygiene; first aid kits; protection equipment when needed

Pay reasonable wages and do not exploit workers, **especially women and children:**

- *Wages shall allow workers to have adequate household income and food security*
- *Children may only help in the field in activities which do not impede their security and time to study*

Key takeaway

1. Bringing the Peregrina uniqueness to the world: a commitment from AlUla Peregrina Trading, through **its high-end ingredients.**

2. The interest of stakeholders from the **international cosmetic market** will only be maintained by the assurance of several **quality and sustainability prerequisites.**

3. At the farm, **applying the right techniques and methods** means producing superior quality seeds which, in a competitive market, are a differentiator and fetch higher prices.

4. To sustainably produce only the finest quality ingredients, **APTC and Peregrina farmers shall build together the most exclusive value chain in AlUla.**

5. Peregrina farmers and AlUla's communities benefit from APTC's long-term commitment to **ensuring stable income for its producers**, and **supporting the local Peregrina economy** through the development of Peregrina-based activities (local employment and demand from tourism).

APTC Standard actions are requested by APTC (and the international market) for immediate implementation.
Failure to comply with these actions will result in inability for APTC to buy your seeds.

Guidelines on GAP are actions to be progressively implemented in the coming months and years, with support from APTC and the RCU, as they are also required also but need more training and resources.

Our approach: ensuring the high value and recognition of Peregrina products with the best agricultural model

On-farm biodiversity

1. Biodiversity fundamentals
2. Biodiversity preservation

Agro-ecosystems

Biodiversity

Diversity within and among **living organisms**

Ecosystem

A physical location **with interdependent interactions occuring within this space**: between communities of living organisms (animals, plants, microorganisms…) and their environment (soil, water, climate).

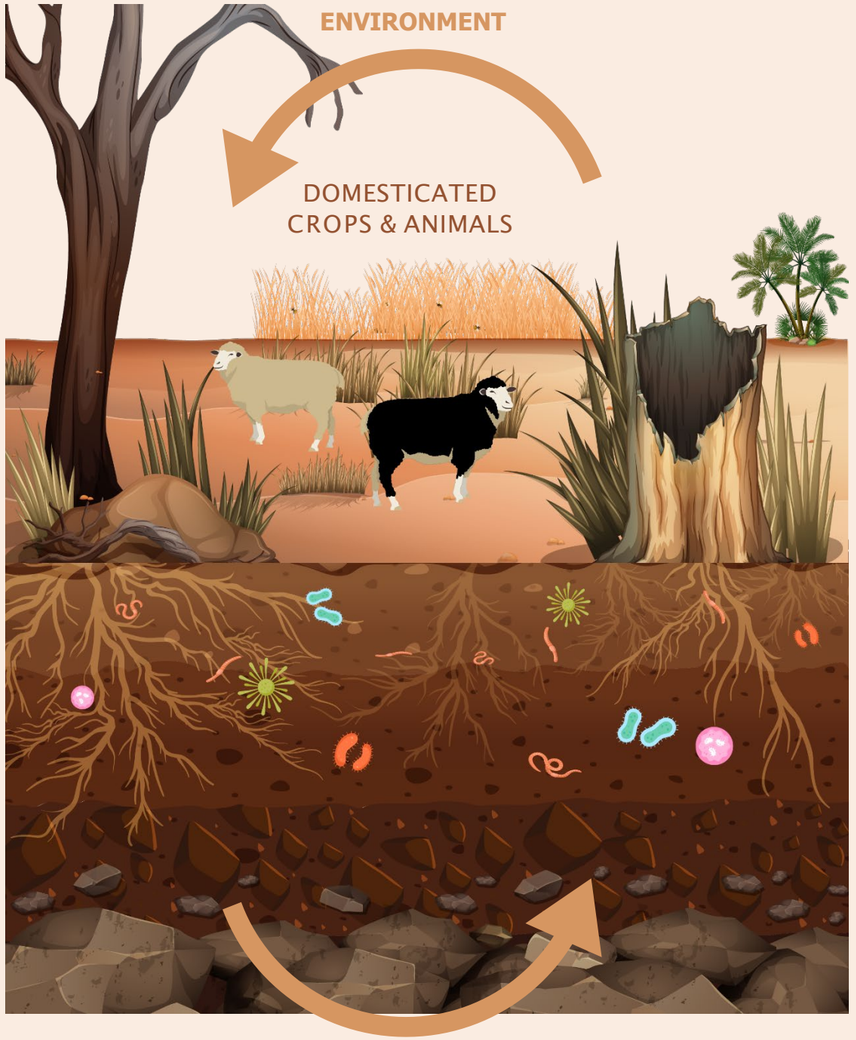
Natural ecosystems
Deserts, ponds, wadis…

Agro-ecosystem

Cultivated ecosystem co-produced by nature and humans. **Shaped by the activity of agriculture** to support food production systems.

