



# NOVATERRA

## WP4-New soil management strategies for improving crop health with less chemicals

*UCSC, IRTA, CORTEVA, HORTA, TERRAS, SOGRAPE, IPB, UBU, INESC TEC, MYROLION*



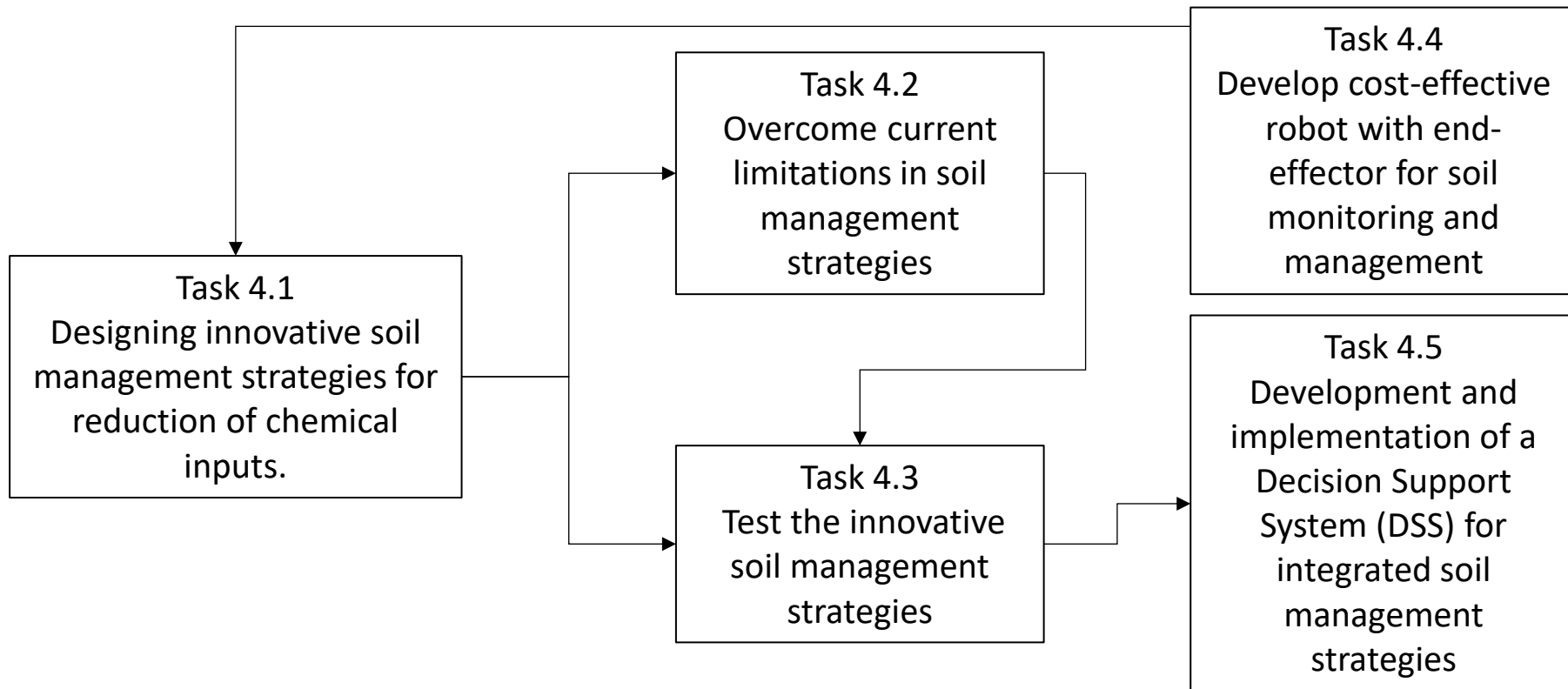
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# WP4: New soil management strategies for improving crop health with less chemicals

## WP Objectives



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| WP4      | SOIL MANAGEMENT STRATEGIES FOR IMPROVING CROP HEALTH WITH LESS CHEMICALS         | LEADER   | Oct-20 | Nov-20 | Dec-20 | Jan-21 | Feb-21 | Mar-21 | Apr-21 | May-21 | Jun-21 | Jul-21 | Aug-21 | Sep-21 | Oct-21 | Nov-21 | Dec-21 | Jan-22 | Feb-22 | Mar-22 | Apr-22 | May-22 | Jun-22 | Jul-22 | Aug-22 | Sep-22 | Oct-22 | Nov-22 | Dec-22 | Jan-23 | Feb-23 | Mar-23 | Apr-23 | May-23 | Jun-23 | Jul-23 | Aug-23 | Sep-23 |  |
|----------|----------------------------------------------------------------------------------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| TASK 4.1 | Designing innovative soil management strategies for reduction of chemical inputs | UNICATT  |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| TASK 4.2 | Overcome current limitations in soil management strategies                       | UBU      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| TASK 4.3 | Test innovative soil management strategies                                       | IPB      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| TASK 4.4 | Develop cost-effective robot with end-effector for soil monitoring and managent  | INESCTEC |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |
| TASK 4.5 | Development and implementation of a DSS for integrated soil managemnt strategies | HORTA    |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |  |



## Task 4.1 Designing innovative soil management strategies for reduction of chemical inputs

Task Leader: UCSC; Partners: UBU, INESTEC, TERRAS, SOGRAPE, CORTEVA, IRTA, HORTA, IPB. Task duration: M01 to M6

- A systematic literature review has been first carried out by UCSC to retrieve all the relevant literature and data; then, a meta-analysis has been conducted to identify best candidate alternatives for reduction of chemical inputs.
- Results from literature search and meta-analysis have been used by UCSC to develop a SWOT (strengths, weaknesses, opportunities and threats) analysis as the basis to integrate alternatives and design innovative strategies to be tested in T4.3.

**Deliverable:** submitted in March 2021



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## Task 4.1 Designing innovative soil management strategies for reduction of chemical inputs

