THE ANALYSIS OF ALMOND CULTIVARS GROWN IN NORTH-WESTERN ROMANIA

Gîtea Manuel*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: giteamanuel@yahoo.com

Abstract

The almond crop has favourable conditions in the North Western Romania. The research was carried out during 2011-2013 in Berechiu.

Weather conditions were favorable for almond fructification in the research area during the studied period. The following parameters were studied: surface of trunk, intensity of blooming, natural fertility, harvesting maturity, fruit's size, fruit's weight, yield in peeling and double kernels. In two elite, was registered a surface of trunk, bigger than Primorsky, intensity of blooming and natural fertility were bigger than in Primorsky. The same situation was registered in kernels and fruits size and weight. In four elites, the double kernels had a bigger value than in Primorsky, the control variety.

For the period 2011-2013, the largest fruit production we have at H 2043 of 1623 kg/ha, H 1344 of 1677 kg/ha, H 2033 of 1711 kg/ha, but especially at H 1919 of 2064 kg/ha, H 2205 of 2264 kg/ha, all of them ensured statistically as very significant, in comparison with the Primorsky reference lot. The weight index ranges from 2.4 g in case of H 2043, 4.4g in case of H 1919.

The yield of 30-45% kernel, the European breeding line, is present in all elites we have studied, as well as at Primorsky reference lot.

Keywords: hybrids, phenophases, kernel production, yield in peeling

INTRODUCTION

The cultivated almond tree is part of *Rosaceae* family, *Prunoideae* subfamily, the genus of *Prunus*.

Despite the fact that it has been cultivated since antiquity, and has been appreciated in numerous countries for its fruits, in our country it still remains an unknown culture for the majority of the population. (Bordeianu, et al 1967; Cociu et al, 2003; Ghena et al., 2004; Şcheau, 1998; Şcheau, 1987)

The mesocarp (the green cover of the fruit), after drying and calcinations, gives an ash containing more than 40% potassium, which can be used for soap and chemical products production.

The endocarp is used for active vegetal coal preparation, necessary for toxic gases absorption as well as for the new cognacs or special wines coloring, conferring them a special flavor. (Gîtea, 2008; Kester et al., 1990)

The fruits of this species constitute a complete food, containing 37.0-61.8% fats, 14.7-37.3% proteins, 7-20% carbon hydrates, 2.4-4.2%g mineral substances, 3.1-5.5% water and numerous vitamins like: B-1, B-2, B-6, P, H, provitamin A, pentatonic acid and folic acid.

They can be prepared in different ways: candies, almond powder, salty almonds, almonds with different flavors, chocolate covered almonds, chocolate with almonds, almond milk, syrups, as well as different cookies containing almonds.

A valuable oil is extracted, especially from bitter almonds, used in pharmaceutical industry for various medicines, water, soaps, perfumes, creams, liquor essences. (Rikhter,1987; Şcheau, 1998; Ştefan et al. 1972)

Almond wood has a reddish color, characterized by high density and brilliant gloss, being used for art objects crafting.

Almond trees are used as a graft for peach and almond tree, especially on soils with a high level of calcium carbonate.(Felipe, 1989; Socias I Company R., 1996; Şcheau, 1996; Şcheau et al. 1994)

In Romania, the almond tree spreading area is almost superposed with that of vineyard, peach and apricot tree. At the beginning, almond trees could be found intercalated around vineyards, alleys and roads and even in the vineyard because it doesn't have big shadow and doesn't affect vineyard development. The first grafted types were introduced in our country when state nurseries were set up in 1896.

During the last 30 years, the almond tree has been systematically cultivated in the research stations.

The ideal cultivar should be of little or medium vigor, with a thin crown and solid stems, well garnished with short fruit formations; it should start bearing fruit early on and ensure large and constant productions, lively colored and uniform fruit, having the taste and the technological characteristics demanded by the standards of free markets and the food industry. (Grassely et al., 1980; Potlog A.S.,1980; Şcheau V., 2003)

The problems concerning the cultivar conveyor in almond trees have been, it is and it will remain of great importance for cultivating countries.

