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A research on improvement of almond (*P. amygdalus* L.) by selection of wild growing types in Tokat Central District

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SUMMARY – This study was carried out in 1998-1999 in the Tokat Central District. First 87 sweet almond types were selected from thousands of almond types. Then, according to the method of classification with respect to a weighted scale, 28 types were selected from the 87 almond types and the second year, 8 types were selected from the 28 almond types. All of the selected types have hard shell and are sweet. According to the results of both years in the 8 selected types; the average fruit weights with shell were between 7.58 g (YD-02)-2.18 g (YB-02); kernel weights were between 1.35 g (YD-02)-0.64 g (YD-01); kernel outputs were between 37.16% (YB-02)-17.81% (YD-02); the full kernel ratio was 100.00% in the other types, except for YB-04, _T-11, YD-01 and YB-01. The percentage of double kernels were between 63.33% (YB-02)-3.45% (YD-01).

Key words: Almond, selection, Tokat province.

RESUME – *"Recherches sur l'amélioration de l'amandier (*Prunus amygdalus *L.) par sélection d'amandiers sauvages dans le District Central de Tokat". Cette recherche a été conduite, entre les années 1998-1999, au centre de Tokat. Parmi 87 types d'amandes douces sélectionnées, la première année 28 types, la deuxième année 8 types, ont été acceptés comme les meilleurs types. Tous les types sont des amandes douces et dures. Selon la conclusion de deux années, on a obtenu dans les 8 types d'amandes sélectionnées, les poids des fruits avec coquilles 7,58 g (YD-02)-2,18 g (YB-02) ; les poids intérieurs 1,35 g (YD-02)-0,64 g (YD-01) ; les rendements intérieurs 37,16% (YB-02)-17,81% (YD-02) ; les proportions d'intérieurs pleins 100,00% excepté pour les types YB-04, _T-11, YD-01 et YB-01; les proportions d'intérieurs doubles 63,33% (YB-02)-3,45% (YD-01).*

Mots-clés : *Amande, sélection, province de Tokat.*

Introduction

Almond has been known and consumed for years in the world. From the immemorial most the almond trees were obtained by generative propagation in the almond growing districts that were primary and secondary origin centers. Eventually, the existing trees differ widely from each other in many characteristics.

In many regions such as Tokat, most of growing areas are not suitable for almond production because of high risks of frost damage. For this reason, late blooming, high yield and self fertile genotypes have to be selected (Dokuzo_uz and Gülcan, 1979; Gülcan *et al.*, 1989; Kester *et al.*, 1990). As a matter of fact, a lot of researchers have studied on these subjects (Gülcan *et al.*, 1968; Kester *et al.*, 1980; Kumar and Uppal, 1990; Ledbetter and Shonnard, 1992).

Production of almond was 43 thousand metric tone in Turkey in 1996 year and it was 424 metric tone in Tokat province and 262 metric tone in the central district (Anonymous, 1996, 1998). Because the Tokat region had spring late frost risks, in this study it was aimed to select almond types which late blooming, resistant to frost damage, productive and with the best fruit characteristics.

Materials and methods

This study was carried out in 1998-1999. It's believed that frost damage has been seen every year in Tokat. Because fruiting tree had no frost damage, fruits were picked up from these trees.

The important selection criterion and fruit characteristics were noted according to Dokuzo_uz and Gülcan (1979), Gülcan (1985), _en (1985) and Gülcan *et al.* (1989). The results were analysed according to the method of classification with respect to weighted scale (_en, 1985).

In selected types, especially fruit weight with shell, kernel weight, kernel output, the full kernel ratio, percentage of double kernel, softness of shell (the hardest, hard, soft), shell and kernel colour intensity (dark, middle, light), shrivelling of kernel (shrivelling, middle shrivelling, little shrivelling) and marking of outer shell were determined. In addition, other fruit and pomological characteristics were observed. Selection criterions in observed fruit characteristics, value scores and relative scores were given in Table 1.

