THE INTRODUCTION OF NEW ALMOND CULTIVARS IN SPANISH ALMOND GROWING

INTRODUCTION

Spain is the second world's almond producer (Table 1). Although the United States of America, basically by the Californian production, is the leading producer ahead of all the others, the almond breeding programs of Spain are the most active in the world and those releasing the largest number of new cultivars (Socias i Company et al., 2011). This work has produced a clear penetration of the new plant materials, both cultivars and rootstocks, in the Spanish almond growing regions (Socias i Company et al., 2009).

Table 1. Average almond world production for the period 2000-2009 (web page of FAO).

Country Average production 2000-09 (tm in shell)	
USA	884,914
Spain	223,431
Syria	110,595
Italy	108,648
Iran	99,582
Morocco	78,636
Tunisia	46,300
Turkey	45,466
Greece	45,219
Algeria	37,526
Lebanon	27,210
Pakistan	26,247
China	25,600
Libya	25,400
Afghanistan	22,299
Portugal	17,099
Uzbekistan	17,016
Australia	12,981
Chile	10,364
Israel	7,091
France	3,712
Rest	25,708
Total	**1,901,041**

The Spanish market only distinguishes two cultivars as such, 'Marcona' and 'Desmayo Largueta', whilst the rest of cultivars are grouped under the undefined name of 'Comunas'. Even such important cultivars as 'Guara' and 'Ferragnès', representing and important share of the Spanish production, are not marketed as individual cultivars. Similarly, some new releases with an excellent kernel quality are also marketed in a mixture of kernels. As a consequence, the Spanish production statistics do not reflect the level of production attributable to the new cultivars. In addition, the statistics on the surface planted with each cultivar are not

Figure 1. Evolution of the production of plants of almond cultivars from the CITA breeding program by the Spanish nurseries.

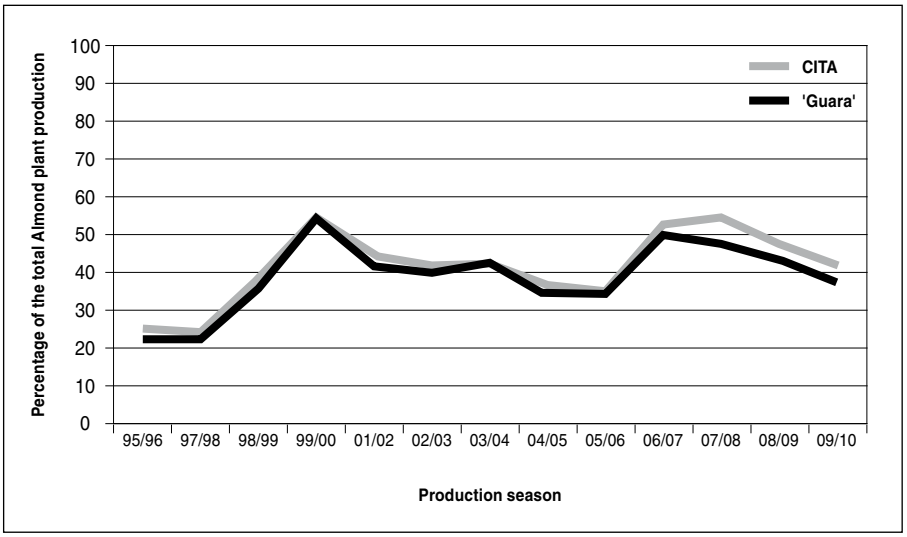
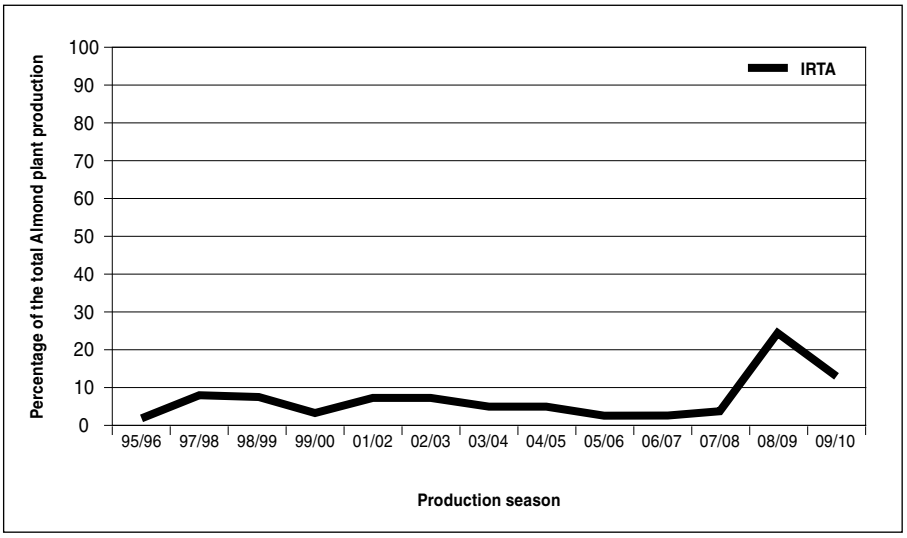