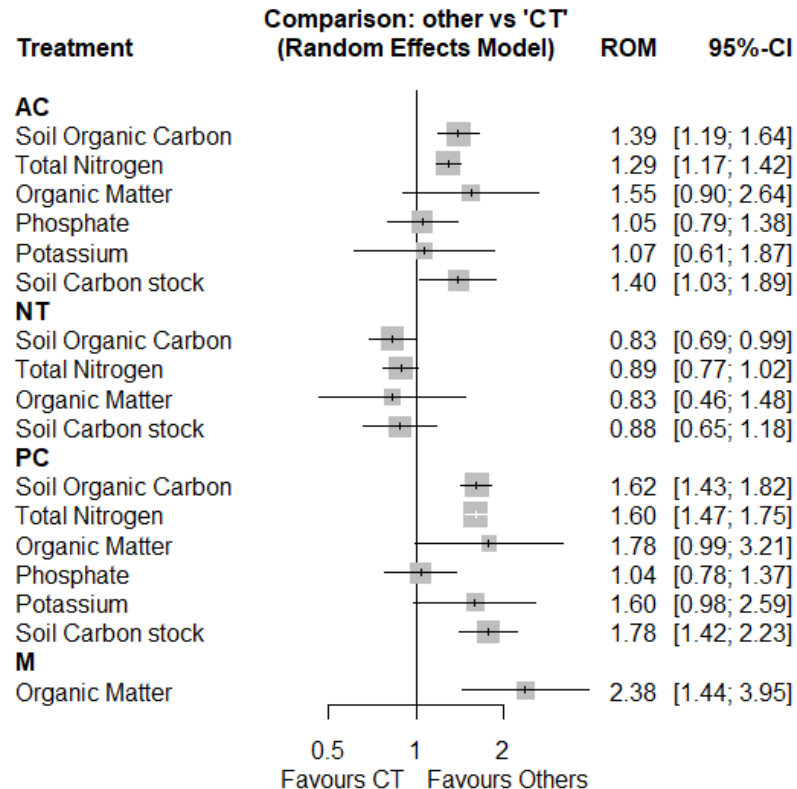
Task Leader: UCSC; Partners: UBU, INESTEC, TERRAS, SOGRAPE, CORTEVA, IRTA, HORTA, IPB. Task duration: M01 to M6

### Materials and Methods

- A systematic literature review to retrieve all the relevant literature and data;
- an ex-ante meta-analysis to identify best candidate alternatives for reduction of chemical inputs;
- Inclusion of results from previous EC projects (i.e., LIFE+ SOIL4WINE and Core Organic Cofund BIOVINE);
- a SWOT analysis to identify best candidate alternatives for reduction of chemical inputs, as the basis to integrate alternatives and design innovative strategies to be tested.

### Main results

Many approaches can improve soil health, fruit quality, and environment. For instance, **cover crops and margins positive contribute to the soil health and potentially on the control of arthropods, soil-borne pest, and foliar pathogens.**



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## Task 4.1 Designing innovative soil management strategies for reduction of chemical inputs

Task Leader: UCSC; Partners: UBU, INESTEC, TERRAS, SOGRAPE, CORTEVA, IRTA, HORTA, IPB. Task duration: M01 to M6

|                       | Partner | Type               | Title                                                                                                  | Location - Date    |
|-----------------------|---------|--------------------|--------------------------------------------------------------------------------------------------------|--------------------|
| Practice abstracts    | UCSC    | -                  | <i>Designing innovative soil management strategies for reduction of chemical inputs.</i>               | -                  |
| Publications          | -       | -                  | -                                                                                                      | -                  |
| Conferences/Workshops | UCSC    | Technical workshop | Perspectives on soil management in olive groves: results of a meta-analysis from the NOVATERRA project | Online, 20/01/2023 |



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## Task 4.2 Overcome current limitations in soil management strategies

Task Leader: UBU; Partners: UCSC, CORTEVA, IRTA, IPB, MYROLION, TERRAS. Task duration: M06 to M24

Specific experiments to overcome known limitations of some soil management strategies:

- Subtask 4.2.1: Combine cover crops with conservation biological control; Task Leader: IPB
- Subtask 4.2.2: Optimize fertilization to reduce the grass cover impact on crop yield and vigor; Task Leader: CORTEVA
- Subtask 4.2.3: Manage the pruning wood for reducing the inoculum of wood pathogens and increase biodiversity; Task Leader: UCSC

**Deliverable:** submitted in January 2023



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## Task 4.2 Overcome current limitations in soil management strategies

### Subtask 4.2.1 (Task Leader: IPB; Partners Involved: IRTA)

Identify and managing plant species that can be used as permanent grassing or cover crops and floral margins to combine advantages of soil cover and conservation biological control practices (conserving natural enemies and enhance their efficacy).

#### Materials and Methods

Activity 1: plant species identification in selected olive groves and sampling of arthropod community present in ground cover vegetation using an entomological net (natural enemies were selected in the laboratory).

Activity 2: olfactometer response with potential predators of the olive grove (Chrysopidae and Syrphidae) with ground cover vegetation plants (Brassicaceae, Cichorioideae and Apiaceae).



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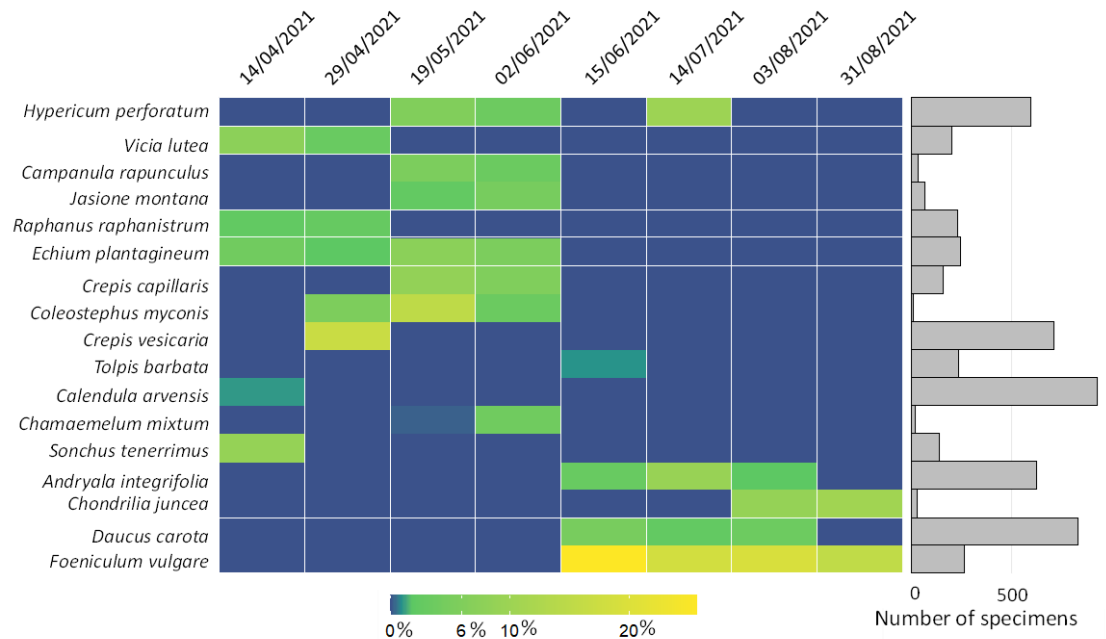
## Task 4.2 Overcome current limitations in soil management strategies

### Subtask 4.2.1 (Task Leader: IPB; Partners Involved: IRTA)

#### Main results

Activity 1: the cover crop native plants contained almost all the canopy olive pest predators; the species of Asteraceae flowered sequentially throughout the season and showed a high diversity of arthropods, mainly Coleoptera, Chrysopidae, and Syrphidae; *Daucus carota* and *Foeniculum vulgare* showed a high abundance and diversity of Chrysopidae, Coccinellidae, Araneae, and Formicidae.

