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Morphological examination of Hungarian apricot rootstock varieties

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Summary: Apricot seedlings are one of the most widely used rootstocks in apricot growing of Hungary. The National List of Hungary contains 7 apricot seedling rootstocks varieties. The production of apricot graft on seedling rootstock takes 3 years from the seed production to the complete graft and requires more space. It is important to provide the trueness to variety name during this process. In the genus *Prunoideae* not only the plant but also the stone should have typical characteristics. It seems to be useful to examine the morphology of stone. The observed varieties were 'Tengeribarack C.1300', 'Tengeribarack C.1301', 'Tengeribarack C.1650', 'Tengeribarack C.1652', 'Tengeribarack C.145', 'Tengeribarack C.1426' and 'Tengeribarack C.2546'.It seems to be the most suitable characteristic to make a distinction between these varieties by stone, the ratio height of stone to lateral width of stone, the ratio of height of stone to ventral width of stone, the ratio of lateral width of stone to ventral width of stone and the ratio of ventral zone to ventral width. From not measured characteristic seems to be most utilizable to make distinction: the fusion of dorsal groove margins, the shape of apex, the presence of a mucro of the apex, the shape of stalk end in lateral view and the texture of lateral surfaces.

Key words: *Prunus armeniaca*, apricot rootstock, stone, morphology

Introduction

Apricot seedlings are one of the most widely used rootstocks in apricot growing of Hungary (*Mády, 1995*). The National List of Hungary contains several apricot seedling rootstocks varieties. Rootstocks varieties are found in different forms in nursery, e.g. as seed cropping tree, as seed, as part of scion-rootstock combinations in a nursery and in a fruit cultivation. The production of apricot graft on seedling rootstock takes 3 years from the seed production to the complete graft and requires more space. It is important to provide the trueness to variety name during this process. In genus *Prunoideae* not only the plant but also the stone should have typical characteristics. *(UPOV, 2002)* It seems to be useful to examine the morphology of stone. The examination of stones seems to be an efficient additional method adapted well to the test of variety and nursery, and needs relatively low level of costs, means and time. We tested the morphology of the seed cropping trees and stones too.

Materials and methods

In 1990, 7 apricot seedling rootstocks varieties were planted as seed cropping trees in Albertirsa, at the Station of Fruit Growing Research Institute, Cegléd. Their spacing was 9.0?6.0 m. The training system was free hedgerow. Albertirsa had a typical sand soil and continental climate of the Great-Plain.

The observed varieties were 'Tengeribarack C.1300', 'Tengeribarack C.1301', 'Tengeribarack C.1650', 'Tengeribarack C.1652', 'Tengeribarack C.145', 'Tengeribarack C.1426' and 'Tengeribarack C.2546'. The above apricot rootstocks are members of the halfwild "tengeribarack" group (*Armeniaca vulgaris cv. minor*).

We examined the morphology of seed cropping trees. The method of examination followed the roles of UPOV (*UPOV, 1979*). We examined the morphology of stones too. We followed the previous guidelines and we tried to find other characteristics on the basis of special literature (*Löschnig & Passecker*) and our observations (*Szani et al., 2005*).

The morphological characteristics were tested in 2004–2005 during two independent growing cycles. All observation was made on 5 plants or 25 parts taken from each of 5 plants.

The statistical analyses of measured data are based on Student's two-tailed t-test of the variance of variety means. We considered two varieties distinct by a quantitative characteristic if they were significantly different at the 1% level in the same direction in both of the two years.

Results and discussion

Descriptions of seed cropping trees

'*Tengeribarack C.1300*'. The vigor of tree is medium – strong and habit is slightly open. The anthocyanin coloration of young shoots tip is medium. On the one-year old shoot there are few – medium lenticels. The prominence of lenticels is inconspicuous or medium. Feathering is slight or medium on one-year old shoots. The ratio of length of petiole and length of blade is low – medium. The ratio of length and breadth of leaf blade is medium. The size of leaf is small – medium. The color of leaf upper side is medium – dark green. The shape of leaf base is attenuate, the shape of tip is acuminate and the angle of tip is broad acute. The margin of leaf blade is biserrate and slightly undulated. The cross section of leaf blade is obtuse. The length of petiole is short – medium, the thickness is medium. The anthocyanin coloration of upper side of petiole is medium – strong. The predominant number of glands is two or three. The size of glands is small – medium. The size of flower is medium. The fruit is very small – small, in profile view rectangular, in frontal view trapezoidal. The depth of suture is shallow – medium. The depth of pedicel cavity is medium. The tip is flat. The surface is smooth. The ground color is orange. The intensity of anthocyanin coloration is weak, their extent is small and their distribution is isolated flecks – solid flash. The flowering and maturity are early – medium.

