Click on the pictures to navigate to the corresponding presentation

PROMOTING THE ECOLOGICAL TRANSITION OF THE OLIVE GROVE

BASIC INFORMATION AND SAMPLING PROCEDURES

for the training of olive farmers

ECOSYSTEM SERVICES

COVER CROPS

SOIL SAMPLING

ESTIMATING THE BIOVOLUME OF TREES

VALORIZATION OF OLIVE MILL POMACES

PHENOLOGICAL STAGES

PESTS AND DISEASES

BATS FOR INTEGRATED PEST MANAGEMENT

SUSTAIN OLIVE PRIMA IN THE MEDITERRANEAN AREA

Co-funded by the Horizon 2020 Framework Programme of the European Union

This project is part of the PRIMA programme supported by the European Union

This document is part of the set of educational and training materials produced by the **SUSTAINOLIVE** project www.sustainolive.eu

Design, layout and assembly of this document have been made by
José Liétor Gallego

SUSTAIN OLIVE

Materials and activities for capacity building of farmers

ECOSYSTEM SERVICES

What are **ECOSYSTEM SERVICES** ?

Those **BENEFITS** that ecosystems provide to society by improving people's **HEALTH**, **ECONOMY** and **QUALITY OF LIFE**

Some examples

- Production of clean water
- Soil formation
- Crops and timber
- Climate change mitigation
- Pollination .....

Our **future** depends to a large extent on human capacity to **adequately manage** ecosystem services

What **TYPES** of ecosistem services can be defined ?

PROVISIONING ecosystem services

REGULATING ecosystem services

CULTURAL ecosystem services

SUPPORTING ecosystem services

PROVISIONING

ecosystem services

Consisting of those **products extracted** from the environment to be directly or indirectly **consumed by humans** :

- Food and timber
- Water (for agriculture and consumption)
- Energy resources (firewood, peat, lignite ...)
- Raw materials
- Minerals
- Genetic resources
- Medicinal resources

REGULATING
ecosystem services




Consisting of ecological processes that benefit us through their **regulatory mechanisms**, helping to mitigate some **global and local processes and impacts** :

- Climate regulation
- Water cycle regulation
- Improved air quality
- Soil erosion control
- Damage reduction from natural disasters
- Disease and pest control
- Maintenance of soil fertility
- Regulation and sanitation of water
- Pollination

CULTURAL
ecosystem services

Consisting of those **non-material benefits** that human beings obtain through ecosystems :

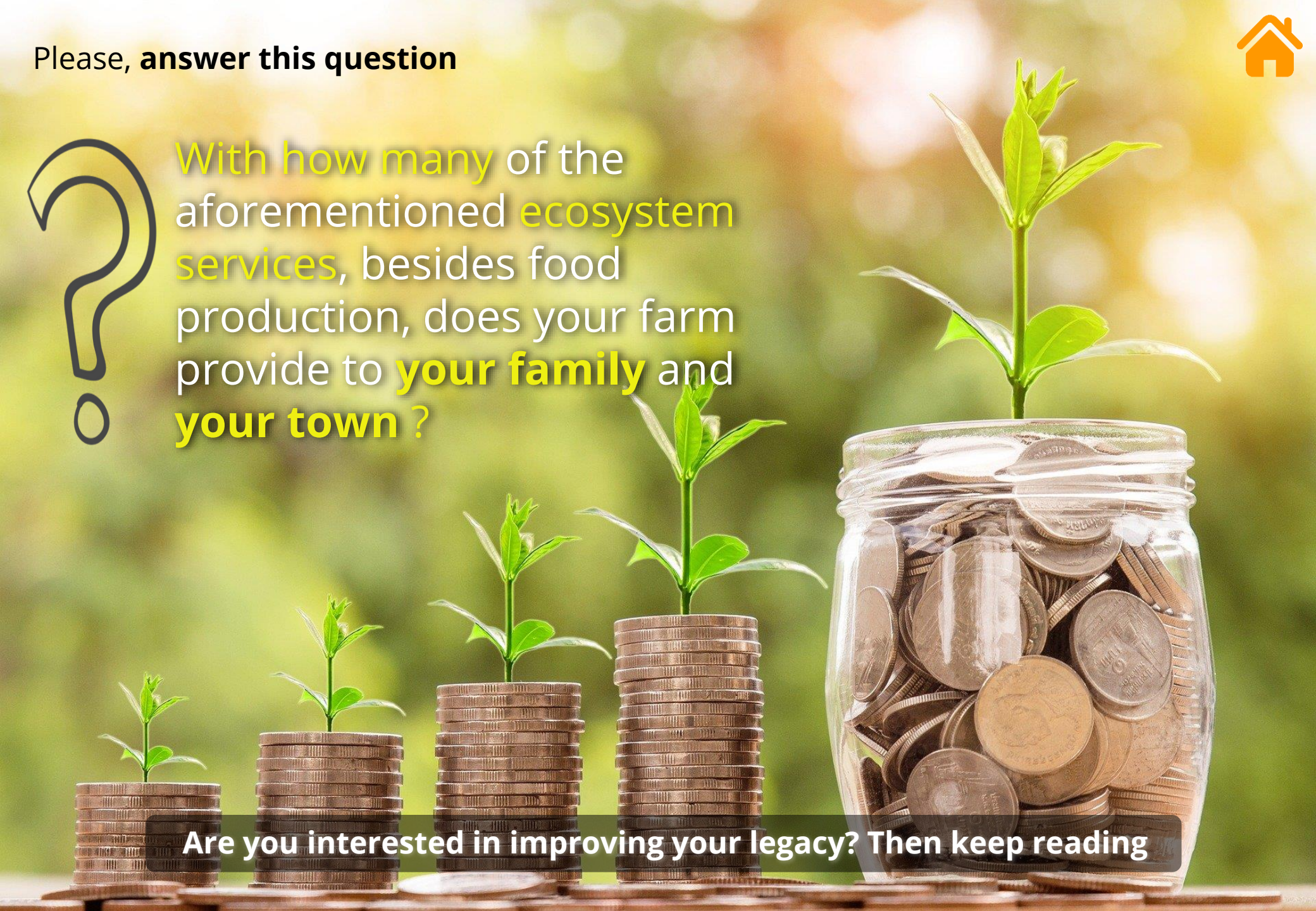
- Educational values
- Cultural diversity
- Source of inspiration
- Spirituality and religious values
- Aesthetic and landscape values
- Social relationships
- Entrenchment to the land
- Cultural heritage
- Recreational and ecotourism services
- Scientific knowledge

SUPPORTING
ecosystem services

Consisting of ecological processes that aset the essential basis and structures **for remaining types of ecosystem services** :

- Water cycle
- Soil formation
- Primary production
- Photosynthesis
- Species habitat
- Conservation of genetic diversity
- Nutrient cycles

Please, **answer this question**



What main **sustainable**

management practices

can improve delivery of ecosystem services by olive farmers ?

Implementing temporary spontaneous or seeded cover crops

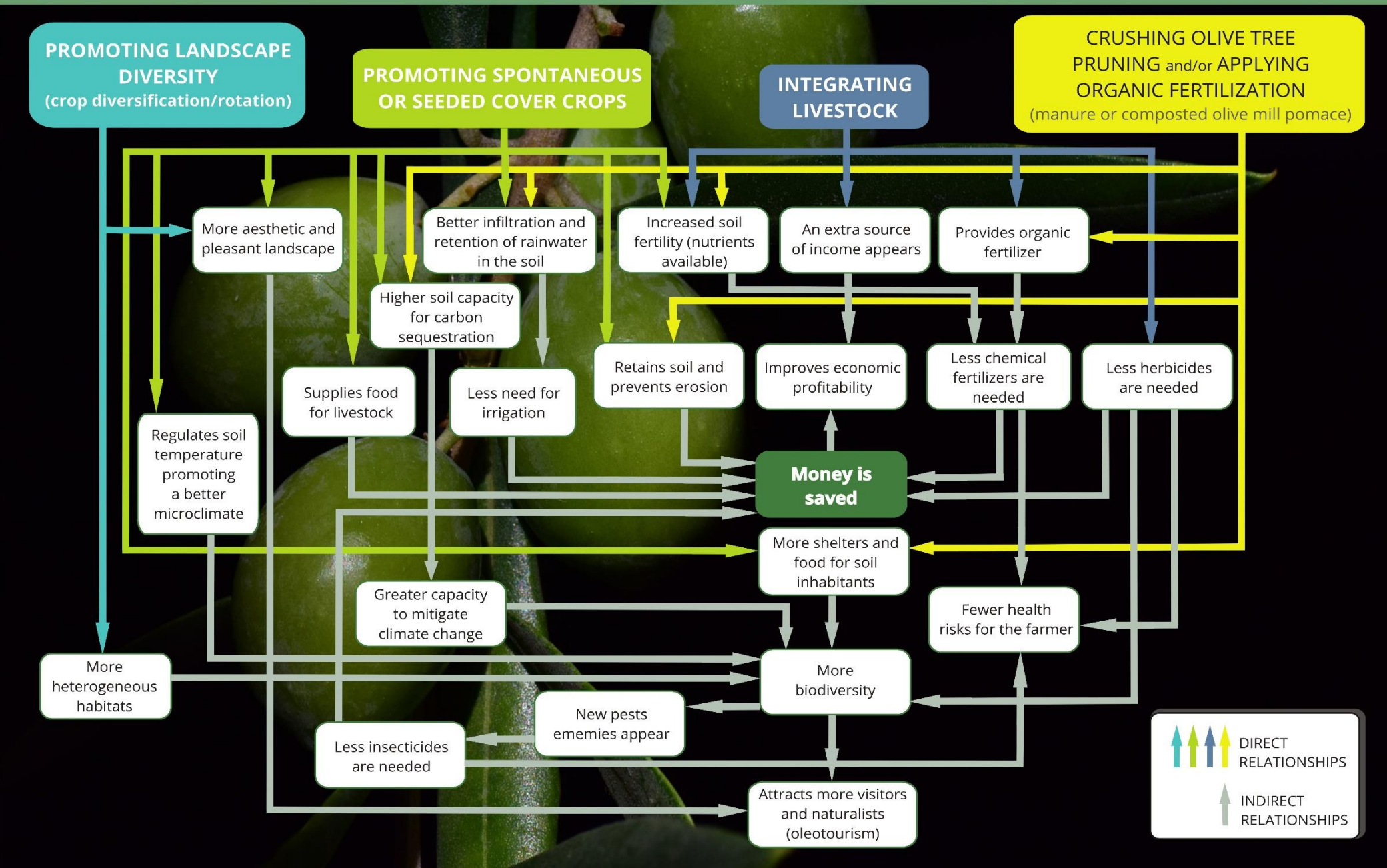
Crushing olive tree pruning waste

Applying organic fertilization

Integrating livestock

Promoting landscape diversity and heterogeneity

What main **benefits** are involved when sustainable management practices are applied ?