Activity 2: the volatile compounds of some plants attract exert influence in the attraction / repulsion of natural enemies and pests.



The NOVATERRA project has received funding from the European Union

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## Task 4.2 Overcome current limitations in soil management strategies

### Subtask 4.2.1 (Task Leader: IPB; Partners Involved: IRTA)

|                       | Partner  | Type                                                                                             | Title                                                                                                                                                     | Location - Date                                   |
|-----------------------|----------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Practice abstracts    | IRTA     |                                                                                                  | <i>Characterizing wildflowers in olive orchards to enhance biological control</i>                                                                         | Tarragona (Spain) (June 2024)                     |
| Publications          | -        | -                                                                                                | -                                                                                                                                                         | -                                                 |
| Conferences/Workshops | IRTA     | Poster at "XIII Congreso Nacional de Entomología Aplicada (XIX Jornadas Científicas de la SEEA)" | <i>Caracterización floral de olivares en el sur de Tarragona para la mejora del control biológico por conservación</i>                                    | Gijon (Spain) (3rd-7th October 2024)              |
|                       | IPB/CIMO | Poster at "IX Simpósio Nacional de Olivicultura"                                                 | <i>Existem associações específicas entre artrópodes e plantas em floração no olival transmontano?</i>                                                     | Oeiras, Portugal – October 25th to 27th, 2021     |
|                       | IPB/CIMO | Oral Communication at "9th IOBC-WPRS Meeting on Integrated Protection of Olive Crops"            | <i>A selection of wild flowers to enhance Prays oleae natural enemies</i>                                                                                 | Lisbon, Portugal – October 26th to 29th, 2021     |
|                       | IPB/CIMO | Oral Communication at "12º Encontro Nacional de Proteção Integrada"                              | <i>Forficula auricularia L. (Dermaptera: Forficulidae) como potencial predador da mosca-da-azeitona</i>                                                   | Portalegre, Portugal - October 30th to 31st, 2023 |
|                       | IPB/CIMO | Poster at "XIII Congreso Nacional de Entomología Aplicada (XIX Jornadas Científicas de la SEEA)" | <i>Influencia del manejo de la cubierta vegetal en la abundancia de las principales plagas del olivo y sus enemigos naturales.<br/>Proyecto NOVATERRA</i> | Gijón, Spain - October 7th to 11th, 2024          |



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## Task 4.2 Overcome current limitations in soil management strategies

**Subtask 4.2.2** (Task Leader: CORTEVA; Partners Involved: UBU, UCSC, TERRAS, MYROLION)

Adapt the Optinyte™ technology to grapevine and olive crops.

Optinyte™ technology (CORTEVA) contains Nitrapyrin, a nitrogen stabilizer, which is proven to minimize nitrogen loss by keeping nitrogen in the root zone, providing better crop utilization, and helping to maximize crop yield.

### Materials and methods

- Field tests: 100% N; 70%N+Instinct; 60%N+Instinct+Bios\_0026/Bios\_0009
- INSTINCT applied to soil @1 L/ha to cover 40% of the total surface (band around the plant).
- Biostimulants: Utrisha Rhizo@1 Kg/ha applied to soil same day as INSTINCT or Utrisha N@333-500 g pr/ha, foliar applied, approx one month after INSTINCT application
- Each location with 4 replicates; 10-20 plants per sub-plot.
- Vines - 6 locations tested: 1/6 in 3 consecutive years (2021,2022,2023, Spain); 3/6 in 2 consecutive years (2021, 2022 – 2 in Italy and 1 in Spain); 2/6 only in 2023 (France).
- Olives - 4 locations tested, all of them 2 years in a row (1 Spain, 2 in Italy and 1 Greece).



## Task 4.2 Overcome current limitations in soil management strategies

**Subtask 4.2.2** (Task Leader: CORTEVA; Partners Involved: UBU, UCSC, TERRAS, MYROLION)

### Main results

Vines: From the 11 tests, 8 did not show statistical differences among any treatments while in 2 of them, 70% fertilization + INSTINCT or 60% N fertilization + INSTINCT + biostimulants were statistically similar to 100% N and superior to UTC. In 1 test reductions of 30-40% in N input were not compensated by INSTINCT or INSTINCT + Bio\_0009.

Olives: In 7 out of the 9 tests, 70% fertilization + INSTINCT performed numerically better or equal to 100% Fertilization. In Greece, 40% reduction was not compensated by INSTINCT + biostimulants.

**The N reduction is possible without losing yield quantity when stabilizing the N in the root zone with INSTINCT (+biostimulants). The factors behind the success or the failure of this management practices and the implications at quality level still need to be investigate.**



## Task 4.2 Overcome current limitations in soil management strategies

### Subtask 4.2.2 (Task Leader: CORTEVA; Partners Involved: UBU, UCSC, TERRAS, MYROLION)

|                       | Partner               | Type                                                                                                   | Title                                                                                                                   | Location - Date                                                                                                                    |
|-----------------------|-----------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Practice abstract     | TERRAS GAUDA          | -                                                                                                      | <i>Balancing sustainability and productivity: Striving for sustainable vineyard fertilisation</i>                       | April 2024                                                                                                                         |
|                       | UNIVERSIDAD DE BURGOS | -                                                                                                      | <i>Improvement of soil health and quality in Mediterranean vineyards</i>                                                | -                                                                                                                                  |
|                       | CORTEVA               | -                                                                                                      | <i>INSTINC™: OPTIMISING crop yield with innovative technologies</i>                                                     | December 2023                                                                                                                      |
| Publications          | UNIVERSIDAD DE BURGOS | Book Chapter - Book of Extended Abstracts<br><br>ISBN: 9782832512258<br>DOI: 10.3389/978-2-8325-1225-8 | <i>Novaterra project: Increasing sustainability in viti culture using novel fertilization and management Strategies</i> | July 21–22, 2022, Porto, Portugal<br>International Conference on Smart and Circular Agriculture towards Sustainability (SCAS 2022) |
| Conferences/Workshops | UNIVERSIDAD DE BURGOS | Technical Workshop                                                                                     | <i>Experiencias sostenibles en viñedo: Proyecto H2020 NOVATERRA y proyecto LIFE-GAIA Sense</i>                          | Burgos, Spain - December 16th 2021                                                                                                 |



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## Task 4.2 Overcome current limitations in soil management strategies

