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Adaptation of some foreign almond cultivars in the ecological conditions of Kahramanmaras province in Turkey

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SUMMARY – Phenological and pomological characteristics and yielding status of nine foreign almond cultivars ('Ferragnès', 'Cristomorto', 'Nonpareil', 'Garrigues', 'Yaltinski', 'Picantili', 'Drake', 'Tuono' and 'Desmayo Largueta') were studied in their 5th and 6th leaves. 'Ferragnès' was found to be the latest flowering cultivar, while 'Desmayo Largueta' was the earliest flowering one. Out of the nine cultivars tested, 'Ferragnès', 'Cristomorto' and 'Tuono' gave the highest yields. Although 'Nonpareil' had the highest kernel percentage, its nut weight was found to be the lowest. 'Picantili' and 'Yaltinski' produced as much as 50% double kernels. 'Ferragnès', 'Tuono' and 'Drake' produced nuts mostly on the spurs, while 'Picantili' only on one-year-old shoots. The late flowering 'Ferragnès', with good yielding performance, appeared to be the best cultivar for the region.

Key words: Almond, *Prunus dulcis*, cultivars, adaptation.

RESUME – *"Adaptation de quelques cultivars étrangers d'amandier dans les conditions écologiques de la province de Kahramanmaras en Turquie". Dans cette étude, on a examiné des caractères phénologiques et pomologiques et de productivité de 9 variétés étrangères d'amandiers ('Ferragnès', 'Cristomorto', 'Nonpareil', 'Garrigues', 'Yaltinski', 'Picantili', 'Drake', 'Tuono' et 'Desmayo Largueta') en cinquième et sixième sèves. 'Desmayo Largueta' est la variété la plus tôt fleurie. 'Ferragnès' est la variété la plus tardivement fleurie. 'Ferragnès', 'Cristomorto' et 'Tuono' sont les plus productives entre les variétés étudiées. 'Nonpareil' a des fruits qui ont de hauts rendements mais leur poids d'amande est peu élevé. 'Picantili' et 'Yaltinski' ont des fruits jumeaux selon une proportion de 50%. Les fruits de 'Ferragnès', 'Tuono' et 'Drake' sont sur les branches "spur". Les fruits de 'Picantili' sont sur les branches de 1 an. On peut dire que 'Ferragnès' est la meilleure variété pour cette région du fait de sa floraison tardive et de sa production élevée.*

Mots-clés : *Amandier,* Prunus dulcis*, variétés, adaptation.*

Introduction

Excessive diversification, spring time freeze and pollination deficiencies are the most serious problems for the almond culture in the countries of South Europe, Near East and North Africa (Tasias i Valls, 1990). In Turkey, almost all almond orchards consist of seedling trees, which aggravate the diversification with low quality fruits. Almond is grown in almost every region of Turkey, except the North-East and higher elevations of Anatolia (Dokuzoğuz and Gülcan, 1979). However, many of the existing trees are subjected to spring frosts and therefore farmers often do not trust almond as a reliable crop. Recently, in the frost-free areas of South East Anatolian Region, experiments conducted with high quality foreign cultivars under irrigated conditions gave highly promising results (Kaska *et al*., 1999; Kaska, 2001) (Fig. 1).

The main problems of almond culture all over the country can be summarized as: (i) lack of high quality cultivars; (ii) lack of irrigation; (iii) low horticultural inputs; and (iv) damage of spring frosts. These problems could be solved by planting the improved cultivars, irrigating the orchards, supplying the nutritional requirements of the trees, and finally growing almonds in the frost free areas or selecting late flowering cultivars.

The aim of this research was to determine the suitable cultivars to the Kahramanmaras ecological conditions for commercial almond production.

Fig. 1. Traditional and proposed almond growing areas in Turkey (Kaska, 2001).

Materials and methods

The almond orchard was established in 1997 with 10 trees of each cultivar at the Kahramanmaras Sütcü İmam University Nut Research Center (SEKAMER) in Kahramanmaras, Turkey (altitude 940 m). The orchard spacing was 5x5 m and rows were placed at the north and south direction. The observations and measurements covered 5th and 6th leaves (2001 and 2002). The orchard was stone mulched and drip irrigated from the planting. Trees were grown under conventional cultural practices. The following cultivars were tested: 'Ferragnès' (France), 'Cristomorto' (Italy), 'Tuono' (Italy), 'Picantili' (Italy), 'Desmayo Largueta' (Spain), 'Garrigues' (Spain), 'Yaltinski' (Russia), 'Drake' (USA) and 'Nonpareil' (USA).

The first flowering, full flowering and end of flowering were observed, and nut characteristics such as nut weight in shell, width-length-height of nuts, shell thickness, kernel weight, shelling percentage and double kernel ratio were determined. Also, the fruiting behaviors of almond cultivars (bearing on 1-year-old shoots or spurs) were determined. The experiment was a randomized block design with 3 replications. For pomological analysis, fifty nuts of each cultivar were used.

