



# Structure, management and productivity of hedgerow olive orchards: A review



David J. Connor<sup>a,\*</sup>, Maria Gómez-del-Campo<sup>b</sup>, M. Cecilia Rousseaux<sup>c</sup>, Peter S. Searles<sup>c</sup>

<sup>a</sup> School of Land and Environment, The University of Melbourne, Victoria 3010, Australia

<sup>b</sup> Dpto. Producción Vegetal: Fitotecnia, Universidad Politécnica de Madrid, Ciudad Universitaria sn., 28040 Madrid, Spain

<sup>c</sup> Centro Regional de Investigaciones Científicas y Transferencia Tecnológica de La Rioja (CRILAR-CONICET), Entre Ríos y Mendoza S/N, Anillaco (5301), La Rioja, Argentina

## ARTICLE INFO

### Article history:

Received 13 November 2013  
 Received in revised form 10 February 2014  
 Accepted 12 February 2014  
 Available online 14 March 2014

### Keywords:

Cultivar  
 Harvesters  
 Microclimate  
*Olea europaea* L  
 Orchard design  
 Orchard establishment  
 Orchard maintenance

## ABSTRACT

Olive was introduced into cultivation more than 3000 years ago, but only during the last two decades has cultivation shifted from low density to dense hedgerow orchards. This development responds to the need for mechanization to reduce production costs and achieve more timely management interventions. There is, however, little scientific or commercial knowledge available to support this new planting system in olive and to contribute to its development. This review focuses on what is known and what knowledge is required for design and management of hedgerow orchards for continuing productivity and economic viability. The review adopts a targeted approach based on consideration of the impact of orchard structure on microenvironment and production processes and oil quality. Particular emphasis is given to how orchard design and structure affect irradiance interception and how that determines productivity. The review also deals with establishment of orchards (cultivar selection, planting patterns, pruning for row formation) and maintenance of hedgerows for continuing productivity (irrigation, fertilization, pruning to maintain structure and productivity, control of pests and diseases, and regeneration of failed hedgerows). An important underlying consideration is the strong interaction between design and dimensions of both hedgerows and harvesting machines with examples taken from the two common, high density (HD) and super-high density (SHD) orchard designs. The search for new machine designs continues simultaneously with that for cultivars, orchard layouts, and pruning systems better suited to this new production system. Currently, only three cultivars ('Arbequina', 'Arbosana', 'Koroneiki') dominate SHD orchards. Over-row harvesters must match hedgerow dimensions while tree structure and fruiting behavior must suit the harvester. Context is provided by identifying reasons for major differences from traditional olive culture and attitudes from which most existing information on tree response and successful management practice has been accumulated. To account for these differences, terminology is proposed to define hedgerow structure that is required for effective management of oil production, oil quality, sanitary conditions, and profitability under various conditions. The review continues with discussions of requirements and current performance of mechanical harvesters and a comparative lifecycle economic analysis of alternative HD and SHD systems. The latter demonstrates the complexity of analysis and its importance to the choice of orchard design at the outset of each new project. The review concludes with recommendations for basic and applied research to determine optimal hedgerow structures and management for individual situations, development of new cultivars, and maintenance of hedgerow structure for continuing productivity.

© 2014 Elsevier B.V. All rights reserved.

## Contents

1. Introduction .....	72
2. Hedgerows in context .....	73
2.1. Orchards adapted to machines and vice versa .....	73

\* Corresponding author.

E-mail address: [djconnor@unimelb.edu.au](mailto:djconnor@unimelb.edu.au) (D.J. Connor).