Partially closed, it generally corresponds to the spatial unit of a farm and bears relations with the larger region in which it is included.

Ecosystems modified and managed by humans
Farms, pastures, cropped fields…



Agroecosystems are characterised by flows (energy, water) and mechanisms (nutrient cycles, pests and diseases biological control, pollen transfer, etc.).

WILD SPECIES

Wild plants & animals in landscape elements

SOIL MACROFAUNA

Insects
Earthworms
Vertebrates
…

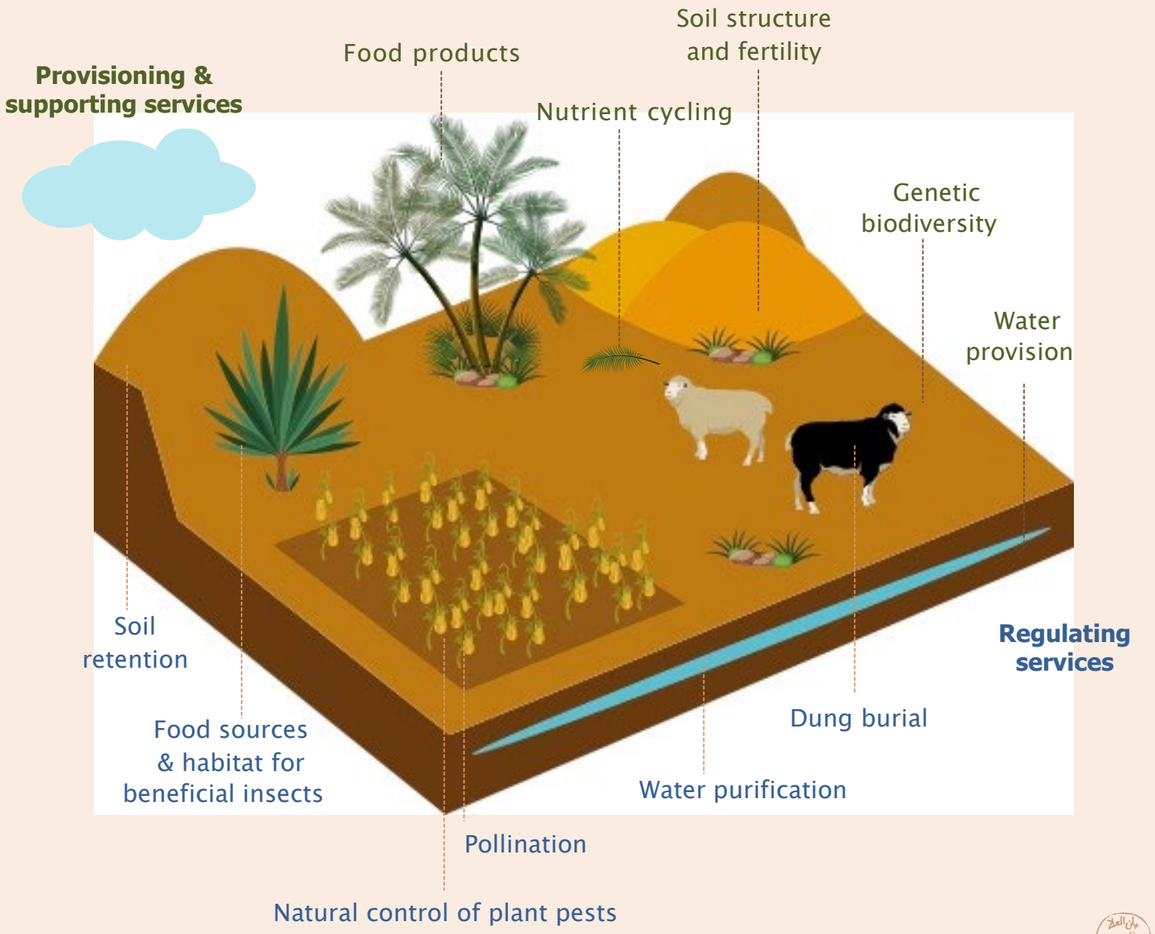
SOIL MICROORGANISMS

Bacteria
Fungi
Nematodes
…

What are ecosystem services, and why do we need them?