### Subtask 4.2.2 (Task Leader: CORTEVA; Partners Involved: UBU, UCSC, TERRAS, MYROLION)

|                       | Partner               | Type                                                                                                                | Title                                                                                                                                                | Location - Date                    |
|-----------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Conferences/Workshops | UNIVERSIDAD DE BURGOS | XXVIII Congreso Nacional de la Sociedad Española de Microbiología, S.E.M. - Oral communication                      | <i>Microbiología Agroalimentaria: mejora de la calidad de uva mediante el empleo de bioproductos de origen microbiano (Proyecto H2020 NOVATERRA)</i> | On line – June 28th – July 02 2021 |
|                       | UNIVERSIDAD DE BURGOS | II Congreso Gestión sostenible del suelo: "Nuevas estrategias para mejorar la salud del suelo" - Oral communication | <i>Investigación e innovación en la Universidad de Burgos para una agricultura sostenible (Proyecto NOVATERRA)</i>                                   | Burgos, Spain – October 10th 2023  |
|                       | UNIVERSIDAD DE BURGOS | XXIX Congreso Nacional de la Sociedad Española de Microbiología, S.E.M. - Poster communication                      | <i>Proyecto EU – H2020 NOVATERRA: Optimización y aplicación de biofertilizantes y bioestimulantes en la fertilización de cultivos mediterráneos</i>  | Burgos, Spain - July 25-28th 2023  |
|                       | UNIVERSIDAD DE BURGOS | International Congress TerraEnVision – Session organizer - Poster                                                   | <i>NOVATERRA Project: multidisciplinary and international consortium to enhance sustainable production in vineyard and olive groves</i>              | Valencia, Spain - July 8-11th 2024 |



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## Task 4.2 Overcome current limitations in soil management strategies

### Subtask 4.2.3. (Task Leader: UCSC)

In situ composting of pruning wood in small-scale experiments (years 1 and 2), comparison of the microbial communities in:

- wood residues left on soil,
- incorporated in soil,
- composted as they are or with a microbial starter obtained from the soil microbiome.

### Materials and methods

Experiment 1: evaluation of the effect of the high temperatures reached in the compost on the viability of some wood pathogens. Pieces of pruned wood collected from non-symptomatic plants were sterilized, inoculated with *Phaeomoniella chlamydospora*, *Phaeoacremonium minimum*, and *Cadophora luteo-olivacea*, incubated for a month at 25°C and exposed to a heat treatment at 60°C or left at 25° C. Experiment 2: comparison of traditional practices for pruning wood management with composting, evaluating their effect on the presence and viability of pathogenic populations and the microbial community in general.



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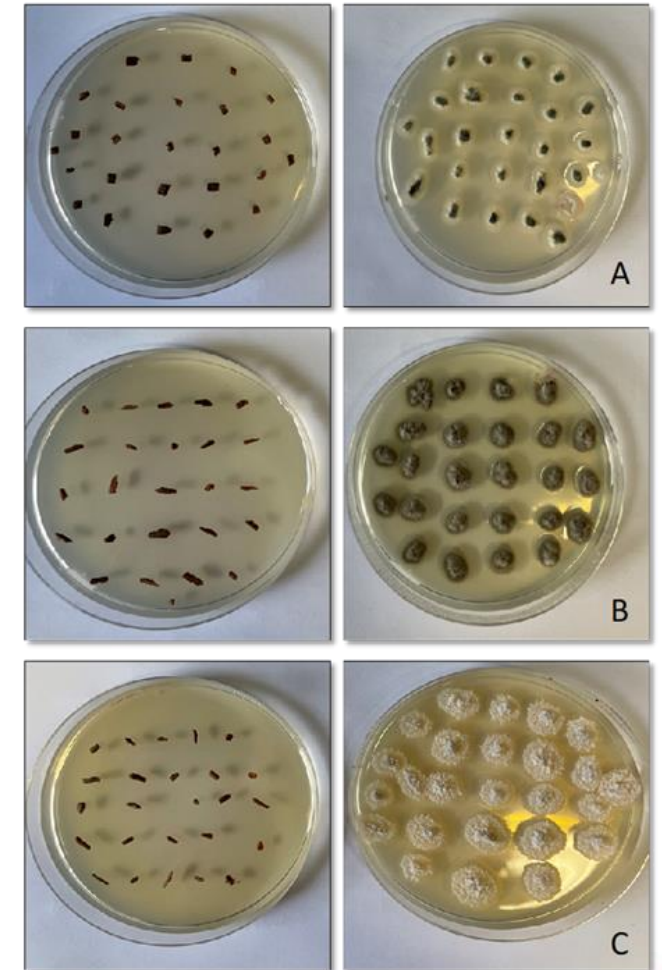
## Task 4.2 Overcome current limitations in soil management strategies

### Subtask 4.2.3. (Task Leader: UCSC)

#### Main results

The heat treatment caused, after 5 days of exposure, the complete devitalization of the pathogens. Composting significantly reduced both the quantity and viability of fungal species associated with wood diseases.

**The high temperature reached during the composting has the potential of reducing the inoculum of wood pathogens in pruning residue, so contributing to the reduction of inoculum into the vineyard.**



## Task 4.2 Overcome current limitations in soil management strategies

### Subtask 4.2.3. (Task Leader: UCSC)

|                       | Partner | Type                          | Title                                                                                                | Location - Date             |
|-----------------------|---------|-------------------------------|------------------------------------------------------------------------------------------------------|-----------------------------|
| Practice abstract     | UCSC    | -                             | <i>Manage the pruning wood for reducing the inoculum of wood pathogens and increase biodiversity</i> | -                           |
| Publications          | UCSC    | Technical paper               | <i>Compostaggio del legno di potatura della vite: effetti sui patogeni del legno e biodiversità</i>  | Bologna, Italy - March 2024 |
| Conferences/Workshops | UCSC    | Technical conference - poster | <i>Compostaggio del legno di potatura della vite: effetti sui patogeni del legno e biodiversità</i>  | Bologna, Italy - March 2024 |



## Task 4.3 Test the innovative soil management strategies

Task Leader: IPB; Partners: UCSC, TERRAS, UBU, IRTA, MYROLION. Task duration: M12 to M36

Test the innovative strategies in olive groves and vineyards in comparison with the common practice:

- ✓ Subtask 4.3.1: Use of cover crops and floral margins to enhance biological control of pests in vineyards and olive groves; Task Leader: IPB; TERRAS, UBU, UCSC, MYROLION, IRTA
- ✓ Subtask 4.3.2: Combine cover crops and optimized fertilization plans to improve plant health in vineyards and olive groves; Task Leader: CORTEVA; UBU, UCSC, TERRAS, MYROLION
- ✓ Subtask 4.3.3: Soil management for disease control in vineyards; Task Leader: UCSC

**Deliverable:** pending



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## Task 4.3 Test the innovative soil management strategies

### Subtask 4.3.1 (Task Leader: IPB; Partners Involved: TERRAS, UBU, UCSC, MYROLION, IRTA)

Comparison of pest management in orchards with:

- natural cover ground + natural shrub margins + very low chemical pressure;
- selected species for cover ground + natural shrub margins + very low chemical pressure;
- bare ground + conventional insecticide program.