'*Tengeribarack C.1301*'. The vigor of tree is medium – strong and habit is slightly open. The anthocyanin coloration of young shoots tip is medium – strong. On the one-year old shoot there are few lenticels. The lenticels are inconspicuous. Feathering is medium on one-year old shoots. The ratio of length of petiole and length of blade is low. The ratio of length and breadth of leaf blade is medium. The leaf is small. The color of leaf upper side is medium green. The shape of leaf base is truncate, the shape of tip is acuminate and the angle of tip is broad acute. The margin of leaf blade is serrate and slightly – medium undulated. The cross section of leaf blade is flat. The length of petiole is short, the thickness is thin – medium. The anthocyanin coloration of upper side of petiole is medium. The predominant number of glands is one. The glands are small. The size of flower is small - medium. The fruit is small, in profile and frontal view trapezoidal too. The depth of suture is medium. The pedicel cavity is shallow. The tip is flat. The surface is smooth. The ground color is light orange. The intensity of anthocyanin coloration is weak - medium, their extent is very small - small and it is covered all over with very small dots. The time of flowering is medium and the time of maturity is late.

'*Tengeribarack C.1650*'. The vigor of tree is strong and habit is upright. The anthocyanin coloration of young shoots tip is medium. On the one-year old shoot there are few – medium lenticels. The lenticels are inconspicuous. Feathering is slight or medium on one-year old shoots. The ratio of length of petiole and length of blade is medium. The ratio of length and breadth of leaf blade is medium. The leaf is small. The color of leaf upper side is light – medium green. The shape of leaf base is attenuate, the shape of tip is acuminate and the angle of tip is narrow acute. The margin of leaf blade is biserrate and slightly – medium undulated. The cross section of leaf blade is obtuse. The petiole is short and thin. The anthocyanin coloration of upper side of petiole is strong. The predominant number of glands is one. The size of glands are very small – small. The flower is small. The fruit is small, in profile and frontal view trapezoidal. The depth of suture is medium. The depth of pedicel cavity is shallow - medium. The tip is flat. The surface is smooth. The ground color is light orange. The intensity of anthocyanin coloration is weak, their extent is small – medium and it is covered all over with very small dots. The time of flowering is medium and the time of maturity is medium – late.

'*Tengeribarack C.1652*'. The vigor of tree is medium and habit is open. The anthocyanin coloration of young shoots tip is medium – strong. The number of lenticels on the one-year old shoot is medium. The prominence of lenticels is inconspicuous or medium. Feathering is medium on one-year old shoots. The ratio of length of petiole and length of blade is medium. The ratio of length and breadth of leaf blade is medium. The size of leaf is small – medium. The color of leaf upper side is medium green. The shape of leaf base is attenuate, the shape of tip is acuminate and the angle of tip is narrow acute. The margin of leaf blade is serrate and slightly – medium undulated. The cross section of leaf blade is obtuse. The length of petiole is short – medium, and it is thin. The anthocyanin coloration of upper side of petiole is medium – strong. The predominant number of glands is two or three. The glands are small. The size of flower is small – medium. The fruit is very small – small, in profile view rectangular, in frontal view trapezoidal. The depth of suture is medium. The depth of pedicel cavity is shallow – medium. The tip is flat. The surface is slightly bumped. The ground color is light orange. The intensity and extent of anthocyanin coloration is medium, their distribution is isolated flecks – solid flash. The time of flowering is medium and the time of maturity is medium – late.

'*Tengeribarack C.145*'. The vigor of tree is medium and habit is slightly open. The anthocyanin coloration of young shoots tip is medium – strong. The number of lenticels on the one-year old shoot is medium. The prominence of lenticels is medium. Feathering is slight or medium on one-year old shoots. The ratio of length of petiole and length of blade is low – medium. The ratio of length and breadth of leaf blade is low – medium. The leaf is small. The color of leaf upper side is medium – dark green. The shape of leaf base is truncate, the shape of tip is acuminate and the angle of tip is broad acute. The margin of leaf blade is biserrate and slightly - medium undulated. The cross section of leaf blade is flat. The petiole is short. The thickness of petiole is medium. The anthocyanin coloration of upper side of petiole is medium –

strong. The predominant number of glands is two or three. The size of glands are small – medium. The size of flower is small – medium. The fruit is very small – small, in profile view rectangular, in frontal view trapezoidal. The depth of suture is medium. The depth of pedicel cavity is shallow – medium. The tip is flat. The surface is smooth. The ground color is orange. The intensity of anthocyanin coloration is medium – strong, their extent is small – medium and their distribution is isolated flecks – solid flash. The time of flowering is medium and the time of maturity is medium – late.