- **Ecosystem services**: the multitude of **benefits provided by ecosystems to humans**. Ecosystem services make human life possible, they are the foundation of all food and agricultural systems.
- **Biodiversity is essential** to ecosystems function and services delivery: in agroecosystems, it impacts nutrient cycling, pest regulation and pollination, agricultural productivity…
- The "giving and taking" **balance is essential**: changes in biodiversity can influence the supply of ecosystem services.
- **Agriculture** both benefits from and influences ecosystem services: promoting the healthy functioning of agroecosystems ensures the **resilience of agriculture.**
- **Learning to strengthen the ecosystem** linkages that enhance resilience and to mitigate the forces that impede the ability of agroecosystems to deliver goods and services **is an important challenge**.

Benefits from agroecosystems



Ecosystem services and agriculture

Agricultural land accommodates a **diverse range of living organisms providing specific services** (or disservices). Some examples above and below-ground:

Pollinators (bees and other insects)	Plant pollination	**Fruit production**
Beneficials (some arthropods and birds)	Pest control	**Reduction of damages**
Plant pests & diseases (insects, bacteria, fungi…)	Eat or damage crops	**Potential yield reduction**

Who they are	What they do	Effect on crop
Natural vegetation	Soil conservation, modification of soil structure & fertility Regulation of water flow	**Water uptake**
Beneficial microorganisms (bacteria, fungi) and microregulators (nematodes)	Symbiosis Soil fertility (decomposition & elemental transformation) Biological control of pests and diseases	**Nutrient uptake Reduction of damages**
Ecosystem engineers (earthworms, ants)	Modification of soil structure & fertility Regulation of erosion	**Water & nutrients uptake**
Plant pests & diseases (insects, bacteria, fungi…)	Eat or damage crops	**Potential yield reduction**

Improving on-farm biodiversity (1)

- **Management practices** of agroecosystems drive the provision of multiple ecoservices.
- Sustainable management involves **agricultural production systems that reproduce natural mechanisms** of ecosystems

EXAMPLES OF POSITIVE IMPACTS ON BIODIVERSITY OR SERVICES – PRACTICES TO IMPLEMENT

What to do	Targeted effects	How
Maintaining healthy soil	- Rich populations of soil organisms with effects on nutrients and water cycles	- Mulching with plant material - Inputs of organic matter
Increasing in-field Diversity	- Maintained agricultural genetic diversity and associated natural biodiversity: better resilience - Reduced abundance of insect pests specialising on a particular crop - Reduced reliance on inputs	- Prefer crop mixtures to monocultures - Create a diverse cropping pattern on the farm: different plant species and varieties (peregrina, date palm, citrus, vegetables…)
Covering soil	- Regulation of erosion and improvement of soil structure - Returning nutrients to the soil - Effect on water cycle (moisture retention, prevention of runoff)	- Mulching with plant material -Plantation of native plants

Healthy soil – Healthy environment – Healthy crop

Improving on-farm biodiversity (2)

EXAMPLES OF NEGATIVE IMPACTS ON BIODIVERSITY OR SERVICES – PRACTICES TO AVOID

	What not to do	Adverse consequences	How to avoid
	Excessive irrigation	- Nutrient runoff - Soil erosion - Water resource depletion	- Use underground or drip irrigation with buried pipes, rather than surface basin - Cut irrigation by two
	Agrochemical inputs (plant protection products or fertilisers)	- Leaching in soil, water, air and surrounding biomass - Loss of balance in populations - Loss of pollinators, wild flora and fauna	- Do not use agrochemicals unless advised to do so by experts, considering all possible methods and alternatives
	Poor waste management	- Environmental pollution and decline of natural populations	- Keep your farm clean: dispose of all waste responsibly, do not litter

Healthy soil – Healthy environment – Healthy crop

Key takeaway

1. **Agroecosystems** are transformed by humans (farmers), they are not natural but still **possess important biodiversity and provide provisioning ecosystem services** that are essential to human wellbeing.