Figure 2. Evolution of the production of plants of almond cultivars from the IRTA breeding program by the Spanish nurseries.



fully reliable and do not give a trustworthy picture of the presence of the new cultivars in the Spanish orchards. The long life of the almond orchards renders updating of these figures quite difficult, thus not reflecting the dynamics of cultivar change produced in the Spanish orchards during the last four decades.

Probably the best figure to show the changes produced in the Spanish almond orchards is the production of almond plants by the Spanish nurseries. Therefore, in order to obtain a real figure of the introduction of the new cultivars in the Spanish orchards, we have revised the statistics of the plants marketed by the Spanish nurseries as collected by the Spanish Office of Plant Varieties.

MATERIALS AND METHODS

The Spanish Office of Plant Varieties at the Ministry of the Environment and Rural and Marine Affairs collects the data from the different Autonomous Regions on the production of fruit plants by the Spanish nurseries. The years studied were from the 1995/96 to the 2009/10 seasons. The data collected had to be carefully revised in order to avoid unaccuracies, such as synonyms and incorrect wording. Some clones were identified with acronyms or abbreviations not corresponding to any known selection or breeding clone. The most notable case of synonymy was that of 'Desmayo Largueta', also referred to as 'Largueta', 'Desmayo blanco', 'Desmayo común' or 'Desmayo verde'. The same cultivar could also be identified in different lists by the cultivar name or the trade mark, such as 'Avijor' or 'Lauranne'.

Once the data were refined from any detected unaccuracies, the cultivars were grouped according to their origin (Table 2). These figures allowed obtaining the total

Table 2. Production of almond plants by the Spanish nurseries (1995/96 to 2009/10).

Cultivar	Nº of plants
Guara	6,999,329
Aylés	25,028
Moncayo	134,024
Blanquerna	18,461
Cambra	31,853
Felisia	10,663
Belona	78,036
Soleta	68,784
Mardía	4,000
CITA cultivars	**7,370,178**
Masbovera	322,234
Francolí	80,613
Glorieta	240,360
Tardor	2,500
Constantí	95,020
Marinada	183,253
Tarraco	53,416
Vairo	132,790
IRTA cultivars	**1,110,186**
Almudena	1,560
Antoñeta	85,778
Marta	119,309
Penta	4,304
Tardona	647
CEBAS cultivars	**211,598**
Marcona	1,659,200
Desmayo Largueta	1,560,723
Garrigues	344,906
Ramillete	269,016
Atocha	104,561
Desmayo Rojo	109,124
Carreró	103,486
Soft-shell	7,920
Other Spanish	435,007
Traditional Spanish cultivars	**4,593,943**
Ferragnès	2,408,780
Ferraduel	1,866,750
Lauranne	47,985
Other French	22,101
French cultivars	**4,345,616**
Tuono	497,816
Cristomorto	61,832
Fragiulio	4,320
Italian cultivars	**563,968**
Nonpareil	1,100
Texas	8,365
Californian cultivars	**9,465**
Others	**37,910**
Total	**18,095,625**

Figure 3. Evolution of the almond cultivars plant production from the CEBAS breeding program by the Spanish nurseries.

