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Almond selection in microclimate areas of northeast Anatolia

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SUMMARY – Northeast Anatolia is the highest altitude region of Turkey. There are high mountains and wide valleys in which fruit grown is naturally. Upper Fırat river basin and Çoruh valley are the most important micro climate areas in the region. Seventeen almond types having late flowering properties were selected in the region during 1992 and 1997. Flowering time and period of the almond types started between 5 April and 3 May and between 8 and 10 days, respectively. The almond types had 3.02-6.14 g at average in-shell weight, 0.72-1.15 g at kernel weight, 14.66-26.81% at kernel rate, 0.0-20.0% at double kernel rate, and 96.0-100.0% at sound kernel rate. These selected almond types were budded in collection parcel at the Horticultural Research Institute of Erzincan in 1997.

Key words: Almond, *Prunus amygdalus*, selection, northeast Anatolia.

RESUME – "La sélection des amandiers dans les surfaces à microclimat de la région nord-est de l'Anatolie". Le nord-est de l'Anatolie est une région qui a la plus haute altitude de la Turquie. Dans cette région, à côté des hautes montagnes, il y a aussi des larges vallées propices pour cultiver des arbres fruitiers. Les Hauts Bassins d'Euphrate et de Çoruh sont les surfaces les plus importantes de la région pour la culture des amandiers. De l'année 1992 à 1997, par travaux de sélection, on a choisi dix-sept types d'amandiers dans la région qui ont la propriété de fleurir tard. D'après les résultats des travaux, les types d'amandiers choisis ont commencé à fleurir entre le 5 avril et le 3 mai, et la période de floraison a varié entre 8 et 10 jours. Le fruit avec sa pelure pèse 3,02-6,14 g, l'amandon intérieur 0,72-1,15 g, le rendement intérieur 14,66-26,81%, la proportion de doubles amandes 0,0-20,0% et la proportion d'amandes en bon état a pu varier entre 96,0-100,0%. Les types d'amandiers sélectionnés ont été greffés dans la parcelle de collection de l'Institut des Recherches Horticoles d'Erzincan en 1997.

Mots-clés : Amandier, *Prunus amygdalus*, sélection, Nord-Est de l'Anatolie.

Introduction

Almond (*Prunus amygdalus* Batsch), like other fruit trees, is a large-sized and long-lived species showing a relatively short juvenile period (Socias i Company, 1997).

The almond is one of the oldest tree nut crops used by human but its exacting environmental requirements have restricted its commercial production to specific areas of the world (Kester and Asay, 1979). Almond production is concentrated in three regions of the world. These are Asian and Mediterranean countries and California, with limited amounts in Australia, South Africa, Argentina and Chile (Kester *et al.*, 1990).

Almond culture are grown all of the areas except coast of East Black sea region and high plateau of Turkey (Gülcan *et al.*, 1989). But, the highest production is produced from Aegean and Mediterranean regions. According to current statistical data, 17,970 almond trees have produced 81 ton yield in northeast Anatolia region (Anonymous, 1999). All of the almond trees grown northeast Anatolia are grown with seed and generally grown in side of field and poly culture with the other fruit species. These areas have moderate continental climate with frequent occurrence of spring frosts that cause damages on almond.

Existing trees differ widely from each other in many characteristics, especially flowering time, yield, quality of nuts and tree vigour. This variability provided an invaluable material for the selections.

Seventeen almond types were selected from Fırat river basin and Çoruh valley, micro climate areas of the northeast Anatolia region, in 1992 and 1997. Selected almond types were budded in collection parcels in Erzincan Horticultural Research Institute in 1997.

Aim of this study was to select almond types starting late flowering, having high yield and quality and tolerant to spring frost from micro climate areas of northeast Anatolia.

Materials and methods

This study was conducted on almond population naturally grown in districts of Kemaliye (Erzincan) and _spir (Erzurum) between 1992 and 1997.

Almond types were compared with using weighted-ranked method (Gülcan *et al.*, 1989). Phonological properties of flowering and pomological characteristics of the almond types were made according to Godini *et al.* (1977) and Gülcan (1985), respectively.

Altitude of almond growth areas from sea level was determined by using altimeter barometer, and start of flowering of the almond types is getting one day late at each 35 m altitude (Özbek, 1977).

Weight of the in-shell and kernel were determined with balance (0.001 g sensitivity).

Results and discussion

After determining flowering time and pomological properties of almond types naturally grown, they were evaluated based on weighted-ranked method. According to weighted-ranked method, 17 almond types (24-Ke-29, 24-Ke-40, 24-Ke-45, 24-Ke-46, 24-Ke-80, 24-Ke-84, 24-Ke-125, 24-Ke-138, 24-Ke-158, 24-Ke-159, 24-Ke-170, 24-Ke-188, 24-Ke-191, 24-Ke-192, 24-Ke-193, 25_s-13 and 25_s-35) were selected. According to weighted-ranked graduation method, altitude from sea level, first and last flowering time, flowering period and days to between flowering and harvesting time of the almond types were given in Table 1.

