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Scientia Horticulturae 111 (2007) 255–259
SCIENTIA HORTICULTURAE
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Preliminary results on fig soil-less culture

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Received 16 December 2005; received in revised form 19 July 2006; accepted 25 October 2006

Abstract

A fig soil-less culture was conducted in a greenhouse to get rid off all the inconveniences of traditional farming such as low profitability. The research showed a different way of growing fig trees (*Ficus carica* L.) so that farmers could benefit from it by improving yields.

This type of soil-free culture may allow irrigated farms to boost their fig productions from 4500 kg/ha-year up to 81,000 kg/ha-year; that is an 18-fold yield increase compared to traditional farming. Likewise, water efficiency would also be maximised. A 90% water reduction was achieved by applying this growing technique. Furthermore, fertilisers and pesticide applications, as well as farming costs (hand labour) may be reduced by growing the appropriate fig cultivars. Moreover, the highest fig market demand could be met by scheduling harvesting to provide quality fruit all year round.

Keywords: *Ficus carica*; Syconium; Breba; Fig; Soil-less culture

1. Introduction

Among those fruit crops with low profitability, in Spain, the fig tree (*Ficus carica* L.) stands out with approximately 19,000 ha, an annual production of 43,200 Mt and an average yield of 1660 kg/ha (MAPA, 2001). Whereas most fig orchards are dry farmed, those under irrigation provide quality fruit for fresh market and exports. Under these conditions, fig culture is oriented to both breba and fig quality production using parthenocarpic and biferous cultivars. *Brebas* (first crop on last season growth) are harvested from the end of May to mid July and are highly demanded regardless their high prices. The main crop borne on current season growth is called *fig* and is picked from mid July to the end of September. Sometimes figs are left on the trees because of labour cost.

Annual fig exports and imports have increased in Spain for the last years. During 2002 these were 4384 Mt and 1950 Mt, respectively (MAPA, 2001). On the contrary, the European Union definitively shows a fig shortage: imports of 25,000 Mt/year and exports 6500 Mt/year (Melgarejo, 2000). Consequently, more research is required to cope with Spanish and other countries' demands for *brebas* and *figs*.

Fig cultivation has been associated with low profile and marginal lands. As production costs increased, some farmers quit cultivation while others embraced new culture techniques. Even modern farms hardly keep crop profitability as production costs increase gradually. Harvesting is done by hand and accounts for more than 50% of total production costs (Melgarejo, 2000). So labour cost reduction and yield increase are crucial to definitively keep crop profitability.

Soil-less cultivation for fruit tree species is almost non-existent. Conversely to greenhouse horticulture, there are only small experimental plots for fruit tree soil-less cultivation. Because of lack of information, it is very difficult to adjust the optimal growing conditions to cultivate tree species in this environment. The only previous study for fig culture in Spain was performed by the manuscript authors in 1999. Another research team conducted a similar study in Japan under different growing conditions (Kawamata et al., 2002).

The final aim of this study was to test fig soil-less cultivation under protected conditions. A greenhouse environment would provide the optimal growing conditions to improve fig profitability so that farmers could obtain higher yields and incomes as well.

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doi:10.1016/j.scienta.2006.10.032

2. Materials and methods

2.1. Plant material

Though several fig cultivars were tested, the study mainly focussed on the *Super Fig* 1 variety (SF_1). It is a parthenocarpic and biferous cultivar, with dark colour with greenish hints at ripeness (Fig. 3f) and large fruit size (both brebas and figs). This cultivar hardly shows splitting incidence, a negative trait for international markets. SF_1 also yields fruit with less seeds than the *Colar* cultivar, which is the most planted parthenocarpic and biferous cultivar in Southeastern Spain. Though *Super Fig* 1 fairly yields when traditionally farmed, a greenhouse environment could provide the right conditions to test its agricultural potential.

Plant material was propagated by the research team itself. Tiny hardwood and herbaceous stem cuttings (5 cm) were propagated to produce fig plants (Fig. 3a, b and e). While first crop plants showed an average height of 14.2 cm at planting, second crop ones were 10.41 cm tall (Figs. 1 and 2).

