Extended Practice Abstract Nº 10

New Practices in Rainfed Olive Groves – Adaptation to climate change

Short description of the OG

The OG's aim was to develop and optimise agronomic practices that can contribute to the mitigation of climate change, increasing carbon sequestration, biodiversity and the adaptation of rainfed olive groves to new climate conditions. The OG evaluated the effect of different natural and sown vegetation covers, the advantages of annual light pruning, different soil and foliar fertilization strategies, the use of mycorrhizal fungi, application of biochar and zeolites, the behaviour of the region's most representative varieties to different edaphoclimatic constraints, and the effect of different natural substances that induce resistance mechanisms with a protective effect against adverse environmental factors.

Benefits

Increase tree resilience to summer stress;
Improve soil fertility;
Improve water infiltration/holding capacity and decrease water loss through evaporation;
Increase productivity and production quality

Stage of implementation

Project tasks were finalised in 2022.

Key data box

Theme
Carbon sequestration, agricultural by-products, biodiversity, climate change adaptation, drought-resistant crops

Context
Extreme weather conditions in the northeast of Portugal; soils with poor organic matter content

Duration
52 months

Partners Involved
Academic Institutions: IPB and UTAD
Farmers' Associations: APPITAD, Centro de Gestão da Empresa Agrícola Vale do Tua and Centro de Gestão de Empresas Agrícolas Vimiosense
Farmers: Casa de Santo Amaro, Quinta Vale do Conde, Maria Domingos Carvalho, Almira dos Anjos Lopes Robalo Cordeiro and Maria dos Anjos Rosa Rodrigues

Budget
370 000 €

Main achieved or expected results

The introduction of short-cycle/natural reseeding leguminous cover crops, as well as the foliar application of kaolin, salicylic and abscisic acids, showed significant increases in production. Annual light pruning is recommended, using the 3-cut method to improve productivity and tree resilience. Inoculation with mycorrhizal fungi (MF) in pre-rooted cuttings reduced the initial growth due to competition for photoassimilates; in contrast, it increased the soil's organic carbon (OC) content. In very acidic soil, the

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application of mycorrhizal fungi and zeolites (ZL) at planting improved the growth of olive trees as a result of the improvement of water status, calcium (Ca) and magnesium (Mg) levels and photosynthetic activity. In adult olive groves, the application of biochar (BC) and ZL did not improve production but did increase OC and cation exchange capacity (CEC), which can benefit the system in the long term. Commercial MF showed no benefit. The role of boron (B) was demonstrated in protecting against extreme weather conditions as well as the need to avoid high doses of N, due to its negative effect on OC and glomalin in the soil and the quality of the olive oil produced. Mowed shredded wood (MSW) and manure applications, despite providing little N to trees, increased OC and levels of phosphorus and CEC, leaving good indications for future production cycles. No worrying levels of heavy metals were found in soils and plant tissues with the application of urban solid waste and biomass.

Existing materials

Further reading

Scientific papers:

http://dx.doi.org/10.5424/sjar/2013112-3501
http://dx.doi.org/10.1016/j.scienta.2013.04.035
http://dx.doi.org/10.5424/sjar/2015132-6252
DOI: 10.3232/SJSS.2019.V9.N3.04
doi:10.3390/su122410630
https://doi.org/10.1016/j.scienta.2020.109712
https://doi.org/10.1016/j.scienta.2020.109795
https://doi.org/10.1007/s10705-021-10134-9
https://doi.org/10.3390/soilsystems5020030
https://doi.org/10.3390/agronomy11112172
https://doi.org/10.3390/soilsystems6010007
https://doi.org/10.3390/agriculture12020171
https://doi.org/10.3390/antiox11071332
https://doi.org/10.3390/molecules28020831
https://doi.org/10.3390/horticulturae9010110
https://doi.org/10.3390/molecules28062545
DOI: 10.1111/sum.12948
https://doi.org/10.3390/agronomy13112674
https://doi.org/10.1016/j.scienta.2018.04.019
https://doi.org/10.3390/antiox11071332
https://doi.org/10.1016/j.scienta.2020.109795

Contact information

Publisher: APPITAD
Rua da República, à cocheira, nº 17 e 45, 5370-347 Mirandela
https://appitad.om
Author(s): APPITAD
Contact: inovacao@appitad.pt
Project partners: IPB, UTAD, APPITAD, Centro de gestão da empresa agrícola Vale do Tua, Centro de gestão de empresas agrícolas Vimiosense, Casa de Santo Amaro, Quinta Vale do Conde, Acushla, Manuel Domingos Carvalho, Almira dos Anjos Lopes Robalo Cordeiro, Maria dos Anjos Rosa Rodrigues

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Cover management in rainfed olive groves

Challenge

Tilling represents a risk of erosion, nutrient loss, increased soil temperatures and, consequently, soil water evaporation. Extreme weather conditions potentiate these effects, and thus there is a growing need to adapt the conventional agronomic practices used in rainfed olive orchards.