What are the main **damages** that can result from sustainable management practices not being applied ?

- Soils are usually kept bare from herbaceous cover by combining herbicides and tillage, resulting in negative impacts on **runoff and soil erosion**, and in poorer biodiversity and soil fertility.
- Natural elements providing diversity and **complexity at a landscape scale** (patches of natural or semi-natural Mediterranean woodland and shrubland, hedges and crops such as cereals under rotation) disappear, hampering landscape multi-functionality.
- Several **negative externalities** arise that negatively **impact society**:
  - Health of local communities impacted by **pesticides in drinking water**.
  - Rural **infrastructures damages** caused by intense soil erosion.
  - Intensification of **global warming** since bare soils act as a mirror reflecting solar radiation.

The characteristics of olive groves (regular periods of rest and growth with relatively little demand for nutrients and water) along with their adaptiveness to Mediterranean climate conditions render them suitable for securing **high agriculture productivity levels** that are also **compatible with delivery of multiple ecosystem services**.

You probably think that such services have **no monetary value**. In fact they are **extremely valuable,** and a key to sustaining your **business in the longer term**.

SUSTAIN OLIVE

Materials and activities for capacity building of farmers

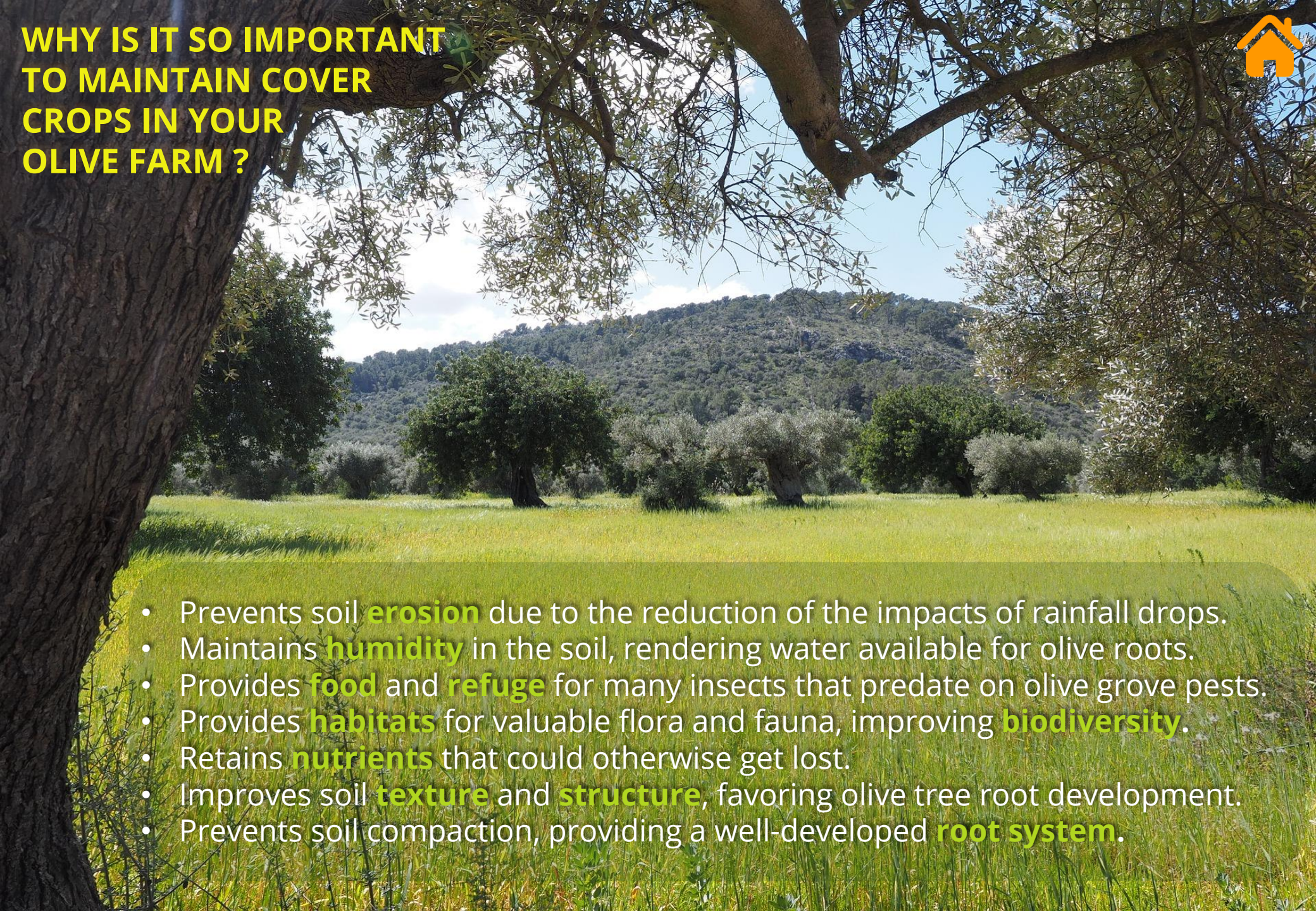
COVER CROPS IN OLIVE GROVES




Olive grove landscapes with cover crops become more attractive indeed. But green cover involves many other ecological, cultural and economic advantages. Let us show you them.




WHY IS IT SO IMPORTANT TO MAINTAIN COVER CROPS IN YOUR OLIVE FARM ?



- Prevents soil **erosion** due to the reduction of the impacts of rainfall drops.
- Maintains **humidity** in the soil, rendering water available for olive roots.
- Provides **food** and **refuge** for many insects that predate on olive grove pests.
- Provides **habitats** for valuable flora and fauna, improving **biodiversity**.
- Retains **nutrients** that could otherwise get lost.
- Improves soil **texture** and **structure**, favoring olive tree root development.
- Prevents soil compaction, providing a well-developed **root system**.

ONE OPTION:

INERT COVER CROPS

1

WITH ROCKS AND STONES FROM YOUR OWN SOIL

by using a **windrower** that moves stones and pebbles to the olive grove inter-rows.
Optionally, you can use the machine **roller** to smoothen the ground.

Stony cover must be oriented **perpendicularly** to the slope, in order to act as an erosion braker, promoting water infiltration.

2

WITH SHREDDED TREE PRUNING REMAINS

by using a **shredder**.

It's a smart way to **reuse** your own nutrients.

3

WITH ORGANIC NETS

made with **natural materials** (straw, stipa, coconut fiber).

This is recommended to avoid soil **crevices** and **gullies** in heavily eroded soils.

ALTHOUGH IT CAN GET EVEN BETTER...

ACTIVE COVER CROPS

1

NATURAL COVER CROPS

by taking advantage of the vegetation that sprouts **spontaneously** in the olive grove.

2

SEEDED COVER CROPS

by planting species of grasses and legumes that could **benefit** the soil, biodiversity and thus also the crop itself.

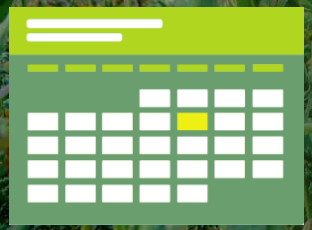
ONCE YOU MADE THE CORRECT DECISION...
HOW TO DEAL WITH COVER CROPS ?

1

MECHANICAL MOWING

by using **brush-cutters** (flail or chain cutters).
There are manual backpack brush-cutters suited for small farms.

WHEN?



AFTER A **DRY SPRING**: Second half of March to first half of April.
So competition for water with olive trees is avoided.

AFTER A **RAINY SPRING**: Before seed dissemination.
So we will avoid cover crop to become incontrollable.

Height of cover crop must be well controlled so that olives in the soil can be picked up using blowers and sweepers.

ONCE YOU MADE THE CORRECT DECISION...

HOW TO DEAL WITH COVER CROPS?

2

LIVESTOCK MANAGEMENT

Several animal species are suitable for the **management** of cover crops: sheep, horses, chicken, turkeys ...

You should **not fear** the loss of leaves and branches from the lower part of the olive trees because they are **scarcely productive**.
Also, as they are consumed at the beginning of spring, so that the loss of biomass **can be recovered** through the more productive upper branches.