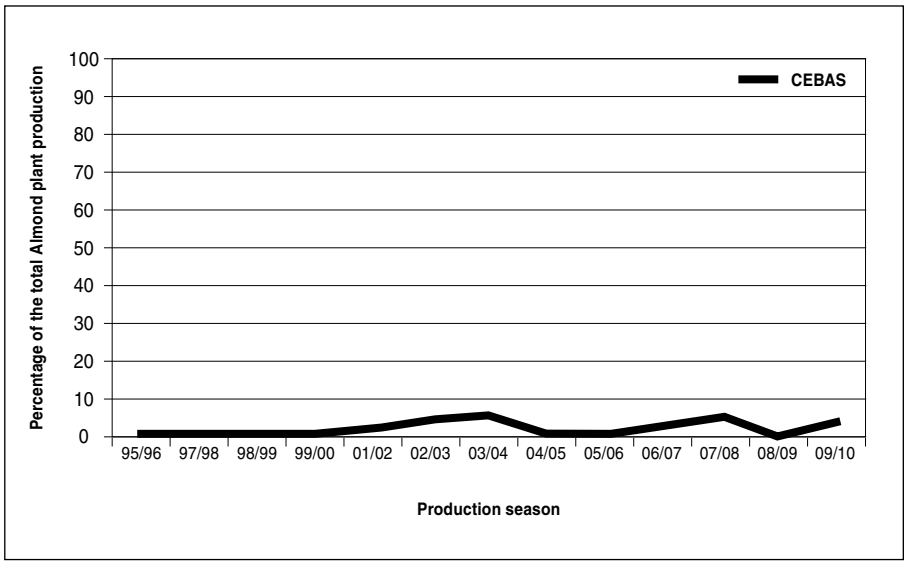
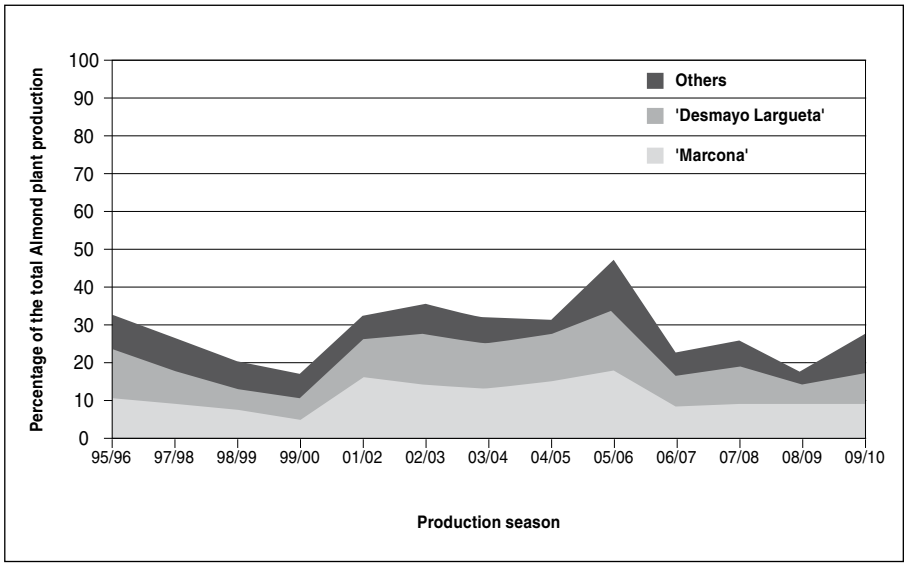


Figure 4. Evolution of the traditional almond cultivars plant production by the Spanish nurseries.



values of each cultivar or group of cultivars and the percentages of each, in order to draw the graphs showing their evolution trends during the period examined.

RESULTS AND DISCUSSION

The first observation from the data is the undoubtful prevalence of the CITA cultivars during the 14 seasons over the total amount of more than 18 million plants produced by the Spanish nurseries. Over this period, the CITA cultivars amounted to 40.73%, with 'Guara' as the leading cultivar, with 38.68%, which represents 94.97% of the CITA cultivars. Although in 2009/10 the percentage of these cultivars slightly decreased (Fig.1), during this period the trend has been towards a constant increase. The new cultivars 'Belona' and 'Soleta' appeared in the season 2006/07 and 'Mardía' in 2009/10. Therefore, for the moment the data do not allow establishing the real level of penetration of these new cultivars in spite of the references of their introduction in the new orchards.

The second Spanish breeding program is that of IRTA developed at the Centre of Mas de Bover. The incidence of the cultivars released by this program amounts to 6.14% of total, although their evolution can be clearly differentiated. Thus, their percentage ranged from 0.15 to 6.64% (Fig. 2) until 2007/08, but the following season there was a sharp increase up to 23.36%, mainly due to the introduction of the last releases from this program and the sound recommendations by the main growers' associations. Probably the data of the coming years will show if this upturn is seasonal (in 2009/10 this percentage was 12.86%) or is maintained.