Solution

Cover management is a simple technique that consists of making use of natural or seeded vegetation, controlled by cattle herding or machinery, to protect the soil surface from being directly exposed to environmental conditions, contributing to soil fertilisation.

Benefits

It diminishes soil erosion risk, promotes biodiversity, increases carbon sequestration, improves soil fertility, prevents soil water content loss through evaporation and increases water holding capacity.

Applicability box

Theme
Drought-resistant crop
Biodiversity
Climate change adaptation
Climate-change mitigation
Erosion control

Context
Extreme weather conditions, high slope landscape, soils with poor organic matter contents

Application time
All year

Required implementation time
None/variable depending on the area and culture involved

Period of impact
All year

Equipment
Mower, shredder, tractor

Practical recommendation

A set of measures may be applied when deciding on managing the cover of an olive orchard. Next is a simple flowchart (Figure 1) that summarises the steps to take when deciding to opt for cover management in an olive grove. In Figure 2, a grove with natural cover managed by herding (a), mowing (b), and seeding (c) and (d) can be observed.

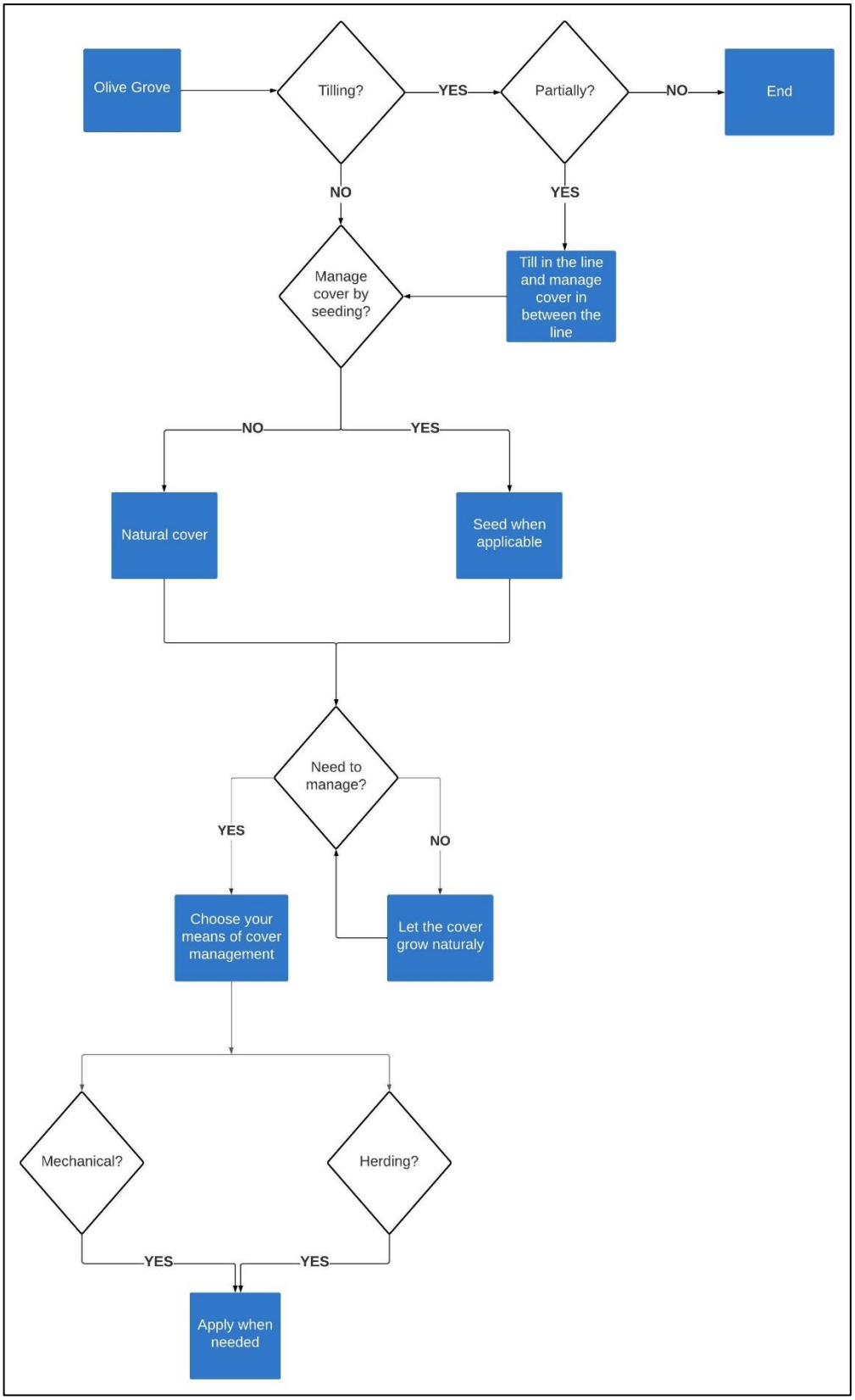

Figure 1. Flowchart on cover management

Figure 2. Natural covers managed by herding (a), mowing (b) and seeded covers (c) and (d).