2.2.	Defining canopy characteristics and hedgerow structure .....	73
2.3.	Hedgerow structure and interception of solar radiation .....	74
3.	Microclimate and its impact on growth and production processes .....	75
3.1.	Responses to irradiance .....	75
3.1.1.	Light quality .....	76
3.1.2.	Vegetative growth and development .....	76
3.1.3.	Fruit density, size and oil content and quality .....	76
3.1.4.	Orchard structure, canopy illumination and oil yield .....	77
3.2.	Temperatures of leaves and fruit .....	77
3.2.1.	Temperature patterns on opposing sides of hedgerows .....	77
3.2.2.	Fruit and leaf temperature .....	78
3.3.	Humidity and air movement .....	78
3.4.	Evapotranspiration and water requirement .....	78
3.5.	Concluding remarks .....	79
4.	Establishing hedgerows for high productivity and ease of management .....	79
4.1.	Location .....	79
4.1.1.	Temperature .....	79
4.1.2.	Common diseases .....	80
4.1.3.	Soils .....	80
4.2.	Topography and orchard size .....	80
4.3.	Cultivars suited to hedgerow systems .....	80
4.4.	Planting patterns .....	81
4.4.1.	Pollinizers .....	81
4.4.2.	Density and early productivity .....	81
4.4.3.	Length and orientation of rows .....	82
4.5.	Management for row formation and early productivity .....	82
4.6.	Concluding remarks .....	83
5.	Maintaining hedgerow structure and productivity .....	83
5.1.	Irrigation .....	83
5.2.	Fertilization .....	83
5.3.	Pruning .....	84
5.4.	Control of pests and diseases .....	84
5.5.	Longevity and productivity .....	84
5.6.	Hedgerow renewal .....	84
5.7.	Concluding remarks .....	85
6.	Harvesters and harvesting .....	85
6.1.	Fruit and tree biology .....	85
6.2.	Harvester designs .....	85
6.3.	Performance characteristics .....	85
6.4.	Concluding remarks .....	86
7.	Economic issues .....	86
7.1.	Economic analysis .....	86
7.2.	Comparison of HD and SHD orchards .....	87
7.3.	Considerations for the future .....	88
8.	Recommendations for future research .....	88
8.1.	What hedgerow structures? .....	88
8.2.	Underpinning research .....	88
8.3.	Cultivars for hedgerows .....	89
8.4.	Maintaining hedgerow structure .....	89
9.	Conclusions .....	90
	Acknowledgements .....	90
	References .....	90

## 1. Introduction

Olive (*Olea europaea* L.) was introduced into cultivation over 3000 years ago and along with grape, date, and fig was one of the earliest tree-fruit additions to the previously grain-oriented agriculture of the Mediterranean Region (Zohary and Spiegel-Roy, 1975). Archeological remains and pollen cores provide evidence for cultivation 3500 BP in Turkey (Vermoere et al., 2003) and somewhat earlier in Crete (Riley, 2002). After early domestication in the eastern Mediterranean olive was spread west along trade routes on both sides of the Mediterranean Sea by the Phoenicians, Romans, and other human civilizations. However, some local selection from wild populations throughout Europe and North Africa likely occurred (Breton et al., 2006, 2009). Today, in the Mediterranean Basin, most orchards are rain-fed with tree densities in

the range 100–300 trees ha<sup>-1</sup>. To ensure survival through periods of drought (Connor, 2005), tree water requirement is reduced by pruning while losses to weed transpiration and soil evaporation are minimized by tillage. Well developed tolerance and avoidance mechanisms of olive trees (Connor and Fereres, 2005) greatly assist in resistance to drought, although under such conditions productivity is low and variable, as evident in a recent yield survey for Spain (Gómez-del-Campo and Barranco, 2009).

Hedgerow production systems are well established in many temperate fruit tree crops such as apple and peach (Robinson et al., 1991), but are relatively new in olive and currently occupy about 1% (80,000 ha) of the crop's global area of ca 10 Mha (Tous et al., 2010). They are, however, becoming the most common orchard design in new plantings, especially in non-traditional production zones away from the Mediterranean Region. Potential advantages

Download English Version:

<https://daneshyari.com/en/article/4566864>

Download Persian Version:

<https://daneshyari.com/article/4566864>

[Daneshyari.com](https://daneshyari.com)