ADVANTAGES

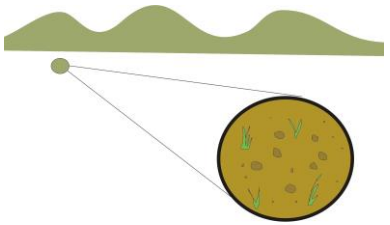
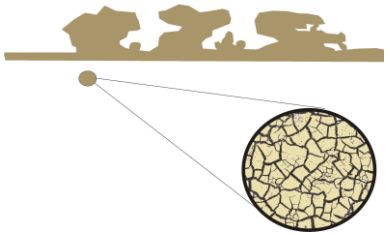
- While feeding, livestock **manures** the ground.
- When **legumes** are present, livestock will spend more time eating them (not browsing olive leaves) due to their high protein content.
- Livestock management is the **cheapest** and most **efficient** method to control cover crops, specially in organic olive groves.

How many animals and for how long?

Consult a qualified technician to determine the appropriate **livestock load** for your olive farm.

HOW TO ACCELERATE SEED RIPENING

Analyse 3 main factors and make simple decisions

HOW STEEP ARE YOUR SLOPES ?	IS THERE ANY EVIDENCE OF EROSION ?		ARE LEGUMES PRESENT ?
	No evidence of soil erosion 	Evidence of soil erosion 	
Low to medium	> Plant legumes > Provide manure and/or grazing	> Plant legumes and grasses > Provide manure and/or grazing	No legumes 
	> Let legumes produce seeds > Provide manure and/or combine with grazing	> Let legumes and grasses produce seeds > Provide manure and/or combine with grazing	With legumes 
High	> Plant legumes and grasses > Provide manure and/or combine with grazing		No legumes 
	> Let legumes and grasses produce seeds		With legumes 

SUSTAIN OLIVE

Materials and activities for capacity building of farmers

SOIL SAMPLING

HOW IMPORTANT ARE SOILS FOR YOUR OLIVE FARM ?

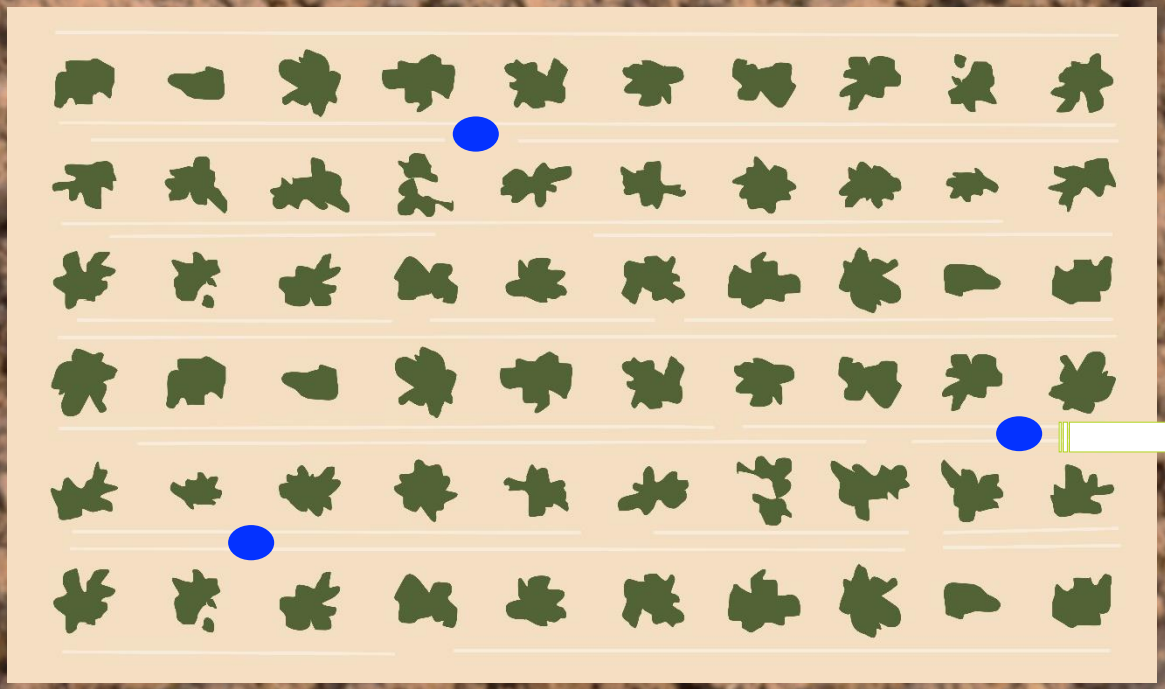
Soils are much more than a mere structure where trees grow. It contains the food and the water for olive trees. It also provides bacteria and micro and macro fauna that help your crop develop all of its biological functions.

A well-managed and healthy soil might foster plenty of olives, resulting in greater profits.

TAKING SOIL SAMPLES

1

At least, **three** sites will be **randomly** selected, located in the **inter-rows** of the olive grove.



2

In **each** of the three sites you must collect:

2.1 A sample of the **top 30 cm** of soil

2.2 A sample of **0-5 cm** of bulk density soil

2.3 A sample of **15-20 cm** of bulk density soil

Don´t worry. We will show you how to do that.

2.1

TOP 30 cm
SOIL SAMPLING

- Open a **30 cm** deep hole in the ground, leaving a **flat** vertical profile.

- Starting from the top, take a **representative** soil sample of between **1 and 2 kilos** weight. It´s very important that all soil profile strata along the entire 30 cm are **equally** represented.

- Keep the sample in a **strong** plastic bag to be transported to the lab.

2.2

0-5 cm SOIL BULK SAMPLING

1

First of all, you will need a metallic 5 cm heigh **core**, a **penknife** and a rubber **hammer**.

Insert the metallic core on top of the soil and **deepen** with the rubber hammer until the top of the core is **leveled** with the ground.

2

Cover the metallic core with a plastic cap and **clean** the soil carefully around the core with the penknife, deepening the cleaning up to 5 cm deep.

3

Dig the soil down to the base of the core and then **cut** the soil at the core level with the knife.

4

Store the core sample into a plastic **bag**.

5

2.3

15-20 cm SOIL BULK SAMPLING

- Using the **same hole** where you have taken the 0-5 cm soil bulk sample, build a flat horizontal **platform** of 15 cm depth.

- **Proceed as with the 0-5 cm soil bulk sampling.**

SUSTAIN OLIVE

Materials and activities for the capacity building of farmers

ESTIMATING THE BIOVOLUME OF OLIVE TREES

WHY ESTIMATE THE BIOVOLUME OF AN OLIVE TREE ?

BIOVOLUME is measured In **cubic meters**

Because **key information** about your farm is determined by tree biovolume (or tree biomass), including:

TREE NUTRIENT RETENTION

- The proportion of the **fertilizers added that remain** in the permanent woody structures of the olive tree

CARBON STORAGE CAPACITY

- The **speed** at which your olive trees **grow**
- The level of efficiency of your farm in accumulating atmospheric carbon, and thus of contributing to **climate change mitigation**

HOW TO ESTIMATE THE BIOVOLUME OF AN OLIVE TREE ?

1

CHOOSE BETWEEN 3 AND 5 REPRESENTATIVE OLIVE TREES OF YOUR FARM

The following should not be considered as **representative** trees:

- **Too old** or **too young** compared to average age of your olive trees
- **Too big** or **too small** compared to average size of your olive trees
- **Too thick** or **with too sparse** treetops compared to average canopy of your olive trees

HOW TO ESTIMATE THE BIOVOLUME OF AN OLIVE TREE ?

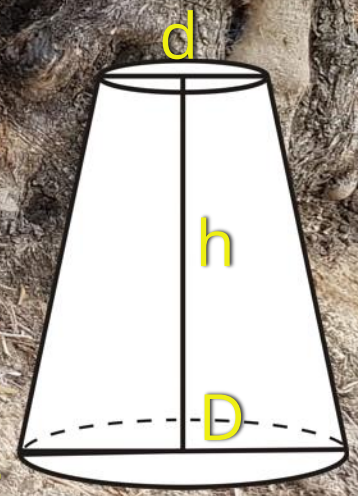
2

For each olive tree selected **TAKE THESE MEASUREMENTS :**

Diameter of the trunk at the root collar (D) and at the birth node of primary branches (d).

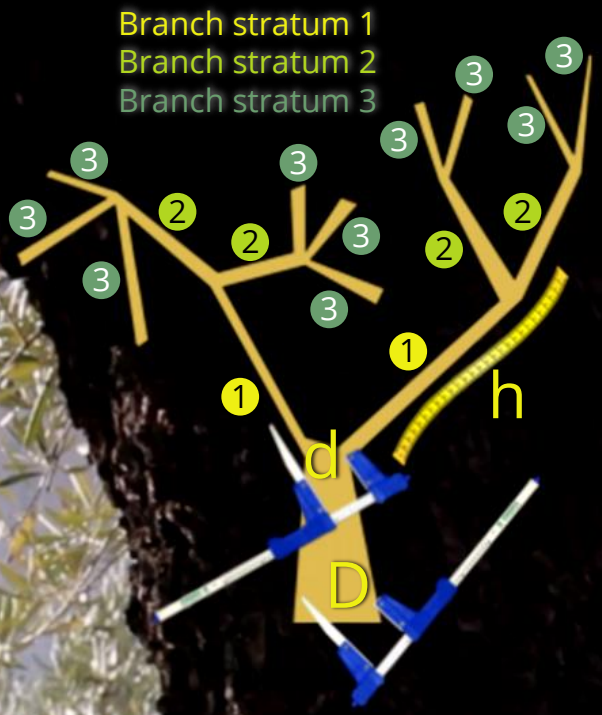
Diameter of 1 – 2 – 3 branch strata (≥ 2cm) at the basis (D) and the tip of each branch (d).