The study of the selected elites for the fruit-growing region in the north-western part of our country represents a main preoccupation.(Şcheau, 1998; Şcheau et al, 2006)

MATERIAL AND METHOD

On the farm of PFA Gîtea Daniela, the following almond hybrids: H14/2205/84, H 16/1919/84, H 1/2033/84, H 19/1532/82, H 1/2043/84, H 3/1344/82 were planted in 2004's spring at 4 meters between the rows and two meters per row (1250 trees per ha) linearly with 12 trees per variant (4 replications of 3 trees).

Yearly 150 kg of N/ha, 100 kg of P_2O_5/ha and 200 kg of K_2O/ha in the first four years after planting, and 250kg of N/ha, 250kg of P_2O_5/ha, 250 kg of K_2O/ha in the following years were administered.

Between the rows was maintained dead fallow by repeated disc and milling works, and on the rows hand work in the first three years after planting were performed, after which herbicide was administered with a Roundup of 3 l/ha in the following years, as well as mechanical and manual mowing. The treatments were performed after warning.

The trees were managed vessel shaped with flattened framework on row direction.

The elites coding is the following: the first digit represents the number of hybrid combination from the notebook containing the performed cross-breeding, the second digit represents the number of hybrid field, and the third digit represents the year of hybridization.

In case of the studied elites, the following observations, determinations and analysis were made:

Blooming – There were recorded daily, based on experience, the date of first flowers blooming, as well as the end of blooming, being taken into account the date when the petals were shaken off under the tree.

For these two moments of blooming there was calculated the average over the three years of study.

The intensity of blooming – There was recorded on a scale from 0 – zero floral induction, up to 5 – maximum floral induction, based on daily trips experience, the observations being made in the middle of blooming, calculating the average over the three years of study.

Natural fertility – On the inspected branches, 2 – 3 days before blooming, the flower buds were counted, having a number of 300–500 pieces. Each branch was labeled, a label being put under the roof structure, where it has been recorded the number of flowers found on each tree.

In July, after the physiological fall there were counted the fruits resulted from these flower buds, counted before, and it was calculated the percentage (%) of natural fertility.

Harvest maturity – Starting from the 1st of August, it has been recorded daily, near each elite, the date when the first fruits endocarp began to crack, respectively when the last fruits have opened their endocarp. The data represents the average over three years of study.

The surface of trunk section – There were measured with the caliper, in case of each tree, 2 diameters being determined the average, calculating the radius. It was applied the formula: $\frac{\pi R^2}{2}$ determining the surface of trunk section in cm².

Fruit production in the endocarp – In case of each tree out of those 5 per variant, the fruits were completely harvested and were weighed in kilograms/tree, the sum of those 5 trees was calculated and determined the kg of fruits/elite, then reported per hectare.

Size – In case of 25 fruit samples were measured with caliper the large diameter, the small diameter and the height, it was determined the average of those 75 measurements, after which it was calculated the size of fruit in millimeters, applying the formula:

$$\frac{D+d+h}{3}$$

Weight – Samples of 50 fruits were weighed using the analytical balance, then it was determined the average weight in grams (g).

The yield in peeling – Using the same 50 fruit samples weighed before, each almond was cracked, and then the resulted 50 kernels were weighed. It was determined as percentage (%) how much the kernel represents out of the total weight of those 50 fruits, and those data determined as percentage was called yield in peeling.

Double kernels – Using the same 50 fruit samples weighed for their weight before cracking, the double kernels were counted and reported as percentage (%).

Kernel production – Given the fruit production and the yield in peeling, it was determined the kernel production in kg/ha, applying the formula:

Kg of fruit/ha x yield in peeling (% kernel) = kernel production (kg/ha)

RESULTS AND DISCUSSIONS

Regarding the growth vigor, expressed by the surface of the trunk section (cm^2) the values are highly variable, from 99.7 cm^2 in case of H 2205 to 346.5 cm^2 in case of H 1919 (Table 1).

Thus, we have highly vigorous elite, such as: H 1919; medium vigorous: H 1344; poorly vigorous: Primorsky (Mt_1), the other elites being very poorly vigorous.

Compared to Mt_1 there are ensured statistically as significantly distinctive the elite: H 1344 and very significant H 1919, the rest of the elites are negatively ensured with different degrees of significance.

THE COURSE OF MAIN FRUCTIFICATION PHENOPHASES

In table 2 it is presented blooming, its intensity, natural fertility and harvest maturity in case of those six elites, as well as Primorsky reference lot, in those three years of research.