Table 1. Selection criterions, value scores and relative scores of selected almond types

Selection criterions	Value scores	Relative scores (%)
Fruit weights with shell	(10-8-5)	16
Kernel weight	(10-8-4)	22
Kernel output	(10-8-3)	22
The full kernel ratio	(10-6-3)	10
Percentage of double kernel ratio	(3-6-10)	10
Softness of shell	(3-6-10)	5
Shrivelling of kernel	(6-8-10)	5
Kernel featherny	(3-6-10)	5
Kernel colour	(3-6-10)	5

Results and discussion

At the end of 1998, 87 sweet almond types were selected from thousands of almond types. Then, according to the method of classification with respect to weighted scale, 28 types were selected from 87 types and at the second year, 8 types were selected from 28 almond types. On the other hand, 10 almond types had frost damage in the second year. For this reason, the other types were evaluated. These types blooming dates were between in 3^{th}-11^{th} March 1999 and were harvested in 7^{th}-15^{th} August 1998 and 1999. The comparison of results of the best types were given in Tables 2, 3 and 4.

In the selected types, the average fruit weights with shell were between 7.58 g (YD-02)-2.18 g (YB-02); kernel weights were between 1.35 g (YD-02)-0.64 g (YD-01); kernel outputs were between 37.16% (YB-02)-17.81% (YD-02). The full kernel ratio was found 100.00% in the other types, except for YB-04, _T-11, YD-01 and YB-01. The percentage of double kernels were between 63.33% (YB-02)-3.45% (YD-01). Shrivelling of kernel was generally observed at little and medium level and kernel colours were between light brown and dark brown (Table 2).

Except for special situations, sour characteristic not desire in almond. In addition, the important selection criterions were softness of shell, kernel output, fruit weight with shell and kernel weight, percentage of double kernel (double + twin kernel), kernel colour intensity and kernel feathery (Gülcan *et al.*, 1968; Anonymous, 1981; Gülcan, 1985; Gülcan *et al.*, 1989). In some other studies values in kernel weights with shell were determined as between 3.45-5.86 g (Bostan *et al.*, 1995), 3.37-5.24 g (Kumar and Uppal, 1990), 2.89-6.14 g (Aslanta_ and Güleryüz, 1995) and kernel weights, kernel outputs and percentage of double kernels were reported to be as following; 0.60-1.40 g (Dokuzo_uz and Gülcan, 1973; Cangi and _en, 1991; Aslanta_ and Güleryüz, 1995; Bostan *et al.*, 1995), 14.29-28.20% (Dokuzo_uz and Gülcan, 1973; Aslanta_ and Güleryüz, 1995; Bostan *et al.*,1995) and 30-0% (Aslanta_ and Güleryüz, 1995; Bostan *et al.*, 1995; Karadeniz *et al.*, 1996). In general, while the kernel output ratio is desired between 18.00-30.00%, percentage of double kernel is desired not to excess 5% (Özbek, 1978). Thus, our findings of fruit weights with kernel, kernel weights and percentage of double kernel were (except for YB-02) parallel with other similar

experiments. On the other hand, kernel outputs were found higher than the other similar studies, such as YB-02 (37.16%).

Table 2. The comparison of results of evaluated fundamental characteristics of the best selected types in Tokat Central District†

Type name	Fruit weight with shell (g)	Kernel weight (g)	Kernel output (%)	The full kernel ratio (%)	Percentage of double kernel (%)	Softness of shell	Shrivelling of kernel	Kernel feathery	Kernel colour intensity††	Total score
YB-01	3.48	0.87	25.00	93.10	0.00	Hard	Little	Little	LB	904
	4.78	1.01	21.13	100.00	12.12					820
YB-03	3.06	0.83	27.12	100.00	0.00	Hard	Little	Little	LB	904
	3.79	0.96	25.33	100.00	0.00					856
YD-03	3.43	0.95	27.70	100.00	0.00	Soft	Medium	A lot	LB	879
	4.84	1.25	25.87	100.00	0.00					923
_T-11	3.53	0.83	23.51	100.00	0.00	Hard	Medium	Medium	DB	874
	4.70	1.08	22.99	96.67	0.00					799
YB-04	3.71	0.85	22.91	100.00	11.11	Hard	Medium	Little	DB	874
	6.00	1.15	25.83	96.67	20.00					855
YB-02	2.18	0.81	37.16	100.00	37.93	Soft	Little	Little	LB	850
	4.23	1.15	27.19	100.00	63.33					898
YD-02	4.13	0.79	19.13	100.00	0.00	Hard	Shrivell	Little	LB	828
	7.58	1.35	17.81	100.00	0.00					806
YD-01	2.71	0.64	23.62	96.65	3.45	Hard	Little	Little	LB	812
	5.11	1.15	22.50	93.55	0.00					834