The length of the trunk and 1-2-3 branch strata (h).



If you use a tape for measuring diameter, you will get the circumference lenght (L). Then you will need to calculate the diameter as $D=L/\pi$

HOW TO ESTIMATE THE BIOVOLUME OF AN OLIVE TREE ?



3

PERFORM THE CALCULATIONS:

Tree volume of each trunk or branch (V) will be estimated through the truncated cone volume formula:

$$V = \frac{1}{3}\,\pi\,h\left(R^2 + r^2 + R{\cdot}r\right)$$

R and r indicate the major and minor radius, corresponding to half of the major and minor diameters (D and d, respectively)

If you have measured 2 trunks and 12 branches, you will get 14 volume metrics.

The aerial volume estimation of your tree will be obtained as the addition of the 14 volume metrics:

$$V_{tree} = \sum V_{trunks+branches}$$

If your **unit** for the calculations is **centimeters**, your result will be in cubic centimeters.
Simply **divide it by a million** to get cubic meters.

HOW EFFICIENT IS THIS BIOVOLUME ESTIMATION METHOD ?

Velazquez-Marti et al. 2014

Variable	V (m^3)	% Biovolume
Trunk + Stratum 1	0,158	76,2
Stratum 2	0,021	10,0
Stratum 3	0,014	6,7
Stratum 4	0,007	3,6
Stratum 5	0,007	3,4

SUSTAINOLIVE approach (N = 20)

Variable	V (m^3)	% Biovolume
Trunk + Stratum 1	0,112	81
Stratum 2	0,012	9
Stratum 3	0,014	10

The trunk + branch stratum 1 (primary branches) account for around **80% of aerial bio-volume.**

So our method seems to be an IMPROVED APPROACH

SOME POTENTIAL APPLICATIONS FOR OLIVE TREE BIOVOLUME

Once olive wood density (δ) is also known, aerial biovolume will allow you to calculate the **AERIAL TREE BIOMASS (B_a)**.

$$B_a = V \cdot \delta$$

Calculating olive tree **WOOD DENSITY** is pretty easy:

$$\delta = \frac{W_p}{V_p}$$

V_p **VOLUME** of a regular piece of wood, (wood core extracted with a **borer pressler** or a cylindrical piece of a **pruning branch**)

W_p **WEIGHT** of the wood piece

$$V_p = \pi \cdot r^2 \cdot h$$

MORE POTENTIAL APPLICATIONS OF OLIVE TREE BIOVOLUME

Estimating **ROOT BIOMASS (B_r)** implies applying a corrective factor that assumes root biomass is approximately 4.2 times lower than aerial biomass (López-Bellido et al., 2016)

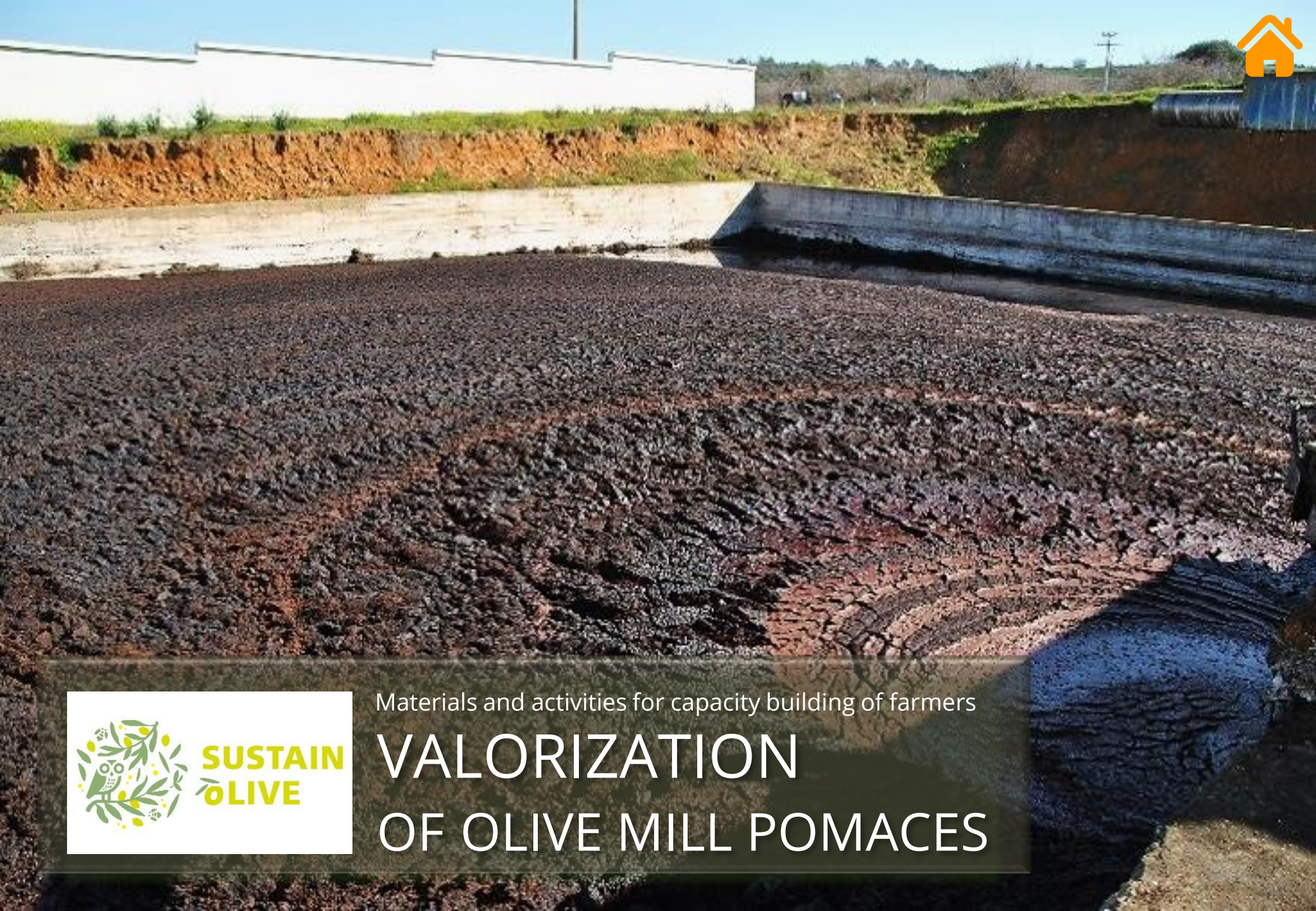
$$B_r = \frac{B_a}{4,2}$$

Once the calculations of B_a and B_r have been performed, you can obtain the total **OLIVE TREE BIOMASS (B_t)** by applying a corrective biomass expansion factor of 1,13 that compensates for the non-measured canopy biomass in leaves and branches placed above stratum 3 (Illarioni et al., 2013)

$$B_t = (B_a + B_r) \cdot 1,13$$





SUSTAIN OLIVE

Materials and activities for capacity building of farmers

VALORIZATION OF OLIVE MILL POMACES

OLIVE MILL POMACES
AN INEFFECTIVELY USED RESOURCE

Once olives are milled to extract olive oil, a waste sub-product called `**olive mill pomace**´ is obtained (800 kg per every 1000 kg of olives, approximately).

Olive mill pomaces are a mix of **fatty** remains, vegetation **waters** and solid parts of the olives, including **pits** and **skins**.

They contain a considerable amount of **nutrients** that the farmer can benefit from. Ultimately, it is an **economic resource** that is often wasted.

Keep reading to know the **alternative uses** that you can provide to **olive mill pomaces**

USE 1

ORGANIC FERTILIZATION

using composted olive mill pomaces

COMPOSTING

A GOOD METHOD TO TAKE ADVANTAGE OF NUTRIENT-RICH OLIVE OIL BY-PRODUCTS

COMPOST is a **fertilizer** produced by the decomposition of organic wastes, in this case olive mill pomaces.

It has been scientifically proven that the annual **production** of any olive grove would be **guaranteed** if 10.000 kilograms of olive mill pomaces compost per hectare were applied.

In fact, the **organic matter** content of olive mill pomaces compost is similar to that in the compost sold for **gardening**.

HOW ARE OLIVE MILL POMACES COMPOSTED?

1 Fresh olive mill pomaces are stacked on a flat and impermeable surface (to avoid the leaching of toxic substances).

2 Nitrogen-rich materials like olive leaves, animal blood or slurry are added (to allow for microorganisms to initiate decomposition).

3 The stacks must be regularly turned over and watered to avoid reaching high temperatures.

4 After around 9 months the olive mill pomaces will have turned into a dark crumbly material with the smell of mulch. Now it is ready to be used.

POTENTIAL BENEFITS
OF APPLYING OLIVE MILL POMACES TO OLIVE GROVE SOILS

Producing olive pomace mill compost costs **less than half of the retail price** of common chemical fertilizers.

- Fosters soil **aeration** and **drainage.**
- Improves the ability of soils to **retain water**.
- Facilitates aggregation with clays that **prevent soil erosion**.
- Acts like a **sponge**, retaining and slowly liberating key **nutrients** for olive trees.
- Allows the proliferation of **microorganisms** that improve the availability of **nutrients** for olive trees.

What are the quality standards for olive mill pomace composting?

Ideally, you should try to obtain a composted olive mill pomace with a **1/20 Nitrogen/Carbon** ratio. If necessary, consult a qualified technician.

USE 2

SOAP MAKING
from olive mill pomaces

Olive mill pomaces still **contain 3-5% of oil** fats so it´s a good resource to produce recycled soap.