#### Materials and methods

Olive groves: three different soil management were carried, Tilling (T), Natural Vegetation (N), and Sown Vegetation (S) with margins. Plants, pests (*Prays oleae*, *Bactrocera oleae*, and *Saissetia oleae*), and natural enemies (predators and parasitoids of *P. oleae*, *B. oleae*, and *S. oleae*) were evaluated per treatment.

Vineyards: four different soil management were carried, Control, Natural Green Cover, Seeded Green Cover, and Floral Green Cover with margins. Plants, pests, and natural enemies (predators) were evaluated per treatment.



## Task 4.3 Test the innovative soil management strategies

### Subtask 4.3.1 (Task Leader: IPB; Partners Involved: TERRAS, UBU, UCSC, MYROLION, IRTA)

#### Main results

##### Olive groves:

- *Prays oleae* - at both years and countries, the dynamics of adult flight have the same gaits at all treatments, and larval parasitism was low and only checked in Portugal;
- *Bactrocera oleae* - in both years and across all countries, the number of adults recorded and the infestation percentage of fruits was very low;
- *Saissetia oleae* - no population was found in any of the olive groves;

Vineyards: the abundance of plants present in the covers of the different treatments was different, with more diversity of plants in the sown cover crop treatments.

**In general, Natural (N) and Sown (S) cover crops increase the abundance and biodiversity of arthropod natural enemies, while pest dynamics and abundance are not negatively affected compared to tilling cover crops.**



## Task 4.3 Test the innovative soil management strategies

### Subtask 4.3.1 (Task Leader: IPB; Partners Involved: TERRAS, UBU, UCSC, MYROLION, IRTA)

|                   | Partner               | Type | Title                                                                                                                                                                | Location - Date |
|-------------------|-----------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Practice abstract | TERRAS GAUDA          |      | <i>How we can improve pest control and vineyard health through green and flower covers.</i>                                                                          | March 2022      |
|                   | UNIVERSIDAD DE BURGOS | -    | <i>Importance of cover crops and floral margins in vineyards</i>                                                                                                     | -               |
|                   | UNIVERSIDAD DE BURGOS | -    | <i>Effectiveness of incorporating cover crops for more sustainable soil management in Mediterranean vineyards</i>                                                    | -               |
|                   | MYROLION              | -    | <i>Testing of innovative soil management strategies - Use of cover crops and floral margins to enhance biological control of pests in vineyards and olive groves</i> |                 |
| Publications      | -                     | -    | -                                                                                                                                                                    | -               |



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## Task 4.3 Test the innovative soil management strategies

### Subtask 4.3.1 (Task Leader: IPB; Partners Involved: TERRAS, UBU, UCSC, MYROLION, IRTA)

|                       | Partner               | Type                                                                                     | Title                                                                                                                                   | Location - Date                             |
|-----------------------|-----------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Conferences/Workshops | UNIVERSIDAD DE BURGOS | Technical Workshop                                                                       | <i>Nuevas estrategias biotecnológicas en producción sostenible</i>                                                                      | Burgos, June 10th 2024                      |
|                       | UNIVERSIDAD DE BURGOS | X Simposio Nacional sobre Control de la Degradación y Recuperación de Suelo -CONDEGRES24 | <i>Contribución de las cubiertas vegetales a la salud de los suelos de un viñedo de la D.O. Ribera del Duero</i>                        | Burgos, June 24-27th 2024                   |
|                       | UNIVERSIDAD DE BURGOS | International Congress TerraEnVision – Session organizer - Poster                        | <i>NOVATERRA Project: multidisciplinary and international consortium to enhance sustainable production in vineyard and olive groves</i> | Valencia, Spain - July 8-11th 2024          |
|                       | IPB/CIMO              | Open Day                                                                                 | <i>Open day in the olive grove</i>                                                                                                      | Bragança, Portugal – 22nd May 2023          |
|                       | IPB/CIMO              | Open Day                                                                                 | <i>II Open day in the olive grove</i>                                                                                                   | Bragança, Portugal – 16th April 2024        |
|                       | IPB/CIMO<br>SOGRAPE   | Summer School                                                                            | <i>SusTEC Summer School - Abordagem integral na proteção da vinha e olival: O projeto NOVATERRA</i>                                     | Bragança, Portugal – 17th to 20th July 2023 |



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## Task 4.3 Test the innovative soil management strategies

**Subtask 4.3.2** (Task Leader: CORTEVA; Partners Involved: IPB, UBU, TERRAS)

Efficacy of the Optinyte™ technology (either incorporated into the soil or applied through irrigation) on soil parameters and plant development in large scale field trials.

### Materials and methods

- INSTINCT applied to soil @1 L/ha to cover 40% of the total surface (band around the plant).
- BIO\_STML\_0009@500 g pr/ha, was included in PT trials
- Each location with 4 replicates; 10-20 plants per sub-plot.
- Vines – 4 trials: 2 locations tested in 2 consecutive years (2022,2023, Spain)
- Olives – 2 trials: 1 location tested, in 2 consecutive years (2022,2023, Portugal)



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## Task 4.3 Test the innovative soil management strategies

**Subtask 4.3.2** (Task Leader: CORTEVA; Partners Involved: IPB, UBU, TERRAS)

### Main results

Vines: cover factor was always significant but direction differed depending on the location: Burgos higher yield without cover and Galicia higher yield with cover, probably related with no water limitation in the last case. Regarding the INSTINCT effect, in 2 trials, no significant differences were seen among treatments in Kg/plant including the untreated. In 1 trial, the addition of INSTINC to 70% N, statistically increased the Kg/plant in regard to UTC and 100% N.

Olives: in Portugal, whether in 2022 or 2023, no statistical difference between treatments was seen including UTC, 30% and 100%N fertilization. However, numerically, it was seen that the addition of INSTINCT with only 30% N and cover crop was negative. The addition of BIO\_STML\_0009 gave the highest numerical increase within cover crop.

**Therefore, the N reduction is possible without losing yield quantity when stabilizing the N in the root zone with INSTINCT (+ biostimulants). Most probably the objective should be 20-30% reduction depending on different factors as the presence of cover crop.**



## Task 4.3 Test the innovative soil management strategies

**Subtask 4.3.2** (Task Leader: CORTEVA; Partners Involved: IPB, UBU, TERRAS)

|                       | Partner               | Type                                                                                                   | Title                                                                                                                   | Location - Date                                                                                                                    |
|-----------------------|-----------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Practice abstract     | TERRAS GAUDA          | -                                                                                                      | <i>Balancing sustainability and productivity: Striving for sustainable vineyard fertilisation</i>                       | April 2024                                                                                                                         |
|                       | UNIVERSIDAD DE BURGOS | -                                                                                                      | <i>Improvement of soil health and quality in Mediterranean vineyards</i>                                                | -                                                                                                                                  |
|                       | CORTEVA               | -                                                                                                      | <i>INSTINC™: OPTIMISING crop yield with innovative technologies</i>                                                     | December 2023                                                                                                                      |
| Publications          | UNIVERSIDAD DE BURGOS | Book Chapter - Book of Extended Abstracts<br><br>ISBN: 9782832512258<br>DOI: 10.3389/978-2-8325-1225-8 | <i>Novaterra project: Increasing sustainability in viti culture using novel fertilization and management Strategies</i> | July 21–22, 2022, Porto, Portugal<br>International Conference on Smart and Circular Agriculture towards Sustainability (SCAS 2022) |
| Conferences/Workshops | UNIVERSIDAD DE BURGOS | Technical Workshop                                                                                     | <i>Experiencias sostenibles en viñedo: Proyecto H2020 NOVATERRA y proyecto LIFE-GAIA Sense</i>                          | Burgos, Spain - December 16th 2021                                                                                                 |