'Tengeribarack C.1426'. The vigor of tree is medium and habit is spreading. The anthocyanin coloration of young shoots tip is medium. On the one-year old shoot there are few – medium lenticels. The lenticels are inconspicuous. Feathering is slightly – medium on one-year old shoots. The ratio of length of petiole and length of blade is medium. The ratio of length and breadth of leaf blade is medium. The size of leaf is small – medium. The color of leaf upper side is medium – dark green. The shape of leaf base is truncate, the shape of tip is cuspidate and the angle of tip is broad acute. The margin of leaf blade is biserrate and slightly undulated. The cross section of leaf blade is flat. The length and thickness of petiole is medium. The anthocyanin coloration of upper side of petiole is medium – strong. The predominant number of glands is one. The glands are small. The flower is small. The fruit is small, in profile and frontal view rectangular too. The depth of suture is dep. The pedicel cavity is shallow – medium. The tip is flat. The surface is smooth. The ground color is orange. The intensity of anthocyanin coloration is weak – medium, their extent is very medium and it is covered all over with very small dots. The time of flowering is late and the time of maturity is late – very late.

'Tengeribarack C.2546'. The vigor of tree is medium – strong and habit is open. The anthocyanin coloration of young shoots tip is medium. The number of lenticels on the one-year old shoot is medium. The prominence of lenticels is inconspicuous or medium. Feathering is slightly – medium on one-year old shoots. The ratio of length of petiole and length of blade is medium. The ratio of length and breadth of leaf blade is medium – high. The size of leaf is small – medium. The color of leaf upper side is medium green. The shape of leaf base is attenuate, the shape of tip is acuminate and the angle of tip is narrow acute. The margin of leaf blade is serrate and medium undulated. The cross section of leaf blade is obtuse. The length of petiole is medium; the thickness is thin – medium. The anthocyanin coloration of upper side of petiole is strong. The predominant number of glands is two to three. The size of glands is small – medium. The size of flower is medium. The fruit is very small – small, in profile and frontal view rectangular too. The depth of suture is medium. The pedicel cavity is medium. The tip is flat. The surface is slightly bumped. The ground color is light orange. The intensity of anthocyanin coloration is weak, their extent is small and it is covered all over with very small dots. The time of flowering and time of maturity is medium.

Descriptions of stones

We were searching for easy applicable characteristics of stone. All stones were described by 8 data (height of stone, width of stone, ventral width of stone, width of keel in lateral view, width of secondary keel in lateral view, width of secondary keel in ventral view, width of keel in ventral view and width of dorsal groove in ventral view *(Table 1.)*) and by their 11 derived parameters. The ratio height of stone to

Table 1. Measurement of stones (Albertirsa 2004–2005.)

Characteristics	Year	Variety C.145	C.1300	C.1301	C.1650	C.1652	C.1426	C.2546	Total mean	SQ between groups	within groups	Level of probability
Height	2004	22.46	21.29	17.82	20.15	18.17	15.54	22.17	19.66	989.08	120.26	***
	2005	18.74	23.47	18.27	19.13	19.15	19.22	20.72	19.82	474.28	104.69	***
Lateral width	2004	18.69	18.98	16.50	17.73	14.68	13.68	18.45	16.96	651.19	177.98	***
	2005	15.41	22.14	17.36	16.34	16.46	19.03	17.91	17.81	754.96	168.29	***
Ventral width	2004	10.58	9.50	9.76	10.03	8.40	9.61	10.03	9.70	68.40	73.95	***
	2005	8.64	11.31	9.86	9.81	9.24	11.84	9.72	10.06	191.16	115.96	***
Lateral width of keel	2004	5.85	6.21	4.40	5.50	4.35	4.31	6.19	5.26	115.92	105.02	***
	2005	4.00	6.20	4.29	4.72	3.83	5.78	5.26	4.87	123.27	62.13	***
Lateral width of secondary keel	2004	3.08	3.46	2.27	2.88	2.54	2.41	3.67	2.90	42.78	36.54	***
	2005	2.46	2.55	2.15	2.16	1.73	3.30	3.02	2.48	43.53	30.79	***
Ventral width of secondary keel	2004	3.99	3.59	2.82	3.75	2.93	3.57	3.70	3.48	28.53	44.95	***
	2005	3.16	4.05	2.64	2.98	1.72	3.92	3.77	3.18	103.36	50.87	***
Ventral width of keel	2004	7.58	6.81	5.70	7.10	5.46	6.43	7.55	6.67	105.24	67.46	***
	2005	5.18	7.27	5.91	6.82	5.03	7.74	6.52	6.35	158.05	57.91	***
Ventral width of dorsal groove	2004	4.22	3.60	3.43	3.97	3.75	3.42	4.36	3.82	20.82	27.78	***
	2005	3.82	4.17	4.08	3.83	3.56	3.54	4.45	3.92	16.69	19.43	***