Ingredients to produce soap

Essential

- Olive mill pomaces
- Caustic soda (Sodium hydroxide)
- Distilled water

Optional

- Texturizing agents (e.g. *Aloe vera*)
- Flavoring agents (e.g. essences from aromatic plants)
- Other vegetable oils
- Artificial colorings

There is a wide range of **entrepreneurial options** to produce **cosmetics** based on olive mill pomaces.

USE 3

CERAMIC USE
of olive oil mill pomaces

HOW ?

By **replacing part of the clay and water** used to build the bricks by a percentage, **up to 8 %, of olive mill pomaces**.

This mixturing follows the same kneading, shaping and firing processes as for ceramics made exclusively with clay and water, whilst it counts with **extra advantages**.

La Rubia García et al. 2010

ADVANTAGES

of including olive mill pomaces in manufacturing of bricks

La Rubia García et al. 2010

- Being a wet by-product, it **reduces manufacturing costs**.
- Its high organic matter content provides energy, therefore **reducing fuel consumption** in the oven.
- It has a very small particle size and a high moisture content which results in a low porosity and high plasticity. Thus, it´s **easy to mold**.
- It is an effective **lightening** additive so it can be useful as an **insulator**.

A MINOR **INCONVENIENCE**

Bricks from olive mill pomaces show a decrease in mechanical properties compared to those manufactured only with clay. Nevertheless, their resistance to compression reach the minimum established by the regulations.

USE 4

FEEDING LIVESTOCK
with olive mill pomaces

ADVANTAGES

of including olive mill pomace in sheep and goats feed

- Reduces the **costs of feed and fodder.**

  Molina Alcaide, 2015
  Meneses Rojas & Cerda Godoy, 2016

- Can be **mixed with hay or alfalfa** up to 48%, without any inconveniences.

  Meneses Rojas & Cerda Godoy, 2016

- Does not affect the **main characteristics** of carcasses of lambs and goats.

  Gaona Cano, 2011
  Meneses Rojas & Cerda Godoy, 2016

- Improves the **fat profile** of goat milk...

  Molina Alcaide, 2015

  ... resulting in a higher concentration of non-saturated fatty acids that trigger HDL (`**good colesterol**´).

  Basque Technology Center Neiker-Tecnalia & UPV / EHU Faculty of Pharmacy, 2010

SHEEP and GOATS

Olive mill pomaces are an interesting **FOOD SUPPLEMENT**, especially during summer and other periods with **NO NATURAL GRASS** available.

PIGS

What results are obtained after **adding moderate levels of olive mill pomaces** (up to 100 g / kg) in the final stage of pigs´ diet?

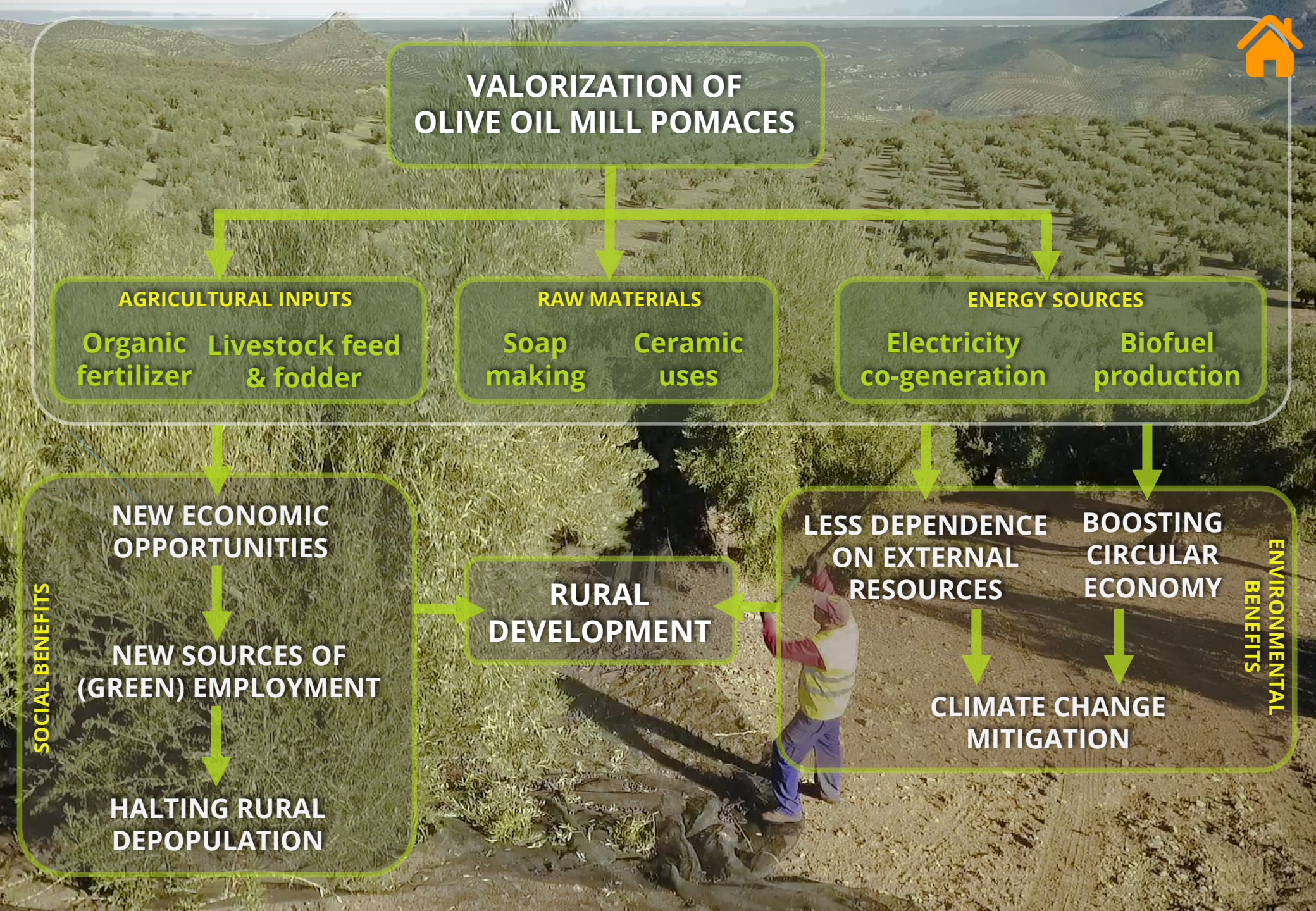
- Improves **daily growth.**
- Decreases the **fat cover** thickness in the carcass.
- Decreases the proportion of **saturated fatty acids in the carcass**.
- Increases the proportion of **monounsaturated fatty acids**, especially of oleic acid.
- Meat is **healthier** for consumers.

Latorre Górriz et al. 2015

SOCIO-ECONOMIC BENEFITS

of valorizing olive mill pomaces

(and olive industry by-products, in general)


VALORIZATION OF OLIVE OIL MILL POMACES
AGRICULTURAL INPUTS
Organic fertilizer
Livestock feed & fodder
RAW MATERIALS
Soap making
Ceramic uses
ENERGY SOURCES
Electricity co-generation
Biofuel production
SOCIAL BENEFITS
NEW ECONOMIC OPPORTUNITIES
NEW SOURCES OF (GREEN) EMPLOYMENT
HALTING RURAL DEPOPULATION
RURAL DEVELOPMENT
ENVIRONMENTAL BENEFITS
LESS DEPENDENCE ON EXTERNAL RESOURCES
BOOSTING CIRCULAR ECONOMY
CLIMATE CHANGE MITIGATION

SUSTAIN OLIVE

Materials and activities for capacity building of farmers

PHENOLOGICAL STAGES

A-50 WINTER BUD

During the winter phenological period, the buds of olive trees have a **short peduncle**, are acute and completely **closed**. When you tear a leaf, it is **detached by the base** of the peduncle, thus minimizing damage.

B-51 SPROUTING

The buds begin to gain weight, and the **peduncles length,** whilst the formation of the **floral cluster** begins. If a leaf is torn off, the peduncle **drags** part of the skin of the twig and sometimes of the bud.

C-54 FLORAL CLUSTER FORMATION

The floral cluster is fully formed. In the end, the **bracts open,** revealing the calyx.

D1-55 COROLLA IS FORMED AND PREDOMINANT

The floral button swells, the **calyx opens** and the **corolla becomes visible**, and larger than the calyx.

D2-57 COROLLA CHANGES COLOR

The floral button continues to increase in size and the corolla changes **from green to yellowish** white color.

E-60 STAMENS BECOME VISIBLE

The floral button continues to swell, the **corolla begins to open** and the **stamens can be detected** in the background.

F1-61 BEGINNING OF FLOWERING

First few flowers begin to open.

F2-65 FULL BLOOM

Most flowers are open and there is **abundant pollen** in the environment.

G-69 CURDLED FRUIT

The fertilized ovary enlarges and the **curd olive** becomes clearly apparent. The **petals wilt** and fall.

H-75 BONE HARDENING

The tender fruit grows reaching close to half its definitive size, the **bone begins to lignify**, presenting resistance to cutting.

I-81 TURNING COLOR

The fruit reaches its **definitive size** and, partly begins to change its color from **green color to purple**, which is ultimately extended to the whole fruit.