Further information

Further reading

Scientific papers:

- DOI:10.5424/sjar/2015132-6252
- DOI: 10.1016/j.proenv.2015.07.213
- DOI: 10.1016/j.scienta.2013.04.035
- DOI: 10.1007/s10705-015-9730-5
- http://hdl.handle.net/10198/7910

Contact information

Publisher: APPITAD
Rua da República à Cocheira, nº 17, 5370-347 Mirandela
https://appitad.com/
Author(s): UTAD, IPB, APPITAD
Contact: inovacao@appitad.com

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Simplified cost/benefit analysis

Cover management in rainfed olive groves

Introduction – presentation of ex-ante and ex-post situation

The resilience of olive groves in the current climate change context demands immediate action from farmers. The ex-ante widespread adoption of traditional soil management practices, such as tillage for weed control, leaves an unprotected and bare soil during rainfall, wind and heat waves. In the Portuguese northeast region, there has been severe weather changes from softer winters to extreme heat waves during the summer causing a biological change in the olive trees cycle and consequent loss of productivity. It is a common practice to till 2-3 time a year leading to the worsening of the effects, on soil health (erosion, water holding capacity and biodiversity), of extreme weather conditions. A need for a change in the farmers' mindset is urgent. The ex-post situation (natural cover in row/inter-row, seeded inter-row, refers to a change in the cover management practice leading to a change in the soil's nutrition and thus a change in the fertilizer cost.

Economical costs and benefits

The values presented in the column ex-post refer to installation of the practice. The investment in seeds may not occur if the choice is spontaneous vegetation or, occur once at the year of installation. Costs tend to reduce in a long-term period and refer to machine and man work. The comparison in the last line of the table, is estimated after the first couple of year.

Legend

Estimated indicator

Measured indicator

	Ex-ante (€/ha)	Ex-post (€/ha)
Variable costs		
Inputs:		
Seeding/seeds	--	150
Fertilizers	150	100
Machine costs (fuel+depreciation+Manwork)	140	140
TOTAL	290	390
COMPARISON	Global improvement between 1 to 24% of the cost (explanations below): 	
Economical benefits: It will be more evident after the first couple of years. The need for nitrogen rich fertilizers will be lower. As for soil interventions, there is no change in the ex-ante and ex-post situation because the tilling hours will be mowing hours. In a long term period the mulching efect of the grass (spontaneous cover) might diminish the mowing hours. If herding the cover is an option, the mowing cost is eliminated.		

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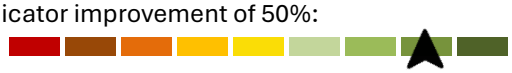
Environmental costs and benefits

Energy	Indicator approximate improvement of 15%: 
The indicator is estimated in a long-term period of time (3-4 years) and based on empirical knowledge of fuel consumption as after 3-4 years, the need for cover interventions will be less.	
Water	Indicator improvement of 50%: 
The type of crops considered is rainfed. A 50% improvement of soil moisture during the summer has been reported by Carlos M. Correia *et al* (1) at 10-20 cm depth.	
Soil	Indicator improvement of 15%: 
The indicator is estimated based on improvement in soil properties measured by Carlos M. Correa *et al* (1) at 10-20 cm depth.	
Air	Indicator approximate improvement of 15%: 
The indicator is estimated based on empirical knowledge. The presence of vegetation favours carbon sequestration and consequently increases air quality.	
Biodiversity	Indicator approximate improvement of 45% 
The indicator is estimated based on empirical knowledge of auxiliary fauna and flora preservation. A study by José Alberto Pereira *et al* (2) refers the benefits of biodiversity in spontaneous ground covers.	

Bibliography and references

(1). Sandra Martins, Cátia Brito, Ermelinda Silva, Alexandre Gonçalves, Margarida Arrobas, Ermelinda Pereira, Manuel Ângelo Rodrigues, Fernando M. Nunes and Carlos M. Correia; Synergy between Zeolites and Leguminous Cover Crops Improved Olive Tree Performance and Soil Properties in a Rainfed Olive Orchard; *Agronomy* ***2023****, 13, 2674*.

(2) Maria Villa, Sónia A. P. Santos, António Mexia, Albino Bento and José Alberto Pereira; Ground Cover Management Affects Parasitismo f Prays Oleae (Bernard); *BioControl* ***2016***, 96. 72.

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