Early blooming begins in 28.03 in case of H 1532 and continues until 11.04 in case of H 1344.

The end of blooming begins in 7.04 in case of H 2205 and continues until 28.04 in case of H 1532.

Table 1

The surface of trunk section in case of the studied almond elites

No.	E L I T E	The surface of trunk section (cm^2)		COMPARED TO M_{t1} (PRIMORSKY)		
		2004-2012	2013	RELATIVE MEAN (%)	± d (cm^2)	Significance
1.	H 16/1919/84	97.6	346.5	215.9	+186.0	xxx
2.	H 3/1344/82	62.1	191.1	119.1	+30.6	xx
3.	PRIMORSKY (M_{t1})	60.1	160.5	100.0	0.0	
4.	H 1/2033/84	61.6	144.8	90.2	-15.5	
5.	H 1/2043/84	56.3	143.6	89.5	-16.9	
6.	H 19/1532/82	41.1	100.3	62.5	-60.2	000
7.	H 24/2205/84	43.0	99.7	62.1	-60.8	000

LSD5%=20.9 LSD 1%=27.7 LSD 0.1%=35.8

The intensity of blooming has values between 3.1 in case of Primorsky and 5 in case of H 2033, H 2043. Natural fertility varies between 12.3% in case of H 2043 up to 64.0% in case of H 1919. It can be seen that in case the intensity of blooming is low, the percentage of fruits is much higher.

Harvesting maturity begins in 20.08 in case of H 2205 and continues until 15.09 in case of Primorsky, ending within 31.08 in case of H 2205, continuing until 23.09 in case of Primorsky.

Table 2

The course of main fructification phenophases in case of almond elites
(Averages 2011-2013)

No.	E L I T E	Blooming		Intensity of blooming (notes)	Natural fertility (%)	Harvesting maturity	
		Beginning	Ending			Beginning	Ending
1.	H 1/2033/84	09.04	21.04	5.0	42.0	22.08	06.09
2.	H 4/2205/84	29.03	07.04	3.5	28.0	20.08	31.08
3.	H 1/2043/84	05.04	18.04	5.0	12.3	30.08	09.09
4.	H 3/1344/82	11.04	21.04	3.2	45.2	30.08	11.09
5.	H 16/1919/84	10.04	19.04	4.7	64.0	31.08	12.09
6.	H 19/1532/82	28.03	28.04	3.3	28.9	25.08	07.09
7.	PRIMORSKY	03.04	11.04	3.1	15.7	15.09	23.09

FRUIT PRODUCTION (IN SHELL) OBTAINED FOR THE YEARS OF RESEARCH

Average fruit production during 2011-2013 (Table 3) compared to Primorsky (Mt_1) is statistically ensured as highly significant in case of H 2205, H 1919, H 2033, H 1344 and H2043.

If we ”trade in fruits” the most valuable varieties are H 2205 with 2264 kg/ha, H 1919 with 2064 kg/ha, H 2033 with 1711 kg/ha, H 1344 with 1677 kg/ha and H 2043 with 1623 kg/ha.

Table 3

Fruit production in case of the studied almond elites

No.	E L I T E	PRODUCION (kg/ha)			AVERAGE (kg/ha)	COMPARED TO M_{t1}		
		2011	2012	2013		RELATIVE MEAN %	± d (kg/ha)	Significance
1.	H 4/2205/84	2664	1665	2463	2264	184.8	+1039	xxx
2.	H 16/1919/84	666	2664	2864	2064	168.5	+839	xxx
3.	H 1/2033/84	1665	1665	1802	1711	139.7	+486	xxx
4.	H 3/1344/82	1332	1998	1702	1677	136.9	+452	xxx
5.	H 1/2043/84	2331	799	1739	1623	132.5	+398	xxx
6.	H 19/1532/82	1332	999	1370	1234	100.7	+9	
7.	PRIMORSKY (M_{t1})	1130	1304	1241	1225	100.0	0.0	

LSD 5% = 159.2 LSD 1% = 211.2 LSD 0,1%= 272.0

KERNEL PRODUCTION OBTAINED FOR THE YEARS OF STUDY

In table 4 it is presented kernel production in case of almond elites in 2011-2013 compared to Primorsky (Mt_1).