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## Task 4.3 Test the innovative soil management strategies

### Subtask 4.3.2 (Task Leader: CORTEVA; Partners Involved: IPB, UBU, TERRAS)

|                       | Partner               | Type                                                                                                                | Title                                                                                                                                                | Location - Date                    |
|-----------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Conferences/Workshops | UNIVERSIDAD DE BURGOS | XXVIII Congreso Nacional de la Sociedad Española de Microbiología, S.E.M. - Oral communication                      | <i>Microbiología Agroalimentaria: mejora de la calidad de uva mediante el empleo de bioproductos de origen microbiano (Proyecto H2020 NOVATERRA)</i> | On line – June 28th – July 02 2021 |
|                       | UNIVERSIDAD DE BURGOS | II Congreso Gestión sostenible del suelo: "Nuevas estrategias para mejorar la salud del suelo" - Oral communication | <i>Investigación e innovación en la Universidad de Burgos para una agricultura sostenible (Proyecto NOVATERRA)</i>                                   | Burgos, Spain – October 10th 2023  |
|                       | UNIVERSIDAD DE BURGOS | XXIX Congreso Nacional de la Sociedad Española de Microbiología, S.E.M. - Poster communication                      | <i>Proyecto EU – H2020 NOVATERRA: Optimización y aplicación de biofertilizantes y bioestimulantes en la fertilización de cultivos mediterráneos</i>  | Burgos, Spain - July 25-28th 2023  |
|                       | UNIVERSIDAD DE BURGOS | International Congress TerraEnVision – Session organizer - Poster                                                   | <i>NOVATERRA Project: multidisciplinary and international consortium to enhance sustainable production in vineyard and olive groves</i>              | Valencia, Spain - July 8-11th 2024 |



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## Task 4.3 Test the innovative soil management strategies

### Subtask 4.3.3 Task Leader: UCSC

In this subtask, results from subtask 4.2.3 are being tested for a 2-year period, at large-plot scale in 2 vineyards.

Conventional residue management is compared with composting and redistribution on the soil surface.

The aerial microbiome composition is evaluated using spore traps and molecular analysis.

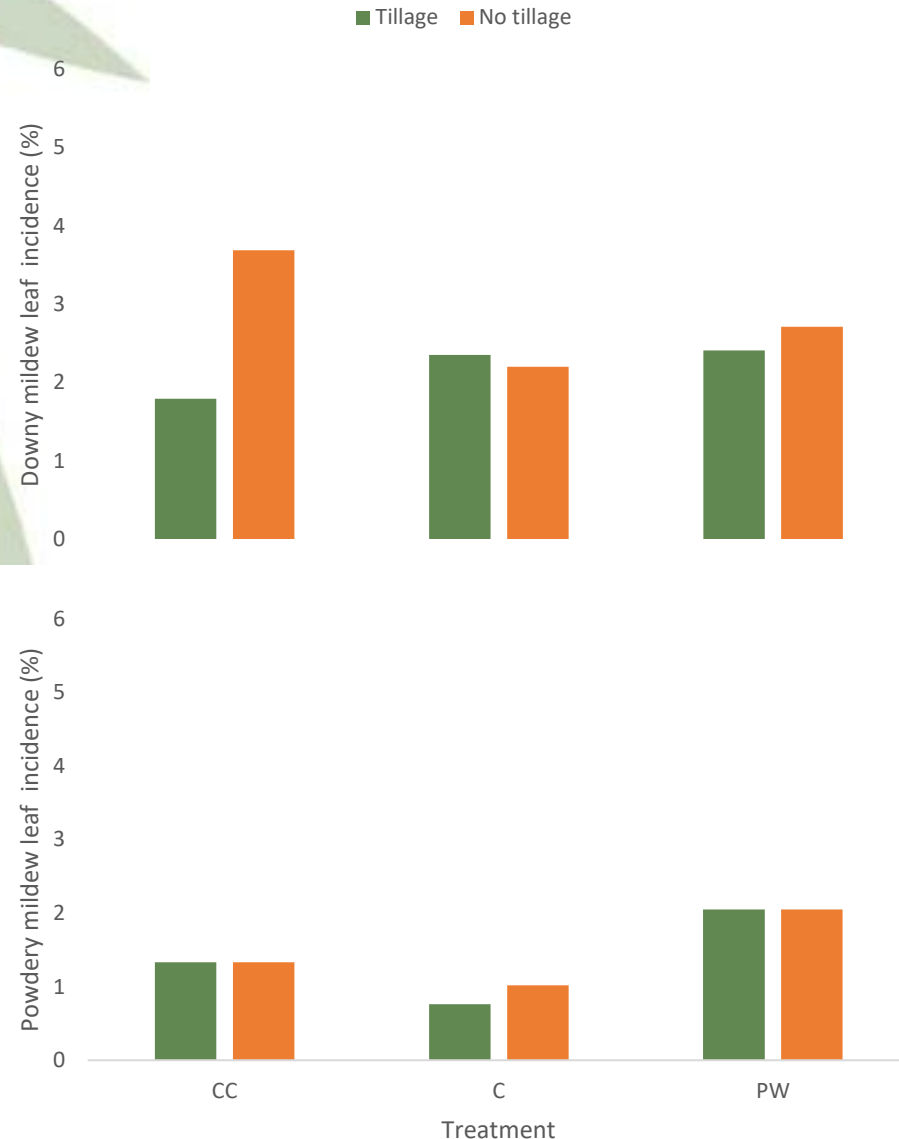
### Materials and methods

Evaluation of the effect of different soil management practices on disease management in vineyards:

- Conventional: Crumbling pruning wood (PW)
- Innovative: Temporary Cover Crops (CC) and Tilled Soil + Compost (C).



## Task 4.3 Test the innovative soil management strategies



### Main results

The innovative technique of in-farm composting and redistribution on the soil surface could reduce the spread of Downy and Powdery mildews and Black Rot. There was a general increase in the airborne biodiversity when cover crops and composting were used.

There was a significant reduction in bunches weight when the innovative techniques were compared with the conventional in the tillage vineyard.