2.2. Growing media and plant density

A randomized block design was chosen to minimize the effect of any interference. Each experimental block either managed plants on sacks or furrows (Fig. 3c and d). The chosen growing media were perlite sacks of 60 and 40 l, and open polypropylene furrows (18 cm high and 25 cm wide) filled with perlite (Fig. 3c and d). The same nutrient solution was applied to all growing containers.

Plant density was different according to the experimental plots. Two fig plants per linear meter were placed in both sacks and furrows. Blocks with two plant rows 1 m apart handle 26,666 plants/ha, and those with three plant rows contain 34,293 plants/ha (Fig. 3e).

2.3. Nutrient solution and irrigation schedule

Several fertilisers were used for plant nutrition. These were calcium nitrate, monopotassium phosphate, potassium and magnesium nitrates, micronutrients mix, iron chelate and nitric acid. The applied nutrient solution showed the following composition:

Anions (mmol/l)					Cations (mmol/l)					pH
NO_3^-	$H_2PO_4^-$	SO_4^{-2}	HCO_3^-	Cl^-	NH_4^+	K^+	Ca^{+2}	Mg^{+2}	Na^+	
12	2	2	0.5	0	0.5	7.5	4	2	0	–

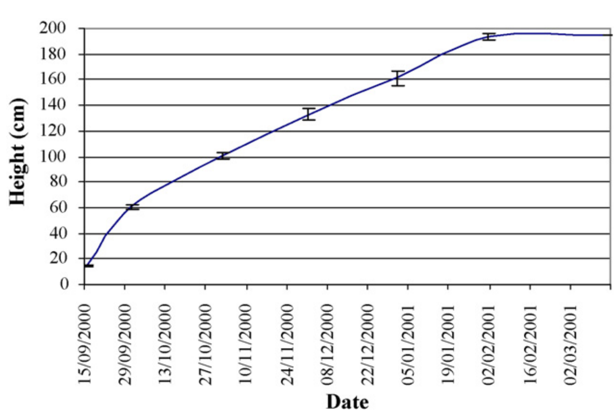

Fig. 1. First crop growth.

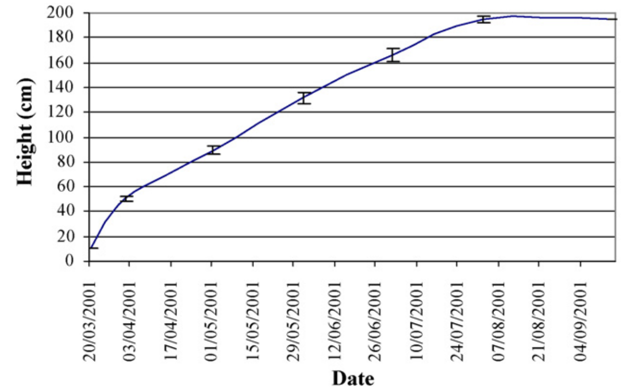

Fig. 2. Second crop growth.

Irrigation was scheduled based on radiation (W/m^2). A computerized weather station located next to the greenhouse provided useful data for irrigation. Plants were first watered at 7:00 a.m., and the rest of daily fertigations were automatically applied depending on the accumulated radiation during the year (during January and February a 5 min. additional irrigation was supplied per every 1000 W/m^2 accumulation; for May and June an additional irrigation every 900 W/m^2 accumulated). Fertilizer tanks were used to fertigate and *Venturi* devices injected fertilizers and nitric acid based on electrical conductivity (3 dS/m) and pH.

2.4. Greenhouse

A 960 m^2 polycarbonate multi-tunnel greenhouse was used on this study. The soil was covered with a polypropylene layer to prevent weeds from emerging. Greenhouse ventilation was automatically controlled by lateral and upper openings. A water heating system kept night and day temperatures above 10 and 17 °C, respectively, and aerothermal devices also provided temperature control within an optimal range. Pressure compensated drippers of 3.8 l/h with anti-drain feature were used for fertigation purposes; one dripper per plant provided fertilizers and water as well (Fig. 3d). To avoid temperature stress during summer (because of solar radiation), polycarbonate walls and top were whitened with calcium hydroxide sprays.

A pump station was set for greenhouse management. The whole system was computerised from the pumping house. *Ambitrol* and *Agronic C* computer software were used.

2.5. Growing techniques

The following practices were performed: