The Effect of Climatic Conditions on Fresh Fig Fruit Yield, Quality and Type of Crop

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Abstract

The present study was conducted to evaluate the effect of different climatic conditions on fresh fig fruit yield, quality, and type of crop of three fig cultivars : Kadota, Kennedy and Larga de Burdeos established in three fields in central-north Chile. Four trials were established in September 1997: two trials at Las Cardas Experimental Station belonging to the Faculty of Agricultural Sciences, University of Chile (30°18'S; 71°15'E), one at Cerrillos de Tamaya (30°43'S; 70°58'E) and one in El Palqui, Ovalle (30°33'S; 71°21'E). Climatic parameters for each locality were registered during 1999 and 2000. Five replications of each cultivar of 3 year old plants were evaluated for each of the following parameters: trunk cross sectional area increment (cm2) at the beginning and at the end of the growing season, shoot growth (cm) from oct. 99 to april. 00, total fig production (Kg/plant and n°/plant)), final fruit size (mm) and weight (g), and soluble solids content (°B). Fruit parameters were evaluated in all fruits present in 4 previously marked shoots in each replication.

Almost all the vegetative and productive parameters evaluated showed significant differences between the trial at El Palqui (with higher temperatures and higher solar radiation), and the other two sites. In cvs. Kadota and Kennedy, the difference in fruit weight per plant was more than 10 times higher, while cv.Larga de Burdeos, though also more productive at El Palqui, showed somewhat less climatic effect. For fruit weight, cv. Kadota had an increase of 71,3% and 85,4% when compared to the fruit of the same cv. collected at Cerrillos de Tamaya and Las Cardas, respectively. Also, for the three cultivars, harvest time began in the 4th week of january at El Palqui and one month later in the other two localities.

INTRODUCTION

The fig (*Ficus carica L.)* is a deciduous subtropical species, native to semi-desert regions in western Asia and later distributed and well adapted across the Mediterranean basin, the rest of Asia and Africa (Condit, 1947; Ferguson et al., 1990). It was introduced to America circa 1520, during the Spanish conquest (Condit, 1947 ; Melgarejo, 1996) and spread through the continent as it became colonized.

At present, the main American countries with commercial plantations are United States, Brazil, Argentina and Mexico; however, in Chile, as in other Latin American countries, its development as a commercial fruit crop has been slow. The actual total area in Latin America probably does not exceed 4,500 hectars. With the exception of Brazil, that has 2,178 hectars with commercial plantations, it is estimated that more than 50% of the fig plants are cultivated in home orchards (Botti and Muchnik, 1998).

The main limitations to increase the area and production of the species is the low number of fig cultivars present and the lack of research and information oriented to obtain profitable yields. In Chile, where desertic conditions are advancing at a dangerous speed, figs could be an attractive export product that can gradually replace some traditional fruit crops with higher water demand (Cancino et al., 2000a, b).

Traditionally, figs have been cultivated under rainfed conditions and with very little technology (Colelli, 1995; Chessa et al., 1998); however, its cultivation nowadays is

increasingly being done under irrigation (Golombek and Lüdders, 1993; Melgarejo, 1998)) and incorporating different technologies to increase fruit yield and quality (Mendes-Pereira, 1981; Erez and Shulman, 1982; Yablowitz et al., 1998).

Most fig studies report that, as a deciduous subtropical species, native to arid, semi-desert regions (Condit, 1947), figs grow best under intense solar radiance, high summer temperatures (ranging between 25 to 42°C), moderate winters and low relative humidity (Mendes-Pereira, 1981; Ferguson et al.,1990; Flores, 1990; Melgarejo, 1996). Sahin (1998) and Özeker and Isfendiyaroglu (1998) mention that the quality of dried fig fruits is comparatively more dependent on climatic conditions than fresh figs, and that table figs can be cultivated under a wider range of ecological conditions. Eisen (1901) reports that most excellent table figs may grow where the heat is moderate, while varieties for drying require much more heat. However, there are no studies showing quantitative data on the importance of the climatic conditions on fresh fig fruit yield , type of crop and quality, three productive parameters that can be decisive in the final income-yield capacity of the cultivated area.

In this study we investigated the effect of different climatic conditions on fresh fig fruit yield, quality and type of crop of three fig cultivars : Kadota, Kennedy and Larga de Burdeos established in three fields in central-north Chile.

MATERIALS AND METHODS

Four trials were established in September 1997 with 3 common type fig varieties (Kadota, Kennedy, and Larga de Burdeos): two trials at Las Cardas Experimental Station belonging to the Faculty of Agricultural Sciences, University of Chile (30°18'S; 71°15'E), one at Cerrillos de Tamaya (30°43'S; 70°58'E) and one in El Palqui, Ovalle (30°33'S; 71°21'E). Plants were trained during winter of 1998 and 1999. Climatic parameters for each locality were registered during 1998 and 1999, including days free of frosts, thermal accumulation (over 10°C), maximum average temperature in January, summer average temperature (oct. to mar.), average relative humidity (oct. to mar.), solar radiation (jan.), accumulation of chilling hours (lower than 7°C) and potential evapotranspiration (dic.to feb.). All trials were drip irrigated based on the ETP of the different localities, following methodology indicated by Goldhammer (2000) and were fertilized according to a foliar analysis program. Planting distances were 6 x 2 m and 6 x 4 m at Las Cardas Exp. Station, 6 x 2 m at Cerrillos de Tamaya and 5 x 4 m at El Palqui. Five replications of each cultivar of 3 year old plants were evaluated for each of the following parameters: trunk cross sectional area increment (cm2) at the beginning and at the end of the growing season, shoot growth (cm) from oct. 99 to april. 00, total fig production (Kg/plant and n°/plant)), final fruit size (mm) and weight (g), and soluble solids content (°B). Fruit parameters were evaluated in all fruits present in 4 previously marked shoots in each replication (6 to 12 fruits/evaluation).

RESULTS AND DISCUSSION

Climatic Conditions of the Trial Sites

The climatic parameters registered for each locality (Table 1) show important differences in most of them for El Palqui as compared to the other two sites, especially for maximum average temperature for january (which is the hottest month), average relative humidity and solar radiation. Despite the fact that the distance between each locality is less than 66 Km (straight line), El Palqui, further away from the coastal influence, in an interior valley, shows better conditions for fig production in agreement with several authors who indicate that figs grow best under intense solar radiance, high summer temperatures, moderate winters and low relative humidity (Mendes-Pereira, 1981; Ferguson et al.,1990; Flores, 1990; Melgarejo, 1998).

Description of Cultivars

Kadota, also known as Dottato, White Pacific, Gentile, and several other

synonyms (Condit, 1955), demonstrated to be a very vigorous cultivar, especially at El Palqui with the best climatic conditions for fig development. The fruit skin developed a bright yellow color at El Palqui, but remained greener at C. de Tamaya and Las Cardas. This coincides with the description given by Condit (1955) “color green in cool climates to golden yellow in hot interior valleys”. The rather thick skin showed very resistant to handling, and the pulp was amber at all three sites.

Kennedy, also known as Brunswick, Dalmatian and Castle Kennedy (Condit, 1955), showed less vigour than Kadota, but the fruit characteristics were very similar to this cultivar in their form and color: yellow skin (at El Palqui) and amber pulp. However, figs were smaller than Kadota’s.

Larga de Burdeos, probably also known as Petite Figue Violette or Violette de Bordeaux (Condit, 1955), is a small, shruby and very prolific cultivar, with very small fruits, spherical or piriform, brown-purple skin and pink pulp. The cultivar is quite vigorous, but never very tall, developing several branches from the base. It is a good cultivar for agroindustrial uses (processed figs in syrup) or for home planting as the tree is dwarf and very productive.

Vegetative and Productive Development

Almost all the parameters evaluated showed significant differences between the trial at El Palqui and the other two trials. Figure 1 shows the evolution in shoot growth from oct 99 to april 00. The fig trees at El Palqui trial showed a rapid and strong shoot growth, reaching 160 cm of shoot growth in spring and summer, whilst Cerrillos de Tamaya and Las Cardas trees developed shoots no longer than 60 cm.

Table 2 shows that all productivity parameters in the three fig cultivars were significantly higher at El Palqui as compared to C. de Tamaya or Las Cardas. In cvs. Kadota and Kennedy, the difference in fruit weight per plant was more than 10 times higher, while cv.Larga de Burdeos, though also more productive at El Palqui, showed somewhat less climatic effect, producing more fruit than the other two varieties in the cooler climates. The productivity projection per hectar gives for El Palqui more than 13 ton/ha of Kadota figs and 9 ton/ha of Kennedy figs, as early as their third year since plantation, an extremely good production for young plants.

Fruit weight, polar diameter with pedicel, and maximum ecuatorial diameter also showed significant higher values for figs harvested at El Palqui as compared to those at the other two sites (Cerrillos de Tamaya and Las Cardas); however, polar diameter without pedicel did not vary. For fruit weight, cv. Kadota had an increase of 71,3% and 85,4% when compared to the fruit of the same cv. collected at Cerrillos de Tamaya and Las Cardas, respectively. According to Condit (1955), Kadota figs range in weight from 30 to 80 g and in size from below to above medium, or even large (57,6 mm in length and 44,8 mm in diameter), both parameters higher than those obtained in this study. Figs from cv. Kennedy are described by Condit (1955) as having an average weight of 42 g, but no data on fig size is reported. This weight is also higher than those obtained in the present study for the same cutivar. Larga de Burdeos, if it corresponds to the cultivar Bordeaux described by Condit (1955), is mentioned having a fig weight of 27 g and a size of 44,8 mm in length and 38,4 mm in diameter. Again, all parameters higher than those obtained in this study. However,it is probable that the size and weight of the fruit in the respective trials will increase once the trees reach their full development.

Concerning soluble solids, no significant differences were found between El Palqui and Cerrillos de Tamaya fruit; however, at Las Cardas, especially in the trial planted at 6 x 4 m, the values were significantly lower at the same harvesting date. It is, nevertheless, surprising that figs from Kadota and Kennedy trees planted at 6 x 2 at Las Cardas had no difference in soluble solids with the other trials.

No clear differences were observed in any of the parameters evaluated between the trials at Las Cardas planted at two different densities. This is probably due to the young age of the trees, which were not showing any competition effect yet.

In regard to harvest time, the first cultivar to ripen in all localities was Larga de

Burdeos, one month earlier than the other cultivars. Also, for the three cultivars, harvest time began in the 4th week of january at El Palqui and one month later in the other two sites, another important productive characteristic that can be directly attributed to climate.

It is interesting to mention that, although the first crop (brevas) was not considered in this study due to the tree training given in their first years of development, all cultivars at El Palqui developed almost all the fruit buds into figs, and very few dormant buds remained for next year's brevas. At Las Cardas, however, all cultivars show 2-5 breva buds/shoot for next spring harvest. This climatic effect on the crop type is of great importance in order to decide the productive orientation of the fig orchard.

Though it is probably true that the quality of dried fig fruits is more dependent on climatic conditions than fresh figs, and that table figs can be cultivated under a wider range of ecological conditions (Sahin, 1998; Özeker and Isfendiyaroglu, 1998), our results coincide whith what Eisen (1901) mentioned 100 years ago " the fig, while less exacting as regards climatic conditions than the olive, demands peculiarities in climate in order to attain perfection, which few localities can supply". The results of this study clearly demonstrate the strong effect of the climate on fresh fig production, both in productivity per hectar, type of production (brevas or figs), timing and in fruit quality, and that finding the 'perfect' climate can be decisive in the final income-yield capacity of the crop.

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Tables

Table 1. Climatic parameters of the trial sites

Climatic parameters	Sites		
	Las Cardas	Cerrillos de Tamaya	El Palqui
Days free of frosts	355	365	320
Summer thermic amount (sep-feb, threshold 10 °C) (°d)	1.372	1.300	1.440
Average maximum temperature (january) (°C)	27	27,5	30,5
Summer average temperature (oct-mar) (°C)	18,5	18	19
Average relative humidity (oct-mar) (%)	65	70	50
Solar radiation (january) cal/cm2*día	550	550	630
Accumulated chilling hours (threshold 7 °C)	500	600	800
Potential evapotranspiration (dic-feb) (mm)	410	420	530
Rainfall (mm)	26,4	51,5	77,5

Table 2. Productive parameters evaluated in three fig cultivars at three different localities in central-northern Chile (1999-2000)

Trial	Variety	Productivity (per)				
		Plant		Area	Shoot	
		Kg/pl	N°Fr./pl	Ton/ha	g/shoot	N°Fr/shoot
El Palqui	Kadota	26,7 e	734,6 c	13,4 f	1028 c	26,6 d
	Kennedy	18,1 d	572,4 b	9,1 e	893 bc	27,3 d
	Larga de Burdeos	12,8 c	817,0 c	6,4 d	731 b	34,2 e
Cerrillos de Tamaya	Kadota	2,5 a	118,2 a	2,1 b	87 a	3,8 abc
	Kennedy	1,1 a	57,6 a	0,9 ab	66 a	2,7 abc
	Larga de Burdeos	5,3 b	525,0 b	4,4 c	89 a	8,0 abc
Las Cardas 6 x 4 m.	Kadota	0,3 a	13,4 a	0,1 a	37 a	1,8 a
	Kennedy	0,3 a	11,3 a	0,1 a	43 a	2,2 ab
	Larga de Burdeos	0,7 a	59,8 a	0,3 a	57 a	4,4 abc
Las Cardas 6 x 2 m	Kadota	0,3 a	12,3 a	0,3 a	48 a	1,7 a
	Kennedy	0,3 a	14,0 a	0,2 a	35 a	1,8 a
	Larga de Burdeos	0,6 a	78,3 a	0,5 a	37 a	7,7 abc