Compared to Primorsky, those 6 elites H 2205, H 1344, H 2043, H 2033, H 1532, H 1919 are statistically ensured as highly significant, having values of production: H 2205 with 887.2 kg/ha, H 1344 with 823.7 kg/ha, H 2043 with 762.1 kg/ha, H 2033 with 740.2 kg/ha, H 1532 with 671.2 kg/ha, and H 1919 with 614.1 kg/ha.

Table 4

Kernel production in case of the studied almond elites

No.	E L I T E	PRODUCTION (kg/ha)			AVERAGE (kg/ha)	COMPARED TO M_{t1}		
		2011	2012	2013		RELATIVE MEAN%	± d (kg/ha)	Significance
1.	H 4/2205/84	1230.8	529.4	901.5	887.2	205.2	+454.8	xxx
2.	H 3/1344/82	675.3	943.1	852.7	823.7	190.5	+391.3	xxx
3.	H 1/2043/84	1123.5	352.4	810.3	762.1	176.2	+329.7	xxx
4.	H 1/2033/84	742.6	697.6	780.4	740.2	162.3	+307.8	xxx
5.	H 19/1532/82	772.6	480.5	760.5	671.2	155.2	+238.8	xxx
6.	H 16/1919/84	207.8	761.9	872.7	614.1	142.0	+181.7	xxx
7.	PRIMORSKY (M_{t1})	398.9	460.3	438.1	432.4	100.0	0.0	

LSD 5 % = 56.2 LSD 1 % = 74.6 LSD 0.1 % = 96.0

THE PHYSICAL PROPERTIES OF THE STUDIED ALMOND ELITES

Size indexes (Table 5) has values between 22.4 mm in case of Primorsky and 25.6 mm in case of H 2033.

In the majority of studied almond elites, the fruit's weight has equal- or higher values than the Primorsky reference lot.

The weight index varies between 2.4 in case of H 2043 up to 4.4g in case of H 1919.

The yield in peeling, respectively % kernel, varies between 30.1% in case of H 1919 to 53.9% in case of H 1532. Double kernels over 10% i.e. imperfect, are not present in any of the studied elites.

Table 5

The physical properties of fruits in case of the studied almond elites, and in case of Primorsky variety

No.	E L I T E	Fruit's size (mm) 2011-2013	Fruit's weight (g) 2011-2013	Yield in peeling (% kernel)				Double kernels (%) 2011-2013
				2011	2012	2013	Average	
1.	H 16/1919/84	24.4	4.4	31.2	28.6	30.5	30.1	8,9
2.	H 1/2033/84	25.6	3.0	44.6	41.9	43.3	43.3	8,3
3.	H 4/2205/84	22.6	2.6	46.2	31.8	36.6	38.2	6,5
4.	H 3/1344/82	25.2	3.0	50.7	47.2	50.1	49.3	0,0
5.	H 1/2043/84	23.0	2.4	48.2	44.1	46.6	46.3	0,0
6.	H 19/1532/84	24.7	2.6	58.0	48.1	55.5	53.9	4,8
7.	PRIMORSKY	22.4	2.5	33.3	35.3	37.3	35.3	1.8

CONCLUSIONS

In two elites, a surface of trunk was registered as bigger than in Primorsky, intensity of blooming and natural fertility were bigger than Primorsky. The same situation was registered in kernels and fruits size and weight. In four elites, the double kernels had a bigger value than in Primorsky, the control lot.

The research was carried out during 2011-2013 in Berechiu and there are the following conclusions:

- Weather conditions were favorable for almond fructification in the studied period.
- For the period of 2011-2013, the largest fruit production we have at H 2043 of 1623 kg/ha, H 1344 of 1677 kg/ha, H 2033 of 1711 kg/ha, but especially at H 1919 of 2064 kg/ha, H 2205 of 2264 kg/ha, all of them ensured statistically as very significant, in comparison with the Primorsky reference lot.
- For the same period, kernel production in case of elites: H 2205, H 1344, H 2043, H 2033, H 1532, H 1919 is statistically ensured as highly significant, having values between 887,2 kg/ha and 614,1 kg/ha.
- Weight index varies between 2.4 g in case of H 2043 up to 4.4g in case of H 1919.
- The yield of 30-45% kernel, European breeding line, it is present in case of all studied elites, as well as in case of Primorsky variety.