J-89 FRUIT RIPENING

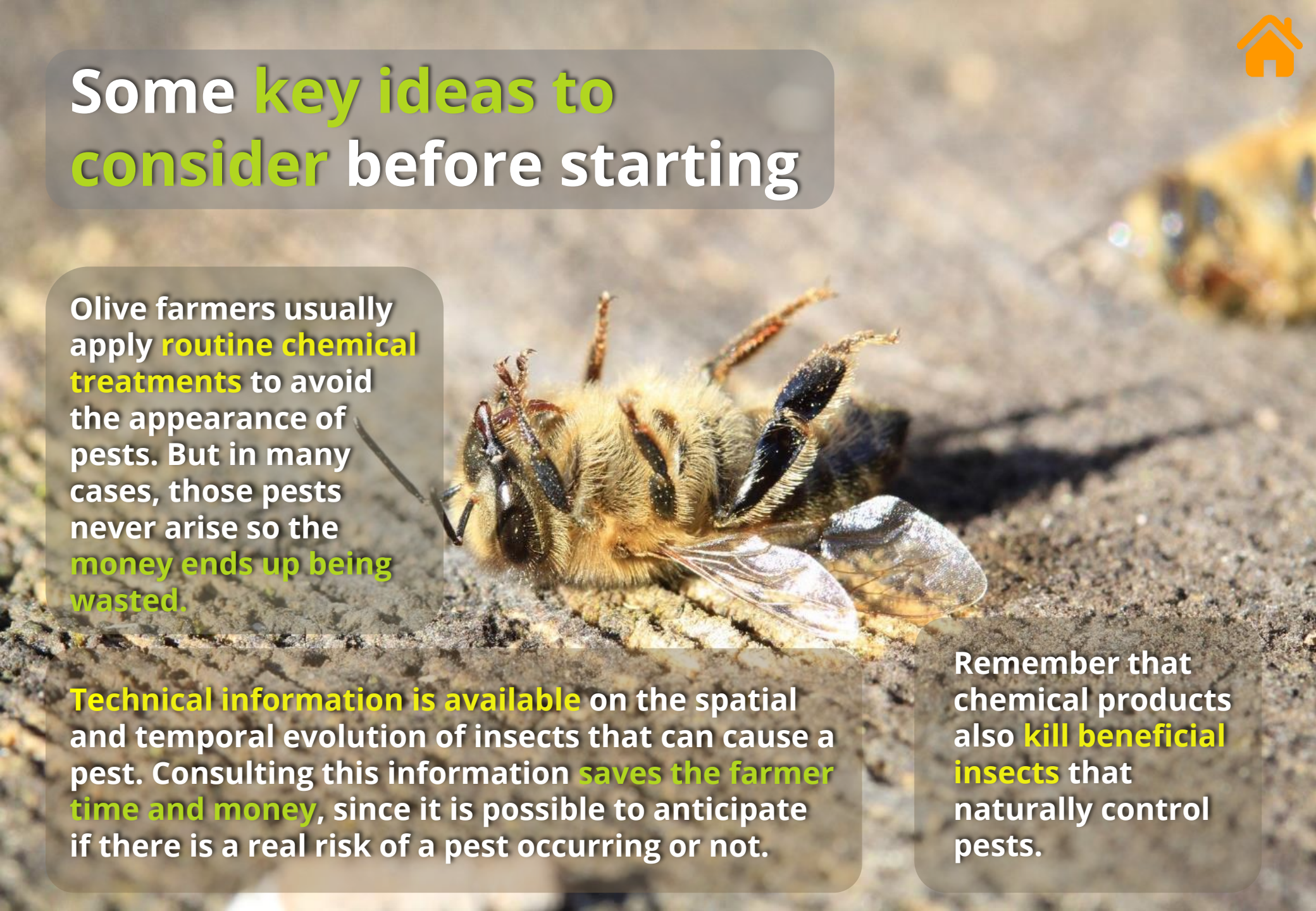
The olive already has a dark color, until full maturity is reached, when it becomes **almost black**, and can then **detach from the peduncle**. Winter rest begins again.

SUSTAIN OLIVE

Materials and activities for capacity building of farmers

SAMPLING PROCEDURES FOR IDENTIFICATION OF KEY PESTS AND DISEASES

Some key ideas to consider before starting



Olive farmers usually apply routine chemical treatments to avoid the appearance of pests. But in many cases, those pests never arise so the money ends up being wasted.

Technical information is available on the spatial and temporal evolution of insects that can cause a pest. Consulting this information saves the farmer time and money, since it is possible to anticipate if there is a real risk of a pest occurring or not.

Remember that chemical products also kill beneficial insects that naturally control pests.

The **OLIVE FRUIT FLY**

Bactrocera oleae

(Diptera; Tephritidae)

It is the **most destructive** olive pest with its larvae consuming olives´ mesocarp and causing both quantitative and qualitative losses for olive oil production.

Olive fruit fly **infesting up to over 90%** of olive fruits in non-treated farms has been reported.

The **OLIVE FRUIT FLY**

Bactrocera oleae

(Diptera; Tephritidae)

- The **egg** is inserted in olive fruits and the **larva** feeds and grows as a **fruit borer** in olives´s mesocarp and **pupates** in the fruit or in the soil.
- The olive fruit is eaten by the fly larvae between the **end of May to mid-June** (depending on the geographic area).
- The olive fruit fly encompasses **4-6 generations** across the Mediterranean basin.
- Hot and dry Mediterranean **summers** reduce insects´ development, while reproduction and preimaginal development continue without interruption throughout **winter**.

1. Eggs in a female abdomen

2. Olive fruit fly laying eggs

3. Olive fruit fly egg

4. Bunch of minced olives

5. Larvae inside olive fruit

6. Outlet hole

Pictures 1,3-6

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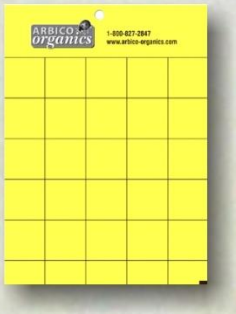
How to know if you should be worried about olive fruit fly ?

Fruit sampling protocol

Device scheme for monitoring *B. oleae* flying populations

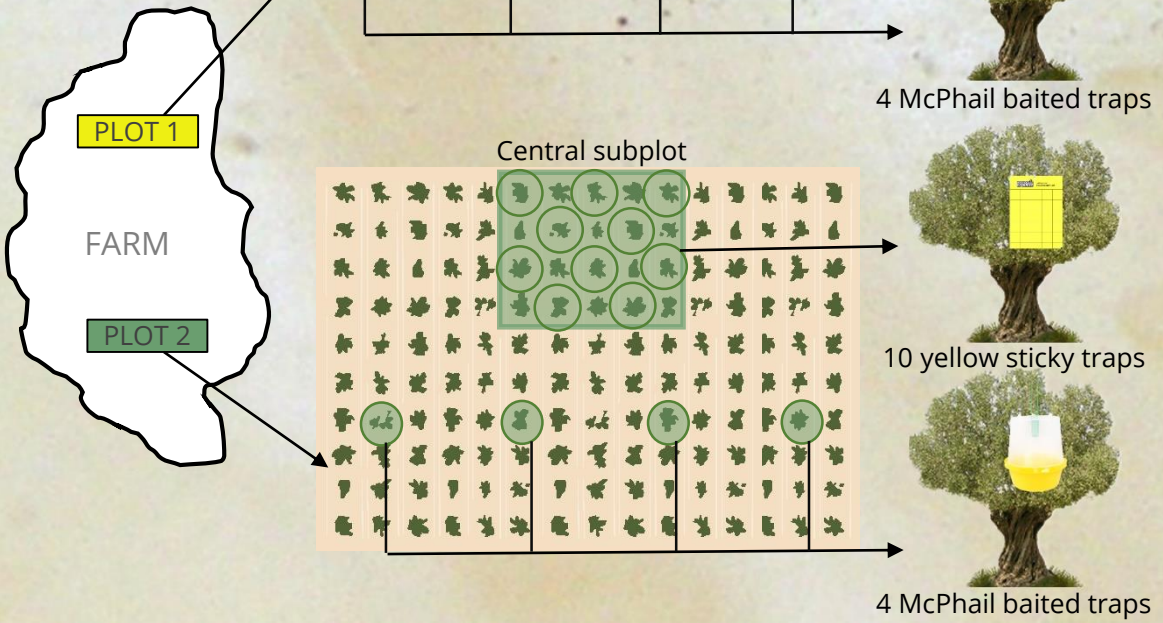


Yellow sticky trap

McPhail baited trap
(with an attracting agent such as diammonium phosphate)

It is recommended to use **4 pairs of plots at least** (e.g. 2 pairs for oil production, and 2 pairs for table olives production, if applicable).

Here you can see an exemplary fruits sampling protocol distributed across a pair of plots.



Before applying any chemical product, it is highly recommended to monitor the density of olive fruit fly populations.

Why spend on chemical inputs if they may not be necessary ?

Background picture: Olive fruit fly on a trap lid
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MONITORING *B. oleae* flying populations (cont.)

Processing procedure for traps

WHEN ?

From the **beginning of stage H-75** (bone hardening) to the **end of stage I-81** (turning color).


early August → mid–November

mid-June → mid-November

June → October

HOW ?

Traps must be renewed at **intervals of 2 weeks.**

Once traps are removed for renewal, captured **flies are counted**.

The **OLIVE MOTH**

Prays oleae

(Lepidoptera; Yponomeutidae)

It is one of the main pests infesting productive olive trees since larvae of the first, second, and third generations attack **inflorescences** (1), **fruits** (2), and **leaves** (3), respectively.