Table 1. Average of total grade and phenological properties of the selected almond types (1992-1997)

Types no.	Total weighted Ranked graduation		Altitude (m)	First flowering (5-10%)	Full flowering (50%)	Last flowering (90-95%)	Flowering period (days)	Between full flowering-harvest (days)
	Flowering	Quality						
24-Ke-29	909	915	1035	8 April	13 April	17 April	10	139
24-Ke-40	916	898	1000	7 April	11 April	17 April	10	152
24-Ke-45	864	854	1010	5 April	8 April	14 April	9	155
24-Ke-46	904	896	1010	5 April	9 April	14 April	9	147
24-Ke-80	901	893	1040	9 April	12 April	16 April	8	138
24-Ke-84	907	909	1150	9 April	13 April	17 April	8	137
24-Ke-125	947	909	1210	18 April	22 April	27 April	9	142
24-Ke-138	907	891	1330	19 April	22 April	29 April	10	138
24-Ke-158	917	909	1355	21 April	26 April	1 May	10	143
24-Ke-159	932	900	1335	23 April	28 April	4 May	10	143
24-Ke-170	905	898	1355	28 April	2 May	6 May	9	143
24-Ke-188	907	909	1365	26 April	30 April	4 May	9	145
24-Ke-191	930	894	1355	30 April	5 May	9 May	9	142
24-Ke-192	908	892	1355	3 May	7 May	12 May	8	136
24-Ke-193	934	904	1355	27 April	2 May	7 May	9	141
25_s-13	926	896	1100	7 April	11 April	16 April	9	149
25_s-35	904	892	1150	8 April	13 April	18 April	10	147

In terms of flowering and fruit quality based on weighted-ranked graduation method, 24-Ke-45 almond type had the lowest grade (864) and the highest was 947 grade in 24-Ke-125 almond type; 24-Ke-45 had the lowest quality grade (854) and the highest value was 915 in 24-Ke-29, respectively.

Altitude of the selected almond types ranged between 1000 m (24-Ke-40) and 1365 m (24-Ke-188).

According to 6 years phenological results, first flowering started between 5 April and 3 May; full flowering occurred between 8 April and 7 May; and end of flowering was between 14 April and 12 May of the selected almond types.

Average flowering period of the selected types ranged between 8-10 days. Between days to full flowering and harvesting were determined as 136 days (24-Ke-192) and 155 days (24-Ke-45).

Pomological properties of the selected almond types were given in Table 2. Average in-shell weight ranged between 3.02 (24-Ke-159) and 6.14 g (24-Ke-29); kernel weight changed between 0.72 (24-Ke-188) and 1.15 g (24-Ke-29 and 24-Ke-138). Average kernel rate was 14.66% (24-Ke-188) and 26.81% (24-Ke-45); double kernel rate ranged between 0.0% and 20.0%, sound kernel rate was determined as 96.0% and 100.0% of the almond types.

Table 2. Average of In-shell and kernel properties of the selected almond types (1992-1997)

Types no.	Weight (g)		Kernel rate (%)	Double kernel (%)	Sound kernel (%)
	In-shell	Kernel			
24-Ke-29	6.14	1.15	18.68	0.0	96.0
24-Ke-40	3.81	0.79	20.72	0.0	100.0
24-Ke-45	3.07	0.82	26.81	0.0	96.0
24-Ke-46	5.25	0.99	18.92	0.0	100.0
24-Ke-80	5.59	1.03	18.49	0.0	100.0
24-Ke-84	6.09	1.01	16.49	0.0	100.0
24-Ke-125	3.76	0.84	22.37	0.0	100.0
24-Ke-138	5.55	1.15	20.74	20.0	100.0
24-Ke-158	5.88	1.10	18.76	0.0	100.0
24-Ke-159	3.02	0.78	25.79	16.0	100.0
24-Ke-170	5.66	1.01	17.82	0.0	100.0
24-Ke-188	4.94	0.72	14.66	0.0	100.0
24-Ke-191	4.16	0.91	21.68	0.0	100.0
24-Ke-192	5.05	1.06	21.01	8.0	100.0
24-Ke-193	5.90	0.91	15.46	0.0	100.0
25-s-13	5.56	1.08	19.42	4.0	100.0
25-s-35	4.88	0.90	18.44	0.0	100.0

Because of growing the selected almond types in same ecological conditions, they were budded in collection parcel at Erzincan Research Institute in 1997.

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