Results and discussion

Full flowering of most cultivars fell into a period between 15 and 25 March in 2001 and 2002, excepting the earliest cultivar, 'Desmayo Largueta'. Full flowering period of the most cultivars was 25-30 days later than those of local seedling trees which were often at risk of frost. Out of the nine cultivars, 'Ferragnès' and 'Picantili' appeared to be the latest flowering ones (Figs. 2 and 3). The blooming dates of the cultivars were fairly stable in both years. Vargas and Romero (2001) stated that the flowering sequence of different cultivars is relatively constant over the years.

Nut characteristics of a given cultivar seemed to be somewhat different in both experimental years (Table 1). Nut weight and size were increased in 'Ferragnès', 'Nonpareil', 'Tuono', 'Garrigues' 'Yaltinski' in the second year. This probably resulted from the increased irrigation in that year. Kernel weight was highest in 'Yaltinski' and 'Picantili' cultivars. However, these two cultivars produced double kernels with high ratios. 'Yaltinski' produced double kernels above 40% in both years and 'Picantili' 54% in the first year, which might decrease their saleable yield. 'Cristomorto' and 'Drake' also

produced double kernels, with lower ratios (below 20%). 'Ferragnès', 'Nonpareil' and 'Desmayo Largueta' did not produce double kernels. Shelling percentage was highest in 'Nonpareil' with 62% and 57% in both years. Godini *et al.* (2001) reported that paper-shelled Californian cultivars such as 'Nonpareil' were excluded from Italian almond evaluation project because of low bearing consistency all over the Mediterranean basin, inadequate kernel protection from bird and rodent attacks and high kernel sensibility to novel orange worm and carcinogenic aflatoxin producing fungi.

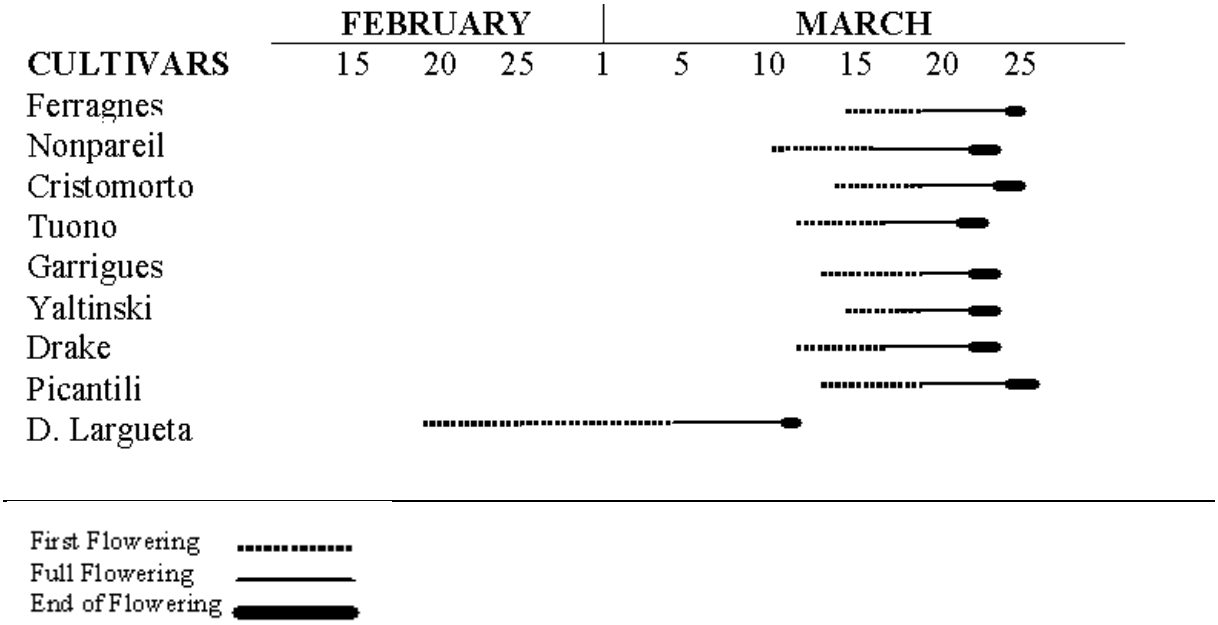

Fig. 2. Flowering periods of the almond cultivars (2001).