Different letters in the same column indicate significant statistical differences (α<0,05).
Abbreviations: Fr.: fruit; Pl.: plant

Table 3. Fruit parameters evaluated in three fig cultivars at three localities in central-northern Chile (1999-2000)

Locality	Cultivar	Average Weight	Dimensions			Soluble Solids
			PDw P	PDw/o P.	MED	
		----- g -----	---------- mm ----------			-Bx°-
El Palqui	Kadota	38,2 e	54,9 f	43,4 c	40,9 g	22,1 b
	Kennedy	32,5 d	54,3 ef	42,9 c	38,5 f	23,2 b
	Larga de Burdeos	19,8 b	41,7 c	28,8 a	31,0 cd	23,5 b
Cerrillos de Tamaya	Kadota	22,3 bc	44,3 cd	38,1 bc	32,5 de	21,1 b
	Kennedy	24,2 bc	49,3 de	43,6 c	33,7 e	21,3 b
	Larga de Burdeos	11,2 a	35,8 b	26,9 a	27,5 ab	24,7 b
Las Cardas 6 x 4 m.	Kadota	20,6 b	47,8 d	39,4 bc	31,9 de	11,9 a
	Kennedy	19,9 b	49,9 def	40,0 bc	31,9 de	10,4 a
	Larga de Burdeos	12,5 a	36,0 b	28,3 a	29,0 bc	10,0 a
Las Cardas 6 x 2 m	Kadota	28,2 cd	46,7 cd	43,4 c	36,7 f	24,1 b
	Kennedy	19,0 b	48,5 d	38,7 bc	30,9 cd	22,0 b
	Larga de Burdeos	8,3 a	29,2 a	28,2 a	26,9 a	14,7 a

Different letters in the same column indicate significant statistical differences (α<0,05).
Abbreviations: PDwP: polar diameter with pedicel; PDw/oP: polar diameter without pedicel; MED:maximum ecuatorial diameter.

Figures

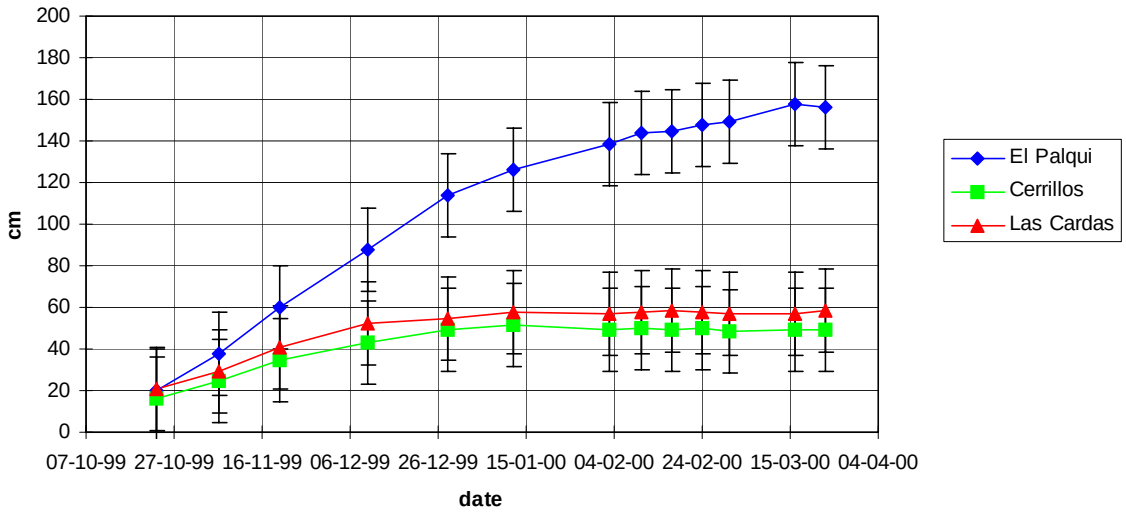

Fig. 1. Shoot length evolution in fig trees from spring 1999 to autumn 2000 in three different localities of central-northern Chile.