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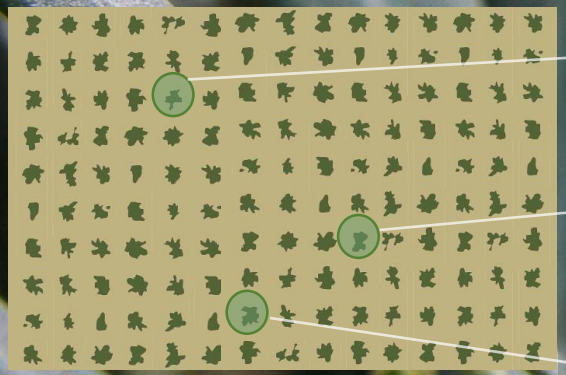
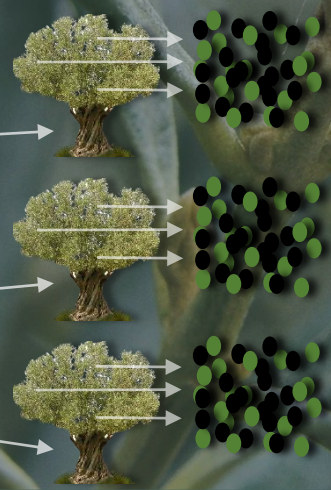
How to know if you <u>should be worried</u> about olive moths ?

Fruit sampling

Device scheme for monitoring *P. oleae* attack intensity





SAMPLING PROTOCOL (each sampling event)

Select **3** random **olive trees.**

Pick **100** random **fruits** from each olive tree (at 4 orientations and different heights).

Fruits will be placed in an **opaque glass or plastic container**, preferably at a temperature lower than the environment.

From the beginning of **stage G-69** (curdled fruit) until after 7-10 days, implement **4 sampling events** at **weekly** intervals.

Background picture: <u>Damages caused by *Prays oleae*</u>
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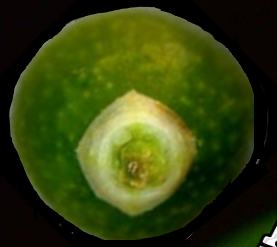
OLIVE MOTH
Examination



Apical view of the fruit with *Prays oleae* eggs
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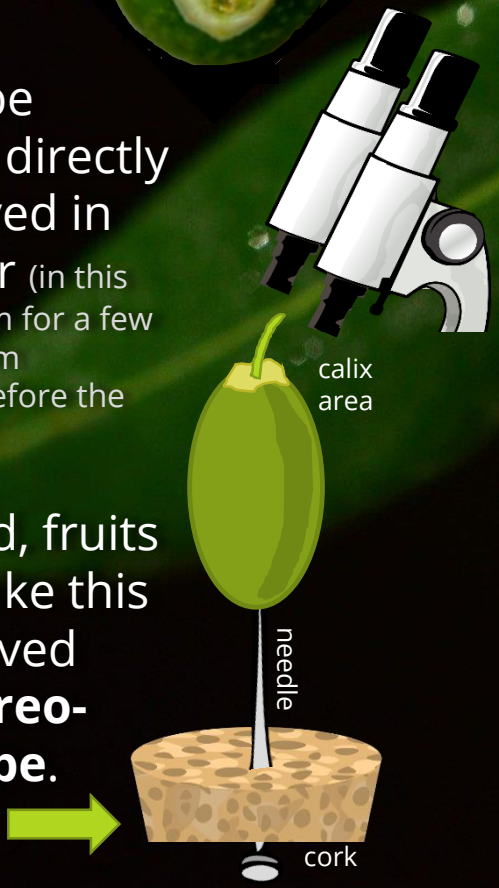
Eggs can be examined directly or preserved in the freezer (in this case, keep them for a few minutes at room temperature before the examination).

Once dried, fruits are fixed like this and observed with a **stereo-microscope**.

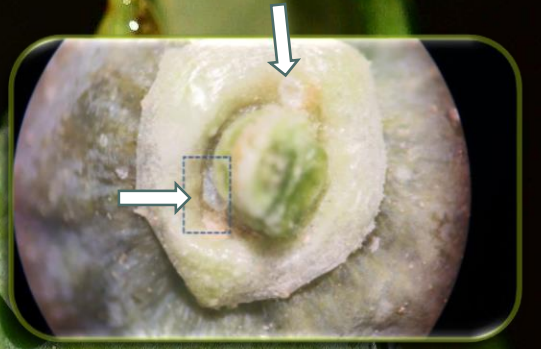


FRESH EGGS

They are **milky white**, not transparent. As the embryonic development progresses, they adopt a **yellowish** hue. At the end, the **black** larva cephalic capsule can be observed.

PREDATED EGGS

Generally due to the predatory activity of green lacewings larvae (*Chrysopidae*). Only the **chorion remains attached** to the basis as a thin and transparent layer with its characteristic crosslinking. Its shape is **irregular**, very often **collapsed or crushed** and shiny.



HATCHED EGGS

They have a **reddish** color and are **bulged** due to the larva excrements accumulated under the chorion. Unlike predated eggs, chorion reticulation can not be appreciated.

The **OLIVE BARK BEETLE**

Phloeotribus scarabaeoides

(Coleoptera; Curculionidae)

It usually breeds in **weakened trees** and in **cut-off branches**.

Adults build small **feeding galleries** on the **terminal twigs** (**Ø 3-5 mm**).

Number of reported **generations**

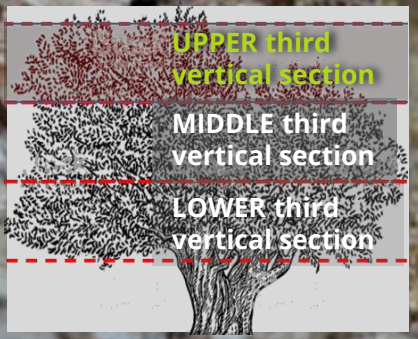
1

2-3

4

Defining **SYMPTOMS**

Galleries may cause **twigs to break** although wounds often **heal gradually** (then **residual marks** can be detected).



Highest densities are found in the terminal twigs of the **upper third vertical section** of olive trees.

Background picture: Olearum.com

How to know if you should be worried about olive bark beetle ?

Sampling twigs


Inlet holes - Junta de Andalucía


Galleries and outlet holes
Junta de Andalucía

HOW ?

3 sequential **samplings along 45-day intervals**: mid-June, late July and mid-September.

In summer, olive bark beetles have a clear preference for twigs of the **Northern and Eastern** orientations of olive trees and olive groves.

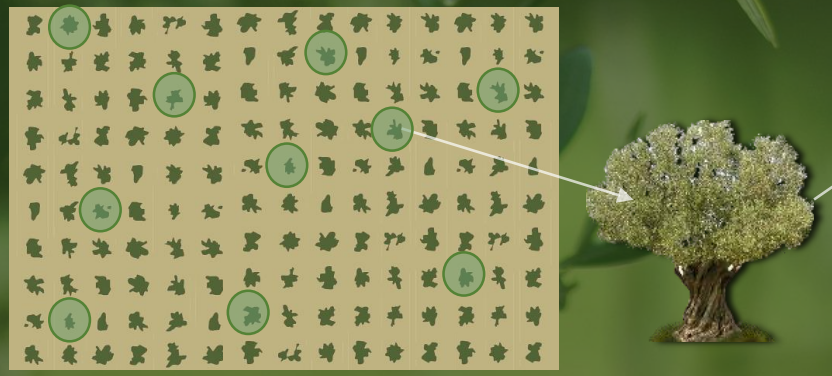
WHEN ?

During the second feeding stage (between **mid-June** and **late September** in Southern Spain).

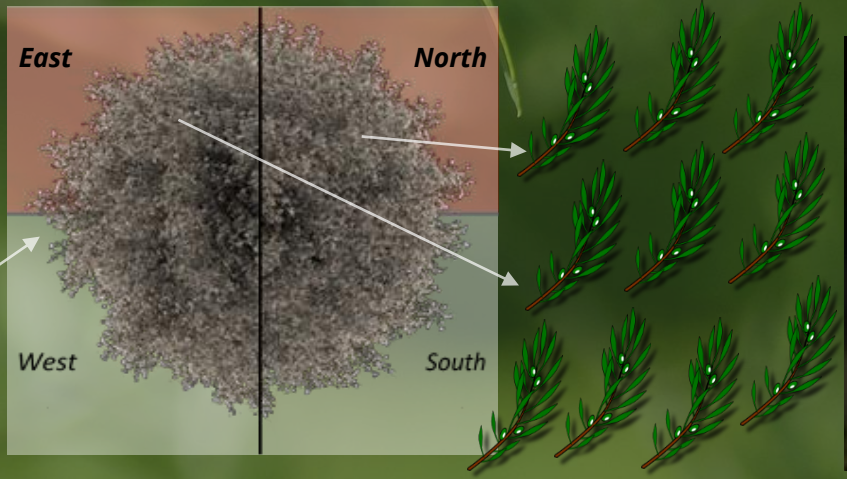
SAMPLING PROTOCOL

(each sampling)

Random selection of **10 olive trees**



Random selection of **10 terminal twigs** from **northern and eastern** orientations of the tree **top**



For each twig, a **terminal** length of **40 cm** is considered, and the **number of feeding galleries** is counted

The **OLIVE KNOT**

Pseudomonas savastanoi
(Bacteria; Pseudomonadaceae)

How to know if you <u>should be worried</u> about olive knot ?

Sampling olive trees

In this example:

4 olive trees with symptoms out of 10 = **40 %**

WHEN ?

Symptoms appear generally in **SPRING**.

HOW ?

By selecting **10 olive trees** at the center of your experimental plot and calculating the **percentage** of them showing olive knot **symptoms**.

Repeat the observation **every two weeks**.

Background picture: Cbh.es

The **OLIVE REPILO**

Spilocaea oleagina
(Fungi; Venturiaceae)

How to know if you <u>should be worried</u> about olive repilo ?