The cultivars released by CEBAS-CSIC of Murcia do not appear in the statistics until the season 2001/02 because this program started later than the previous ones (Fig. 3). From that season their incidence has ranged from 0.2 to 5%, with a global average of 1.17%, showing a lower incidence than the older programs.

The traditional Spanish cultivars still represent nearly a quarter of the total, with 24.57%, with significant variations along the period, although any trend can be noticed (Fig. 4). Among these cultivars, 'Marcona' with 9.17% and 'Desmayo Largueta' with 8.62% are the most important, both with a stable presence along these seasons. The other traditional Spanish cultivars are much less present, including 'Garrigues', 'Ramillete', 'Desmayo Rojo', 'Atocha', 'Carreró', 'Pajarera', 'Aspirilla', 'Cartagenera', 'Peraleja', 'Planeta' and many others less important. The presence of soft-shell cultivars, as opposed to the Californian production, is extremely low, with 0.04%.

The French cultivars developed by INRA also represent another quarter of the nursery production, with 24.01%. 'Ferragnès' with 13.31% and 'Ferraduel' with 10.32% are undoubtedly the most important cultivars, although their share is continuously decreasing along this period (Fig. 5), as their presence lowered from 39.69% in the season 1995/96 to 12.85% in the last one. Nearly insignificant is the presence of the self-compatible cultivar 'Lauranne', as well as that of other cultivars, either releases from the breeding program ('Ferralise' and 'Ferrastar') or traditional French cultivars ('Aï', 'Bartre' and 'Princesse').

The presence of Italian cultivars, mainly 'Tuono' and 'Cristomorto', was very important in the 1970s, but during the period under study only amounted to 3.12%, most of them of 'Tuono', with a few plants of 'Cristomorto' and 'Fragiulio', following a decreasing trend. The presence of Californian cultivars is fully testimonial (0.05%), being most of the plants of 'Texas' and a few of 'Nonpareil'. Finally, 0.21% of the plants could not be identified.

Taking into account that most French cultivars produced by the Spanish nurseries are releases from the INRA breeding program carried out by C. Grasselly, as well as the incidence of the releases from the different Spanish programs, it is evident that the Spanish production is every time more dependant on improved cultivars. The share of new bred cultivars amounts to 71.93%, divided into 48.03% of Spanish programs and 23.89% of the French program. Although the total remains quite

Figure 5. Evolution of the production of plants of French almond cultivars by the Spanish nurseries.

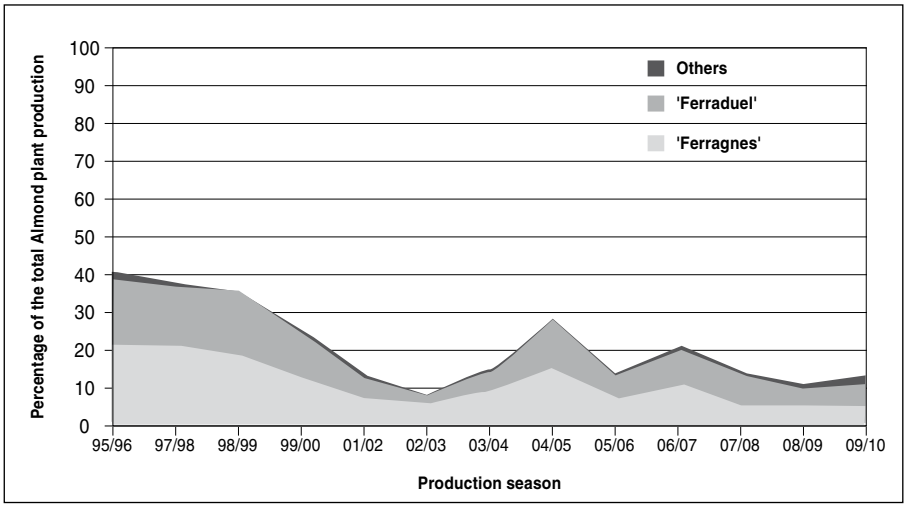


Figure 6. Evolution of the production of plants of bred almond cultivars by the Spanish nurseries.