†Top values are from the first year and bottom ones from the second year.
††LB: Light brown; DB: Dark brown.

Table 3. The other fruit characteristics of almond with shell of the selected hopeful 8 almond types in Tokat Central District†

Type name	Colour intensity††	Shape†††	Width (mm)	Length (mm)	Cheak (mm)	Shape index (length/width)	Shell thickness (mm)	Marking of outer shell
YB-01	LB	NLScy	19.07	35.00	12.71	1.84	3.04	Little
			22.55	37.35	13.93	1.66	3.85	
YB-03	LB	CS	18.47	32.43	12.99	1.76	2.67	Little
			21.95	34.01	13.71	1.55	3.72	
YD-03	LB	Scy	20.17	32.86	13.90	1.63	2.28	Little
			24.50	33.53	15.76	1.37	3.86	
_T-11	LB	OS	20.03	32.10	14.05	1.60	2.90	Little
			22.00	34.80	14.74	1.58	3.71	
YB-04	LB	OS	20.51	34.35	13.66	1.67	2.71	Little
			25.54	39.00	15.52	1.53	3.36	
YB-02	LB	OP	18.64	22.55	12.33	1.21	1.73	Medium
			26.25	33.94	14.90	1.29	4.85	
YD-02	LB	NLScy	20.08	36.86	13.90	1.63	2.28	Little
			26.00	42.80	17.00	1.65	3.56	
YD-01	LB	NLScy	16.21	32.54	12.95	2.00	2.57	Medium
			23.50	32.77	16.66	1.39	4.53	

†Top values are from the first year and bottom ones from the second year.
††LB: Light brown.
†††C: Conical; cy: Cylindrical; P: Pressed; S: Swollen; L: Length; N: Narrow; O: Oval;

Table 4. The other fruit characteristics of kernel almond of the selected hopeful 8 almond types in Tokat Central District†

Type name	Width (mm)	Length (mm)	Cheak (mm)	Shape index (length/width)	Scale off outher shell
YB-01	10.81	23.77	5.12	2.20	Not peal
	13.55	24.67	6.10	1.82	
YB-03	10.96	22.57	5.34	2.06	Not peal
	12.31	24.02	6.19	1.95	
YD-03	12.10	22.54	6.41	1.86	Not peal
	14.81	23.41	7.16	1.58	
_T-11	12.15	21.89	6.59	1.80	Not peal
	13.51	23.66	7.21	1.75	
YB-04	11.00	22.23	5.27	2.02	Not peal
	14.48	26.15	6.34	1.81	
YB-02	9.85	20.07	5.81	2.04	Not peal
	13.67	24.01	6.80	1.76	
YD-02	10.40	23.17	5.17	2.23	Not peal
	14.22	25.30	6.23	1.78	
YD-01	8.19	21.70	5.42	2.65	Not peal
	14.00	23.22	6.63	1.66	

†Top values are from the first year and bottom ones from the second year.

Reason for the differences can be genotypic or due to ecological conditions. These types were wild growing approximately in 800-1200 metres altitude. These areas are arid, no irrigated and stony lands. Thus, no cultivations are possible except for almond, rosehip and wild pistachio species. Researchers also stated that the growing of hard shell almond could be preferred in these areas (Anonymous, 1997). Studies will continue in future on the selected 8 types.

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