*** = 1%

Table 2. Rations of stones (Albertirsa 2004–2005)

Characteristics	Year	Variety C.145	C.1300	C.1301	C.1650	C.1652	C.1426	C.2546	Total mean	SQ between groups	within groups	Level of probability
Index of shape by	2004	2.87	2.21	1.95	1.65	2.29	2.43	2.48	2.27	22.82	48.83	***
Löschnig-Passecker	2005	2.56	2.53	1.98	1.86	2.29	2.68	2.69	2.37	16.95	7.35	***
Ratio height of stone /	2004	1.24	1.06	1.05	1.01	1.17	1.16	1.16	1.12	0.98	0.99	***
lateral width of stone	2005	1.20	1.12	1.08	1.14	1.14	1.24	1.21	1.16	0.47	0.45	***
Ratio height of stone /	2004	2.25	2.08	1.86	1.63	1.95	2.08	2.14	2.00	6.31	9.91	***
ventral width of stone	2005	2.13	2.25	1.83	1.63	2.01	2.17	2.22	2.03	7.77	2.84	***
Ratio lateral width												
of stone / ventral width	2004	1.81	1.96	1.76	1.62	1.67	1.79	1.85	1.78	1.93	2.50	***
of stone	2005	1.77	2.01	1.70	1.43	1.77	1.75	1.84	1.75	4.48	2.40	***
Ratio ventral	2004	0.77	0.74	0.88	0.76	0.77	1.11	0.70	0.82	2.96	1.80	***
zone /ventral width	2005	0.69	0.69	0.87	0.71	0.69	0.74	0.67	0.72	0.67	0.91	***

*** = 1%

lateral width of stone, the ratio of height of stone to ventral width of stone, the ratio of lateral width of stone to ventral width of stone and the ratio of ventral zone to ventral width were selected as most suitable characteristic to make a distinction between varieties *(Table 2.)* The most utilisable characteristic of not measured: the fusion of dorsal groove margins, the shape of apex, the presence of mucro at the apex, the shape of petiole end in lateral view and the texture of lateral surfaces.

Figure 1
Tengeribarack C.1300

'*Tengeribarack C.1300*'. The percentage of stone to fruit is high. The stone is slightly adherenced to flesh. The dried kernel is strong bitter. The ratio of height of stone to lateral width of stone is small. The position of maximum diameter in lateral view is slightly towards base. The texture of lateral surfaces is grained. The development of keel is strong. The ratio of height of stone to ventral width of stone is small – medium. The width of ventral zone is medium. The stone is predominantly asymmetric along the keel. The fusion of dorsal groove margins is complete. The shape of apex is acute. The mucro at apex is prominent. The ratio of lateral width of stone to ventral width of stone is large. The width of stalk end is medium. The shape of stalk end in lateral view is depressed, in ventral view is elliptic. The mucro at apex is prominent. The development of secondary keel is strong. The line of secondary keel is zigzag.

Figure 2 Tengeribarack C.1301

'*Tengeribarack C.1301*'. The percentage of stone to fruit is high. The stone is slightly adherenced to flesh. The dried kernel is sweet. The ratio of height of stone to lateral width of stone is small. The position of maximum diameter in lateral view is in middle. The texture of lateral surfaces is slightly grained. The development of keel is medium. The ratio of height of stone to ventral width of stone is small – medium. The width of ventral zone is broad. The stone is predominantly symmetric along the keel. The fusion of dorsal groove margins is complete. The shape of apex is acute. The mucro at apex is moderately prominent. The ratio of lateral width of stone to ventral width of stone is small - medium. The width of stalk end is medium. The shape of stalk end in lateral view is slightly depressed, in ventral view is broad elliptic. The development of secondary keel is strong. The line of secondary keel is wavy.