2. In arid environments, **farmers and their families have been directly benefiting from natural and agricultural ecosystems for generations**, through provision of food, clean water, clean air, limited desertification…

3. Farmers and workers must learn to **preserve** these ecosystems and their biodiversity, **maintain and improve** environmental quality, and **conserve** resources, held in trust for future generations.

4. Agricultural diversity (crops and livestock) and local wild species (plants and animals) are crucial: agricultural management and crop protection practices should thus be based on a **good understanding of the agroecosystem organisms**, including pest species and beneficials.

5. The use of agrochemicals (pesticides and fertilisers) should be avoided whenever possible. When needed, all actions must be based on knowledge, carefully reasoned and well recorded; preference should be given on organic solutions.

6. Asking for advice or technical assistance from Ag. engineers, technicians or extension staff is always recommended.

The key to sustainability: preservation and enlightened use of biodiversity to improve agroecosystems and satisfy future generations' needs

Conclusions

1.

Together **we learn**

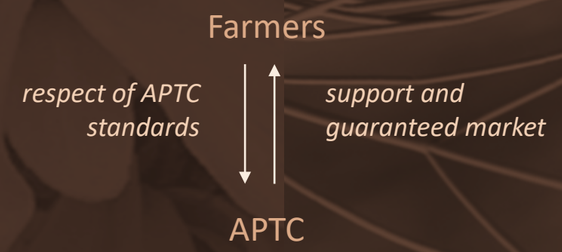
Thriving in a majestic environment, AlUla's native *Moringa peregrina* colours the desert rocks and cliffs of AlUla in spring with strokes of pink and white.

Embedded in AlUla's cultural heritage, the cultivation of precious Peregrina seeds needs continuous research to improve and fully engage in this unique opportunity for the local economy.

2.

Together **we commit**

To promote the exceptional Peregrina ingredients for the cosmetic market, APTC and AlUla's Peregrina producers shall embark hand in hand in this journey towards the development of a strong value chain based on the best agricultural model.



3.

Together **we protect**

As we all benefit from natural and environmental resources, their use shall be managed in a way that is socially and ecologically just.

Peregrina farming must be based on environmental sustainability principles and associated practices to substantially reduce or eliminate trade-offs to biodiversity

Appendix

1. Appendix A: Integrated Pest Management
2. Appendix B: Human and evironmental Health & safety

Integrated Pest Management (IPM)

Definition & principles

- Careful consideration of **all available plant protection methods**
- Integration of appropriate measures that **discourage the development of populations of harmful organisms**
- Promotes the growth of a healthy crop with the **least possible disruption to agroecosystems**
- Encourages **natural pest control mechanisms**
- Keep the use of plant protection products and other forms of intervention to levels that:
  - *are economically and ecologically justified*
  - *reduce or minimise risks to human health and the environment*

Integrated Pest Management (IPM)

Benefits

- **Sustainable pest control:** building-on ecosystem services such as pest predation while protecting others, such as pollination.
- **Reduces pesticide residues:** contributing to food and water safety by limiting transfer of residues in the environment.
- **Enhances ecosystem services:** seeking to maintain the agroecosystem balance and conserve the underlying natural resource base (soil, water and biodiversity).
- **Increases income levels**:
  - *Reduced production costs through reduced levels of pesticide use*
  - *Higher quality crops (with less residues) can command better prices in markets and contribute to increased farmer profitability.*
- **Strengthens farmer knowledge:** promoting farmer stewardship and knowledge of ecosystem functioning adapted to their local context.

Ask for advice!

In case of pest/disease suspicion, refer to your local farmers extension services (professional technicians from the Farmers' Hubs) before taking any action.

Prevention & Thresholds

Prevention

Manage the crop and farm space to prevent pests and diseases from becoming a threat.