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## Task 4.4 Develop cost effective robot with end-effector for soil management

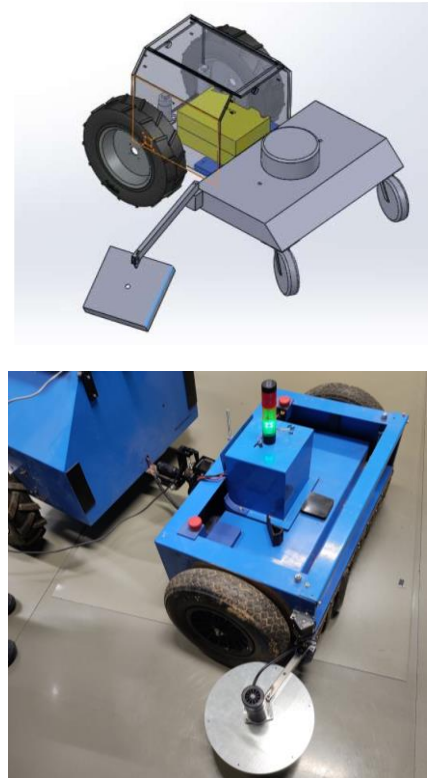
Task Leader: INESC TEC; Partners: UBUCOMP, TERRAS, SOGRAPE. Task duration: M3 to M20

A **modular cost-effective robot** for soil monitoring and work, capable to work in steep slope farms and compatible with the new agronomic approaches proposed in T4.

This mowing robot is extended:

- by **advanced soil sensors** (Soil Apparent Electrical Conductivity (ECa) (AGRAE), and NPK optical sensor) developed under the SMARTFERTILIZERS project. - problem of soil sensing;
- with a **smart mechanical end tool** with **precision spraying nozzles and electrical weed removal**, for weeds removal/control and precision soil fertilization/treatment;
- **Validate the robotic solution;**
- Deploy in long term (Sogrape, Terras Gauda M20-M36)
- Added fertilizers – under project Vine&Wines

**Deliverable:** submitted in March 2021



## Task 4.4 Develop cost effective robot with end-effector for soil management

Task Leader: INESC TEC; Partners: UBUCOMP, TERRAS, SOGRAPE. Task duration: M3 to M20



The **advancement in the robotic end-tool design** made the present solution **more adapted to real-world situations** providing market value and a unique selling proposition for future exploitation.



*Photographic records Before and after mechanical weed control within the grapevine rows (A. inter-row; B. intra-row).*

The development of a **modular cost-effective robot for mechanical weed removal**, mainly in the **intra-row area**, with **high levels of accuracy** for do not damage the **trunk/crop** is still in the **process of improvement**.



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## Task 4.4 Develop cost effective robot with end-effector for soil management

Task Leader: INESC TEC; Partners: UBUCOMP, TERRAS, SOGRAPE. Task duration: M3 to M20

|                   | Partner | Type | Title                                                                                                   | Location - Date |
|-------------------|---------|------|---------------------------------------------------------------------------------------------------------|-----------------|
| Practice abstract | SOGRAPE | -    | <i>Robotic systems for mechanical weed removal as a new soil management strategy on slope vineyards</i> | November 2023   |
| Publications      | -       | -    | -                                                                                                       | -               |
| Conferences       | -       | -    | -                                                                                                       | -               |



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## Task 4.5 Development and implementation of a DSS for integrated soil management strategies

Task Leader: HORTA; Partners: UCSC, IPB, UBU, IRTA, INESTEC, TERRAS, SOGRAPE, CORTEVA. Task duration: M24 to M36

Within LIFE+ SOIL4WINE project, HORTA developed an ICT tool for soil management in vineyards: the tool considered mainly agronomic aspects (e.g., erosion, decline of organic matter, water stagnation, etc).

Within NOVATERRA project, the tool was revised and modified to:

- 1) better respond to DSS users' needs,
- 2) consider aspects related to disease and pest management.

The Tool was also extended to olive groves in order to have a DSS functionality for overall sustainable management of soil in vineyards and olive groves.

**Deliverable:** submitted in February 2024



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## Task 4.5 Development and implementation of a DSS for integrated soil management strategies

1. Collects site specific characteristics

**HORT@ olivo.net**

Private services / Services Horta S.r.l. / Olive supply chain / Olivo.net

**Save Undo**

General

Characteristics of the olive grove

Production destination ●

Prevailing variety ●

Cropping system ●

Training system ●  ?

Plants arrangement ●

Row orientation ●

Average plant height (m) ●  ?

Average foliage distance from ground (m) ●  ?

Average foliage height (m)

Average foliage thickness (m)  ?

Foliage density ●

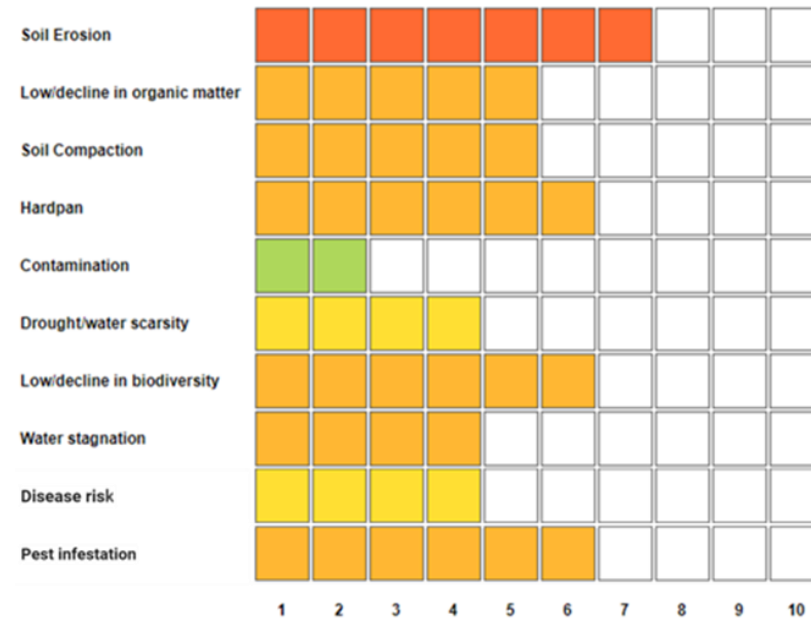
Pruning ●

Pruning frequency ●

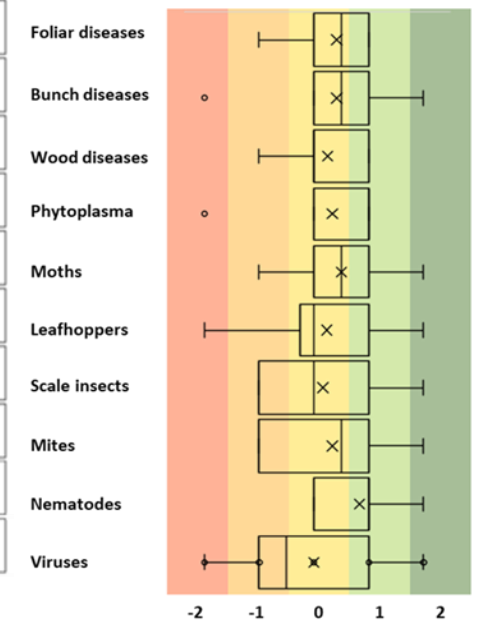
Return of residues ●

2. Calculates impact of the soil management strategy on potential soil threats and diseases and pests' categories

ASSESSMENT OF POTENTIAL THREATS



ASSESSMENT OF POTENTIAL DISEASES RISK AND PEST INFESTATION



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## Task 4.5 Development and implementation of a DSS for integrated soil management strategies