Figure 3
Tengeribarack C.1650

'*Tengeribarack C.1650*'. The percentage of stone to fruit is high – very high. The stone is medium – much adherenced to flesh. The dried kernel is sweet. The ratio of height of stone to lateral width of stone is medium. The position of maximum diameter in lateral view is in middle. The texture of lateral surfaces is strong grained. The development of keel is medium. The ratio of height of stone to ventral width of stone is medium. The width of ventral zone is medium. The stone is predominantly asymmetric along the keel. The fusion of dorsal groove margins is complete. The shape of apex is acute. The mucro at apex is moderately prominent. The ratio of lateral width of stone to ventral width of stone is medium. The width of stalk end is medium. The shape of stalk end in lateral view is depressed, in ventral view is elliptic. The development of secondary keel is weak. The line of secondary keel is wavy.

'*Tengeribarack C.1652*'. The percentage of stone to fruit is high – very high. The stone is not adherenced to flesh. The dried kernel is sweet. The ratio of height of stone to lateral width of stone is medium. The position of maximum diameter in lateral view is slightly towards base. The texture

Figure 4
Tengeribarack C.1652

of lateral surfaces is slightly grained. The development of keel is strong. The ratio of height of stone to ventral width of stone is medium. The width of ventral zone is broad. The stone is predominantly symmetric along the keel. The fusion of dorsal groove margins is complete. The shape of apex is acute. The mucro at apex is prominent. The ratio of lateral width of stone to ventral width of stone is medium. The width of stalk end is medium. The shape of stalk end in lateral view is flat, in ventral view is elliptic. The development of secondary keel is medium. The line of secondary keel is wavy.

Figure 5
Tengeribarack C.145

'*Tengeribarack C.145*'. The percentage of stone to fruit is medium – high. The stone is not adherenced to flesh. The dried kernel is sweet. The ratio of height of stone to lateral width of stone is medium. The position of maximum diameter in lateral view is in middle. The texture of lateral surfaces is slightly grained. The development of keel is medium. The ratio of height of stone to ventral width of stone is large. The width of ventral zone is narrow – medium. The stone is predominantly symmetric along the keel. The fusion of dorsal groove margins is partial. The shape of apex is rounded. The mucro at apex is inconspicuous. The ratio of lateral width of stone to ventral width of stone is medium. The width of stalk end is broad. The shape of stalk end in lateral view is depressed, in ventral view is broad elliptic. The development of secondary keel is strong. The line of secondary keel is zigzag.

Figure 6
Tengeribarack C.1426

'*Tengeribarack C.1426*'. The percentage of stone to fruit is high-very high. The stone is not adherenced to flesh. The dried kernel is sweet. The ratio of height of stone to lateral width of stone is large. The position of maximum diameter in lateral view is in middle. The texture of lateral surfaces is smooth. The development of keel is medium. The ratio of height of stone to ventral width of stone is small. The width of ventral zone is medium. The stone is predominantly symmetric along the keel. The fusion of dorsal groove margins is complete. The shape of apex is obtuse. The mucro at apex is inconspicuous. The ratio of lateral width of stone to ventral width of stone is small. The width of stalk end is narrow. The shape of stalk end in lateral view is flat, in ventral view is elliptic. The development of secondary keel is weak. The line of secondary keel is straight.

Figure 7
Tengeribarack C.2546

'*Tengeribarack C.2546*'. The percentage of stone to fruit is high. The stone is much adherenced to flesh. The dried kernel is bitter. The ratio of height of stone to lateral width of stone is medium. The position of maximum diameter in lateral view is in middle. The texture of lateral surfaces is hammered. The development of keel is medium. The ratio of height of stone to ventral width of stone is large. The width of ventral zone is narrow – medium. The stone is predominantly symmetric along the keel. The fusion of dorsal groove margins is absent. The shape of apex is obtuse. The mucro at apex is inconspicuous. The ratio of lateral width of stone to ventral width of stone is medium – large. The width of stalk end is narrow. The shape of stalk end in lateral view is flat, in ventral view is narrow elliptic. The development of secondary keel is medium. The line of secondary keel is zigzag.

The examination of stones seems to be an efficient additional method adapted well to the test of variety and nursery, and needs relatively low level of costs, means and time.

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