- **Protection and enhancement of beneficial organisms:** landscape & habitat for beneficial organisms providing pest control; overall a higher biodiversity will reduce the risk of pest outbreaks.
- **Avoid introduction of exotic organisms** that can become invasive or bring new pests with them (e.g., the Acacia mistletoe affecting local acacias may have been introduced exotic Acacia trees).
- **Field sanitation and hygiene measures:** regularly clean farm machinery, equipment and clothing to prevent diseases from spreading.
- **Use cultural practices:** crop sequences, borders between crops, associations… that minimize the pressure, reduce the risk of easy spreading of diseases, and maximize biological control.
- Where appropriate, use of pest resistant/tolerant cultivars and standard/certified seed and healthy planting material

Set action thresholds

Before taking any pest control action, identify a point at which pest populations or environmental conditions indicate that pest control action must be taken.

- **Levels or limits of tolerable damage** are more important than pest population levels.
- Sighting a pest does not always mean control is needed, and **not all injury causes** yield-loss.
- The **level at which pests will become an economic threat** is critical to guide future pest control decisions: *'if I don't spray, will I lose some yield that worth more than the cost of the spray?'*
- Requires **knowledge of the effect of pests on the crop yield** and the effect of pesticides on natural enemies
- Coordination can be done through services to farmers

Monitoring & Controlling

Monitor & identify pests

Monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds

- Not all insects, weeds, and other living organisms require control.
- **Be aware** of what different pests and beneficial organisms look like.
- **Regular on-farm monitoring** to assess crop development, diseases, weeds, and pest populations for an early detection of potential issues.
- Monitoring at a larger level can also help early warning.
- Pesticides shall not be used when they are not really needed, or applied on the wrong kind of target

Control

When confirmed that pest control is required, and preventive methods are no longer effective or available, evaluate the proper control method both for effectiveness and risk

- Effective, **less risky pest controls are chosen first**, such as: pheromones to disrupt pest mating, mechanical control (trapping), biological pest control agents (microbial and botanical pesticides).
- Relevant measures will **depend on the crop, target and landscape** configuration.
- If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides with **highly target-specific chemicals.**
- Broadcast spraying of **non-specific pesticides is a last resort.**
- Careful transport, storage, handling, use of the correct dose rates and application methods that both minimise the amounts used and ensure that the pesticide is only applied to the target area, will all minimise environmental contamination by agrochemicals.

Protecting human and environmental health (1)

Hazard

- Plant protection products are designed to kill organisms. Human and animal organisms can share similarities to those of plant pests and diseases, and so these products also **can be harmful to people, livestock or non-harmful wildlife.**
- Adverse effects of agrochemicals depend on the level of **toxicity** to humans as well as the **exposure**.
- **Acute effects** occur **immediately** after the exposure, within minutes or hours. Symptoms are quickly visible, e.g. burns inside the mouth, throat, lungs, stomach, eyes; skin can itch, blister, or crack…
- **Delayed effects** do not appear immediately.
- Symptoms **may take years to appear.** They are caused by **repeated exposure** to agrochemicals over a long period of time, or by a single exposure to a product causing a harmful reaction that is not visible until much later. These effects include cancer and other damage to internal organs (chronic diseases).
- Some chemical fertilisers can also be toxic to humans.

Environmental aspects

- Agrochemicals used incorrectly or without due consideration **can affect all biodiversity and domestic animals, contaminate sources of drinking and washing water, or food, living and working areas.**
- **Specific application** of agrochemicals reduces the impact on human health and the environment
- To avoid any contamination of the environment, **follow the waste management procedures** and proper disposal of excess agrochemical or of empty containers as described in the GAP (see GAP on waste management & prevention of environmental pollution).

Protecting human and environmental health (2)

Personal protective clothing/equipment (PPC)

- Clothing and devices **worn to minimise exposure** and to keep agrochemicals away from the body.
- The **minimum amount to wear** for a specific agrochemical formulation and activity is given on the label
- Examples of equipment:
  - Body protection = overalls,
  - Hand and foot protection = Rubber gloves and rubber boots,
  - Eye and face protection = safety goggles,
  - Inhalation protection = Dust/mist masks
- PPC shall be **worn during the whole period of handling agrochemicals**
- PPC must be **cleaned after every use.**

  If contaminated on the inside, PPC should be removed immediately.
- **In a case of agrochemical poisoning:**
  - Follow the product label instructions if they are available
  - Provide first aid
  - Take the victim to a doctor as quickly as possible, with the product container or label to identify the active ingredient.

We remain at your disposal for any further information

Contact details

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