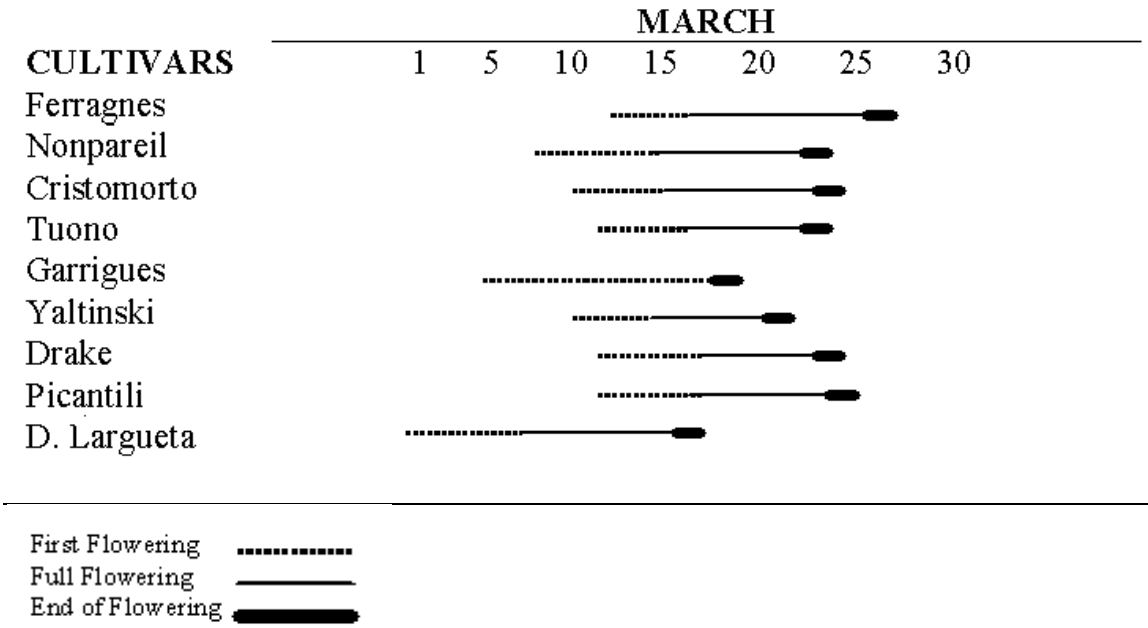

Fig. 3. Flowering periods of the almond cultivars (2002).

Table 1. Nut characteristics of almond cultivars in 2001 and 2002

Cultivars	Nut weight in shell (g)		Nut width (mm)		Nut length (mm)		Nut height (mm)		Shell thickness (mm)		Kernel weigth (g)		Shelling percentage		Double kernel ratio (%)	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
'Ferragnès'	4.3	4.9	15.3	16.5	36.4	38.4	21.8	25.5	2.5	3.1	1.3	1.6	31	33	0	0
'Nonpareil'	1.6	1.9	12.9	13.3	33.5	33.2	18.4	20.8	1.2	1.0	1.0	1.0	62	57	0	0
'Cristomorto'	4.9	4.7	16.5	16.7	36.2	32.8	23.2	24.3	3.5	3.2	1.2	1.1	26	23	10	16
'Tuono'	3.5	4.7	15.8	17.6	28.8	32.2	21.6	29.2	3.1	3.5	1.1	1.3	31	31	0	0
'Garrigues'	3.9	4.0	15.8	16.4	38.3	38.8	24.4	24.9	3.0	2.9	1.2	1.6	32	40	0	0
'Yaltinski'	4.5	5.3	17.6	17.0	43.3	44.1	26.3	28.4	2.6	2.6	1.8	2.2	39	42	48	42
'Drake'	3.0	2.9	17.1	16.9	33.2	31.4	21.8	21.5	2.1	2.0	1.4	1.4	47	48	8	10
'Picantili'	4.6	-[†]	18.4	-	40.3	-	25.6	-	2.9	-	1.8	-	39	-	54	-
'D. Largueta'	5.2	5.1	14.5	14.2	41.0	39.0	23.2	23.8	2.6	2.6	1.4	1.4	27	29	0	0

[†]Data not available.

Fruiting behavior of the cultivars is given in Table 2. 'Ferragnès', 'Tuono' and 'Drake' mainly fruited on spurs and 'Picantili' on one-year-old shoots. Other cultivars yielded on both spurs and one-year-old shoots. This should be taken into consideration during the pruning practice. The average kernel yields per tree were 3.1 kg in 'Ferragnès', 2.6 kg in 'Cristomorto' and 1.8 kg in 'Tuono' in the 5th leaf.

Table 2. Fruiting behavior of the almond cultivars

Cultivars	Fruiting on one-year-old shoots (%)	Fruiting on spurs (%)
'Ferragnès'	0.0	100.0
'Nonpareil'	18.9	71.1
'Cristomorto'	54.3	45.7
'Tuono'	8.9	91.1
'Garrigues'	26.6	73.4
'Yaltinski'	37.5	52.5
'Drake'	5.5	94.5
'Picantili'	100.0	0.0
'D. Largueta'	27.8	72.2

Conclusions

Because of its unique taste, almond cannot be substituted in pastry by other nuts such as peanut, hazelnut or pistachio. Therefore, almond is considered as a nut crop to be developed in Turkey.

In the last decade, the impact of cheap and high quality imported almonds on domestic market has been significant. In order to increase the local farmers' competition, the use of improved cultivars and proper production techniques should be encouraged. To secure satisfactory yield, late flowering cultivars should be planted. Yet, whatsoever the cultivar is chosen, the site selection in almond growing seems to be the most important criteria for commercial production. Kaska (2001) emphasized the importance of the frost-free and newly irrigated soils of "South East Anatolian Project" (GAP) for improving commercial almond culture in Turkey.

The late flowering 'Ferragnès' with high yielding performance appeared to be the best adapted cultivar to Kahramanmaras region. Research with self compatible and late blooming cultivars from Spain and France are still ongoing.

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