These 6 elites: H 14/220/84 (Sandi), H 16/1919/84 (April), H 1/2033/84 (Vio), H 19/1532/82 (Ardeal), H 3/1344/82 (Adria) and H 1/2043/84 (Alexandru) are patented, being the only species in the Catalogue of varieties and hybrids from Romania.

REFERENCES

1. Bordeianu, T., V. Cociu, 1967, *Pomologia Republicii Socialiste România*, Ed. Academiei R.S.R.,p. 44.
2. Cociu V. şi colab., 2003, *Culturile nucifere*, Editura Ceres, 2003
3. Felipe A.J., 1989, Rootstocks for almond. Present situation. Opt. Mediterraneennes Serie A,55:13–17
4. Ghena N., Braniţte N., 2004, Pomicultură generală, Editura MatrixRom,
5. Gîtea Manuel, 2008, Studiul elitelor de migdal în vederea obţinerii de soiuri noi, Editura Universităţii din Oradea,
6. Grassely Ch ,Crossa–Raynaud P,Olivier G,Gall H.1980– Transmission du caractere d'autocompatibilite chez l'Amandier.GREMPA IV colloque ,Izmir (Turchia).Options Mediterraneennes 1981–I:71–75
7. Kester D.E., Grsdziel T., Grassely Ch., 1990 – Almonds. In genetic resources of fruit and nut crops. Intern. Society for Horticul. Wageningen. Netherlands: 699–758
8. Popescu M., I. Miliţiu, Gh. Mihăescu, V. Cireaşă, I. Godeanu, Gh. Dobrotă, N. Cepoiu, 1982,Pomicultură generală şi specială, Ed. Didactică şi Pedagogică, Bucureşti, p.385.
9. Potlog A.S., Nedelea G., Caraus V., 1980 – Genetica şi ameliorarea calităţii plantelor agricole, 1980
10. Rikhter A.A.,1987 – Fatty acid composition of lipids in the leaves and reproductive organs of almond.Fiziologya Rastenii.34:949–955
11. Socias I Company R., 1996 , La taxonomie de l'amandier. GREMPA – Book of Abstract Resumes. Meknes, Maroc, 14–17 October
12. Şcheau V., 1998, Migdalul. Editura Imprimeriei de Vest, Oradea, 1998.
13. Şcheau V., Laslo V., 2003, Biometrie şi tehnică experimentală , Editura Universităţii Oradea, 2003.
14. Şcheau V., V. Cociu, T. Gal, A. Bunea, Violeta Şcheau, M. Cărbunar, 1996, Cercetări în livadă privind studiul portaltoilor generativi ai migdalului, Buletin Ştiinţific nr. 50/(6), I.C.P.P. Piteşti-Mărăcineni, p. 28-36.
15. Şcheau V., 1987, Sortimentul de migdal în bazinul pomicol Oradea, Lucrări ştiinţifice de I.C.P.P.Piteşti, vol. XII, p. 91-97.
16. Şcheau V., 1998, Îmbunătăţirea sortimentului de migdal în zona Oradea, Lucrări ştiinţifice de I.C.P.P. Piteşti, vol. XIII, p. 179-183.
17. Şcheau V., T. Gal, A. Bunea, Violeta Şcheau, 1994, Cercetări privind îmbunătăţirea sortimentului la migdal, Analele Universităţii din Oradea, vol. I, p. 81-98.
18. Şcheau V., M. Gitea, V. Laslo, F. Buie, A. Venig, A. Oneţ, 2006, Almond varieties at Oradea development and research unit, The 4th International Symposium „Natural Resources and Sustainable Development", Oradea, 10-11 octombrie, Ed. Universităţii din Oradea, p. 367-370.
19. Ştefan N., D. Cvasnîi, I. Modoran, V. Şuta, 1972, Îndrumătorul pomicultorului, Editura Ceres, Bucureşti, p.152.
20. *** Staţiunea de cercetare dezvoltare pomicolă Bihor. Academia de Ştiinţe agricole şi silvice – ICPP Piteşti – Mărăcineni , 2002, Editura Treira, Oradea