







## Article

# Low Tunnels inside Mediterranean Greenhouses: Effects on Air/Soil Temperature and Humidity

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**Abstract:** The main objective of this work was to analyze the microclimate generated inside a low tunnel (floating row cover) installed in an Almería-type greenhouse. Low tunnels are commonly used in the open field to protect plants against insect attack and to improve the production of muskmelon and strawberry. Floating row covers can also be used inside greenhouses during the first few weeks after the transplantation of muskmelon and watermelon crops in spring-summer cycles. This work was carried out during the first weeks of a watermelon culture (*Citrullus lanatus* Thunb.) growing with a polyethylene row cover inside an Almería-type greenhouse (2115 m<sup>2</sup>). Air temperature and humidity, plant temperature and soil temperature and humidity were measured in the greenhouse inside and outside the row covers. During the three days of measurement, all greenhouse vent openings were closed. The use of the low tunnels increased average air temperature around plants from 24.0 ± 9.0 °C to 26.9 ± 9.7 °C. A maximum difference in air temperature of about 5.9 °C was observed at noon. The average daily temperature of the crop was 28.2 ± 11.8 °C inside the row cover and 24.6 ± 8.9 °C without it. Similarly, the absolute humidity of air was clearly higher inside the low tunnel (0.0201 ± 0.0098 g/g) than around the plant rows without floating cover (0.0131 ± 0.0048 g/g). The soil temperature was also higher inside the low tunnel compared to the area without this second plastic cover. The effect of the tunnel decreased with depth, with average temperature differences of 1.2 ± 0.5 °C on the soil surface and 0.6 ± 0.5 °C at 20 cm depth.

**Keywords:** floating row cover; crop protection; watermelon; air temperature; soil



**Citation:** López-Martínez, A.; Molina-Aiz, F.D.; Moreno-Teruel, M.d.l.Á.; Peña-Fernández, A.; Baptista, F.J.F.; Valera-Martínez, D.L. Low Tunnels inside Mediterranean Greenhouses: Effects on Air/Soil Temperature and Humidity. *Agronomy* **2021**, *11*, 1973. <https://doi.org/10.3390/agronomy11101973>

Academic Editor:  
Alberto San Bautista

Received: 28 August 2021  
Accepted: 27 September 2021  
Published: 30 September 2021

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## 1. Introduction

Low tunnels (floating row cover) are small arched metal structures, covered with plastic film that provides protection to crops in their early stages of development [1–4]. For example, high or low tunnels are usually used for strawberry cultivation [5]. For the low tunnels, colorless translucent plastic film is often used, similar to that used on the cover of Mediterranean greenhouses [6], usually of polyethylene [7,8]. The main objective of these low tunnels is the advancement or delay of the growing cycle [9,10], thus allowing production to be obtained at times of the year where without this technique it would not be possible. The use of low tunnels produces an increase in the temperature of the air and soil [11,12], which favors the growth of crops [11,13,14]. Other authors have measured higher air relative humidity under low tunnels than without low tunnels [15,16]. In addition, the low tunnels protect against frost [17,18]. They are usually used in outdoor crops [1], although they can also be used in crops inside greenhouses to give extra protection in the early stages of cultivation. Plastic greenhouses are productive structures that have become widespread in regions with mild winters and in regions with warm climates [19],