### 3. Suggest best mitigation activities to reduce soil threats potential and diseases and pests risk

MITIGATION ACTIONS MATRIX

| Threat                                                  |   | ERO | SOM | COMP | HARD | CONT | WSCARS | BIO | WSTAGN |
|---------------------------------------------------------|---|-----|-----|------|------|------|--------|-----|--------|
| Potential index                                         |   |     |     |      |      |      |        |     |        |
| Assessment                                              |   | NP  | NP  | NP   | NP   | n.c. | NP     | NP  | NP     |
| Temporary cover crop / legumes green manure             | ? |     |     |      |      |      |        |     |        |
| Temporary cover crop / Brassica sp. green manure        | ? |     |     |      |      |      |        |     |        |
| Temporary cover crop / gramineaceous sp. green manure   | ? |     |     |      |      |      |        |     |        |
| Permanent spontaneous grassing                          | ? |     |     |      |      |      |        |     |        |
| Permanent artificial grassing                           | ? |     |     |      |      |      |        |     |        |
| Organic amendment                                       | ? |     |     |      |      |      |        |     |        |
| Change in no. of PPP treatments                         | ? |     |     |      |      |      |        |     |        |
| Change in soil management actions (equipment and depth) | ? |     |     |      |      |      |        |     |        |
| Underground drainage system                             | ? |     |     |      |      |      |        |     |        |
| Superficial drainage adjustments                        | ? |     |     |      |      |      |        |     |        |
| Organic mulching                                        | ? |     |     |      |      |      |        |     |        |

#### LEGEND

High efficacy
  Medium efficacy
  Low efficacy
  Not suggested
  No efficacy

|                                 |                                     | FOLIAR DISEASES     |                  |
|---------------------------------|-------------------------------------|---------------------|------------------|
|                                 |                                     | Plasmopara viticola | Erysiphe necator |
| Soil management                 | Grassing                            |                     |                  |
|                                 | Cover crops (soil health)           |                     |                  |
|                                 | Cover crops (floral)                |                     |                  |
|                                 | Tillage                             |                     |                  |
|                                 | Weeding (chemical)                  |                     |                  |
|                                 | Weeding (mechanical)                |                     |                  |
|                                 | Mulching                            |                     |                  |
|                                 | Grassing                            |                     |                  |
|                                 | Tillage                             |                     |                  |
|                                 | Weeding (chemical)                  |                     |                  |
| Management of pruning residues  | Weeding (mechanical)                |                     |                  |
|                                 | Mulching                            |                     |                  |
|                                 | Left on the ground                  |                     |                  |
|                                 | Chopped on the surface              |                     |                  |
| Fertilisation                   | Chopped and buried                  |                     |                  |
|                                 | Removed                             |                     |                  |
|                                 | Composted                           |                     |                  |
| Functional (plant) biodiversity | None                                |                     |                  |
|                                 | Organic                             |                     |                  |
|                                 | Mineral                             |                     |                  |
|                                 | Floral margins                      |                     |                  |
|                                 | Within field floral resources       |                     |                  |
|                                 | Within field aromatic plants        |                     |                  |
| Functional (soil) biodiversity  | Hedgerows                           |                     |                  |
|                                 | Shrubs at row ends                  |                     |                  |
|                                 | None                                |                     |                  |
|                                 | Mychorrizal fungi                   |                     |                  |
|                                 | Plant resistance inducers           |                     |                  |
|                                 | Multi-function microbial inoculants |                     |                  |
|                                 | None                                |                     |                  |



## Task 4.5 Development and implementation of a DSS for integrated soil management strategies

Task Leader: HORTA; Partners: UCSC, IPB, UBU, IRTA, INESTEC, TERRAS, SOGRAPE, CORTEVA. Task duration: M24 to M36

|                        | Partner              | Type            | Title                                                                          | Location - Date |
|------------------------|----------------------|-----------------|--------------------------------------------------------------------------------|-----------------|
| Practice abstract      | HORTA                |                 | <i>A tool for soil management in vineyards and olive groves</i>                | April 2024      |
| Conferences/ Workshops | HORTA, UNAPROL, UCSC | workshop online | <i>Precision agriculture for the sustainable management of the olive grove</i> | 20 January 2023 |
|                        | HORTA, UCSC          | workshop online | <i>L'USO DEI DSS NEI PROGRAMMI DI SOSTEGNO ALLA FILIERA OLIVICOLA</i>          | 7 November 2023 |
|                        | HORTA, UNAPROL, UCSC | workshop online | <i>Gestione dell'oliveto tra presente e futuro – il progetto NOVATERRA</i>     | 16 May 2024     |



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# KPI

| KPI NUM | LINK TO TASK         | DESCRIPTION                                                              | OBJECTIVE                                                                                                           | MONITORING METHODS AND TOOLS | PARTNER IN CHARGE |
|---------|----------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------|-------------------|
| KPI.15  | Task 4.2<br>Task 4.3 | Trials using new soil management strategies                              | 90% of trials to achieve reliable results                                                                           | Case study report            | UCSC / IPB        |
| KPI.16  | Subtask 4.2.3        | Efficacy of composting on viability pathogen's inoculum                  | Reduction in 50% pathogen population                                                                                | Case study report            | UCSC              |
| KPI.17  | Subtask 4.3.3        | Reduction in disease severity using the new soil management techniques   | Increase of 15% in soil C content<br>Reduction in disease severity in 15%<br>Reduction of yield and quality loss in | Case study report            | UCSC              |
| KPI.18  | Task 4.4             | Reduction of overdosage of Nitrogen using soil sensor robots             | Reduction of at least 20%                                                                                           | Case study report            | INESCTEC          |
| KPI.19  | Task 4.4             | Reduction of human labour costs on mowing operations using robotics      | Reduction of at least 50%                                                                                           | Case study report            | INESCTEC          |
| KPI.20  | Task 4.4             | Reduction of pesticides usage by using ultra precision robot for weeding | Reduction of at least 50%                                                                                           | Case study report            | INESCTEC          |



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## WP4: New soil management strategies for improving crop health with less chemicals

Thanks to all partners involved



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