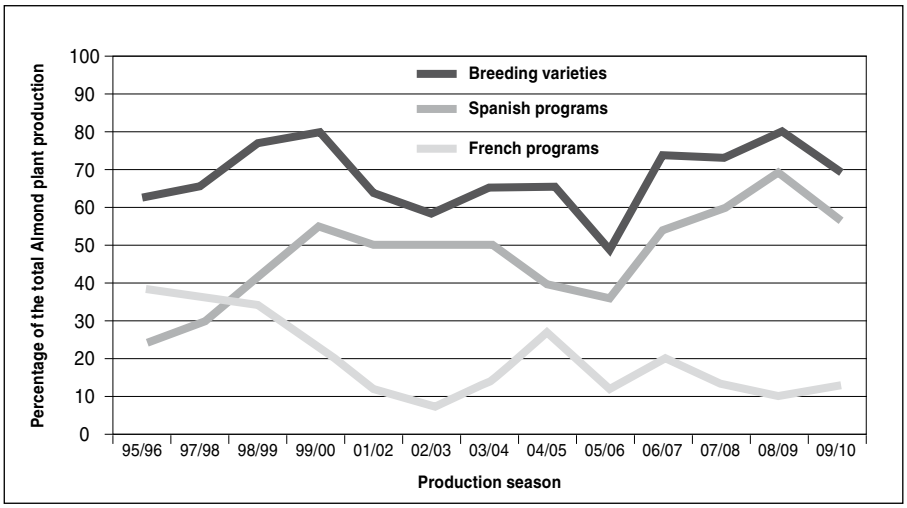
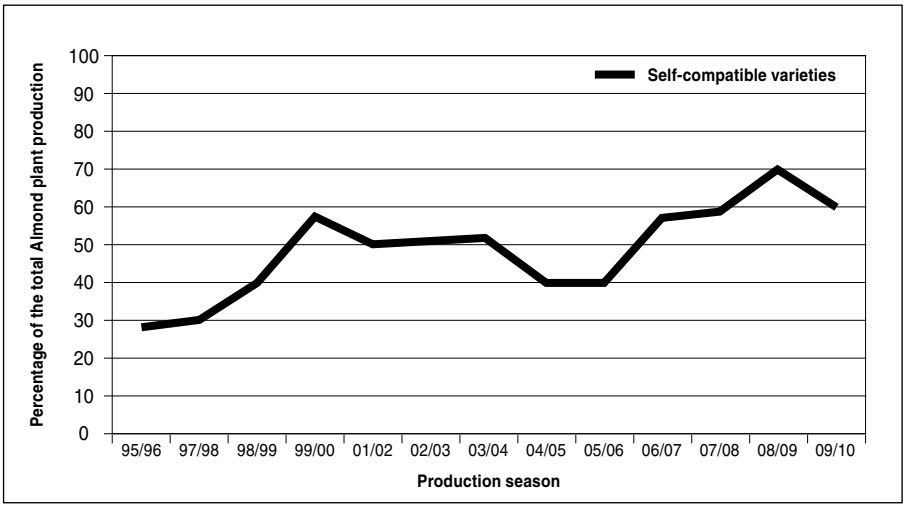


Figure 7. Evolution of the production of plants of self-compatible almond cultivars by the Spanish nurseries.



stable along the period studied, there is a clear increase of the presence of the Spanish releases in detriment of the French releases (Fig. 6).

Considering that self-compatibility has been the main objective of most breeding programs to solve the problems of almond pollination (Socias i Company, 1990), the share of self-compatible cultivars is really significant, with 47.52% of total. The weight of the self-compatible cultivars is mainly due to the new Spanish cultivars because the presence of the traditional Italian cultivars such as 'Tuono' and 'Fragiulio' is very low, and that of the French 'Lauranne' only testimonial. The trend during this period has been the increase of the presence of self-compatible cultivars (Fig. 7), confirming that the Spanish orchards really represent a success of these cultivars (Socias i Company, 2002).

The productive success of these new cultivars is being fully recognized not only by the growers, but also the market and the industry have valued the physical and organoleptic quality of the kernels of some of these cultivars. It must be emphasized that some CITA releases such as 'Belona' and 'Soleta' may exceed the quality rating of the best evaluated traditional cultivars 'Marcona' and 'Desmayo Largueta'.

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