Sampling of leaves

WHEN ?

4 times every year:
March, late May, late August, 15 October to 15 November

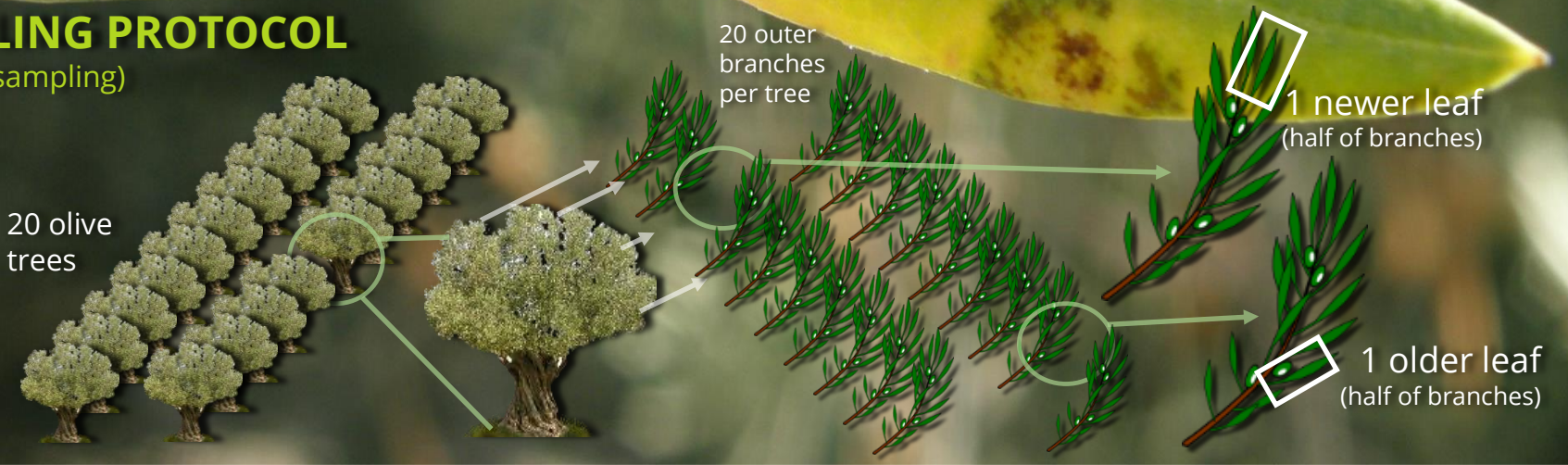
HOW ?

By selecting **20 olive trees**.

20 terminal branches will be sampled from the outer sections of each tree (20 x 20 = 400 shoots). Collect **1 random leaf** per branch.

Half of the samples (**200**) will be collected **at the end tip of the branches** (**new leaves**) and the other half (**200**) **at their older tip**.

SAMPLING PROTOCOL
(for each sampling)



Background picture: leave damages caused by *Spilocaea oleagina*
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The **OLIVE LEADEN REPILO**

Pseudocercospora cladosporioides

(Fungi; Mycosphaerellaceae)

How to know if you should be worried about olive leaden repilo ?

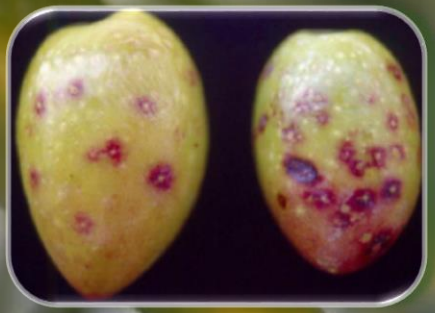
Sampling of leaves

WHEN ?

4 times every year: March, late May, late August, 15 October to 15 November

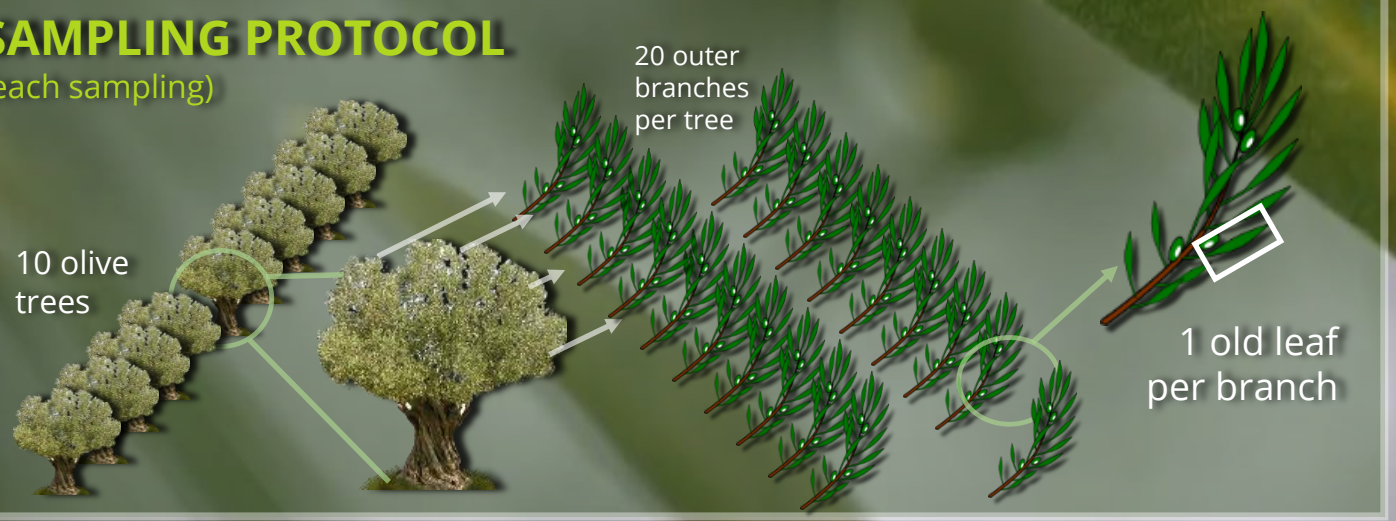
HOW ?

By using the same sampling procedure as explained for *Spilocaea oleagina* although now **only 200 old leaves** must be observed.



SAMPLING PROTOCOL

(each sampling)



Background picture: Olearum.com

SUSTAIN OLIVE

Materials and activities for capacity building of farmers

BATS for integrated pest management

WHY ARE BATS IMPORTANT FOR YOUR OLIVE FARM ?

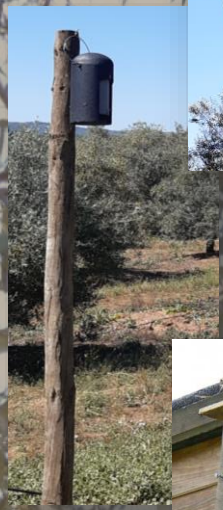
- Insectivorous bats provide a biological control of pests as they **eat huge amounts of insects** (almost half their weight per night)
- Their diet includes many **pests for olive trees** (e.g. *Prays oleae*)
- Studies in other crops (such as cotton and cocoa) have valuated the service of biological pest control provided by bats at approximately **170€/ha/year**

Bats and landscape

Bats benefit from landscape elements that provide water, commuting routes, roosts and feeding areas such as **small ponds, riparian vegetation, caves, old buildings and isolated trees or tree patches**.

The increase of agricultural areas coupled with the intensification of management practices often leads to more **homogeneous landscapes with scarce roosting sites, creating areas unattractive to bats.**

PROMOTING BATS IN OLIVE GROVES



Providing artificial roosts, commonly known as **bat boxes**, is an effective way of promoting bat activity in your olive grove.

Bat boxes must be placed **as high as possible** (on top of poles, in trees or in walls) in **wind sheltered and sun exposed** locations (at least 6-8h of sun/day). In warmer climates they should be painted white or light gray whereas in colder climates they should be painted black or dark gray.

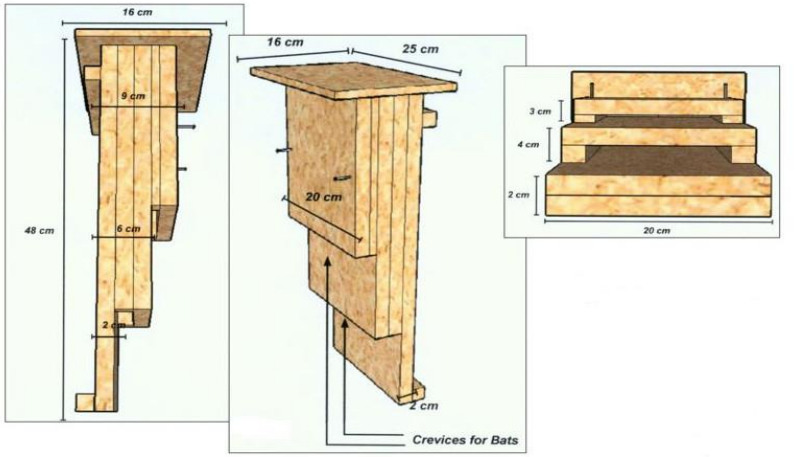
Bat boxes should be installed preferably **in early Spring.**

BUILDING A BAT BOX

Bat boxes can be made of several materials and they are sold in a variety of shapes and sizes. Alternatively they can be constructed by yourself following one of the many construction plans available online.

URL1 URL 2

As an example, the plan for **the Kent model,** made with untreated timber (20mm thick) is presented here.



Evaluating the measures

Bats occurrence can be assessed by counting bats at sunset as they leave bat boxes.

With the increase of bat numbers, the infection rates originated from insect pests should start to decline.