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Effects of environmental factors on morphological and quality parameters of table beet root

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Summary: In our trial morphological and quality parameters of 15 table root varieties were tested at 3 different sowing dates: 15 April, 9 July and 19 August 2010.
In the trials the root shape of the varieties form the April sowing date approached most the regular spherical shape (diameter/length –1.0) which is favoured both by fresh market and the processing industry. In the July and August sowings the roots were elongated with reduced proportions.
The highest red pigment content (betacyanin) was observed in the second sowing of July (>80 mg/100 g). In the late sowing (August, under plastic tent) a further 10–20 mg/100 g pigment increase was measured in relation to the earlier sowing dates of the same varieties. A similar trend could be observed in yellow pigments (vulgaxanthis) which proves a close correlation between the quantities of the 2 pigments (r=0.823). The highest vulgaxanthin content (103.3–124.18 mg/100 g) was obtained form roots of the late sowing harvested in December.
Varieties reacted differently to temperature and so to sugar accumulation in the different sowing periods. In the July sowing higher water soluble solids content was measured on the mean of varieties (10.12 %) as compared to the April sowing (7.76%).
Sensory evaluations included inner colour intensity (1–5), with ring (1–3) and taste (1–5) of the raw material evaluated by scoring. According to laboratory measurements better inner colour intensity was observed in the July and August sowing dates. In these samples uniformly coloured, almost with, ring-free roots were obtained. In our trial varieties from the spring sowing had superior taste. Early sowing is recommended for fresh market sale while the second crop (July) harvested in autumn can satisfy processing requirements. In the late sowing (under unheated plastic tent) fresh beet root can be grown at the end of autumn or beginning of winter, thus prolonging the usability of plastic tents.

Key words: sowing date, table beet root varieties, colour and solid content, betacyanins, vulgaxanthins, sensory evaluation

Introduction

Formerly a medicinal plant and now generally used as a vegetable crop table beet root could fully answer modern raw material requirements of the food industry being a natural colouring agent. It is widely used abroad to substitute for the artificial and carcinogen agent E123. The high curative effect is mostly due to its rich vitamin and mineral ontents. Remarkable is the high mineral element content of the root and leaves (*Stefanovits Bányai* et al., 2002) which contributes to the mineral balance of the human organism by strengthening muscles and stamina. Antioxidants, vitamins B and C, pigments and other bioactive compounds are also found (*Goldman* and *Navazio*, 2008).

Despite its favourable effect on the human body table beet root occupies a relatively small growing area (cca. 0.3% of the total vegetable area). In Europe it is more widely used: fresh, salads, components of soups and dessert.

The trial aimed at testing the interaction of varieties and environmental factors on quality parameters at different sowing dates. In the same time suggestions are made how to use beet root harvested at different times according to its quality.

Literary review

Table beet root belongs to the cold tolerant species, its heat optimum being 19±7 °C after Markov-Haev. This temperature interval favours pigment development. Accordingly, in the countries north of Hungary beet root is grown and bred on much larger areas with considerably greater economical importance than in our country. In Hungary beet root is mostly known as canned salad from autumn processing. Researches of the past years confirmed its favourable nutritional-physiological effects so demands, as for fresh salad, also increased. Raw material requirements cannot be satisfied either as used to do up to now. Spring (April) and late (August, under plastics) sowings are well justified. Due to the short growing period (100 days) marketable yield can be obtained in July from spring sowing, in October form the second crop and in December form the late sowing under plastics.

Of the applied methods the early sowing (April) can be mentioned which can be harvested by the end of July but only for fresh market sale.

In Hungary table beet root is generally sown as second crop (end of June, beginning of July) because of the short growing period (100–110 days) and autumn processing capacity. In these months successful production cannot be without irrigation. Even water supply is absolutely necessary otherwise white ring will form and the bottom root will thicken and cause loss in cleaning.

The effect of sowing dates is influenced considerably by the climatic factors of the production area. German trials (Erfurt) showed the highest yield and best quality (low nitrate content) in early (April) sowing while the yield of the June sowing lagged behind (46%) that of the earlier crops. Moreover, the nitrate content also reached 3027 mg/kg value. Sowing dates hardly influenced the water soluble solids content (*Feller* and *Fink*, 2004).

The produce baby beet root and bunched beet root for fresh market seeds were sown early in spring in beds with 200 plant/m^2 using cold tolerant, bolting resistant, quickly thickening varieties. Considering the small root size production can only be profitable if the proportion of the desired root size reaches monogerm seeds, precise sowing and uniform germination (*Takacs-Hajos* et al., 2008).

Unheated plastic tents can be utilized in August sowing for some cold tolerant species including table beet root with quick vigorous growth and short growing period. Temporary cool periods could be parried by using voile covering.

The most important quality parameters include inner colour intensity and uniformity and water soluble solids content. There are considerable differences among varieties (*Takácsné Hájos*, 1999). One of the unfavourable traits is white ring. Some varieties are susceptible but the occurrence can be reduced considerably by proper cultural methods.

The favourable dietary-physiological effect is guaranteed by the red pigment (betacyanins), mineral element and diatetic fibre contents. Red pigments are found in several components which are present in different proportions in the varieties. They also determine the pigment compositions and their stability (*Nagy-Gasztonyi* et al., 2001).

In the water extract of the beet root the totality of pigments is called betalains. The compounds consist of the yellow pigments vulgaxanthin I, vulgaxanthin II and indica xanthin while betanin, prebetanin, isobetanin and neobetanin are responsible for the red colour. Glucose is an important component in the biosynthesis of red and yellow pigments. Thus, the quality of these 2 compound groups correlates with the rate of sugar accumulation (*Mabry*, 1980). In the growing period pigments keep on accumulating till the 100th day than after the 130th day, they can decline even by 40 % (*Shannon*, 1972; *Takácsné-Hájos*, 1997a).

Information about the antitumor effect of table root accelerated the testing of its bioactive components. This special effect is attributed to the red pigment content, to lactic acid in the fermented product and to certain vitamins (C and E). *Rusic* at al. (1983) reported antitumor effects of the fermented beet root juice. Lipid metabolism was also found favourably affected (*Váli* et al., 2007).

Beet root contains numerous vital macro- and micro-elements: fibres (0.9–2.53%), potassium (336 mg/100 g), magnesium (25 mg/100 g). The total sugar content (3.5–8.5%) consist of 92–95% sucrose and only 5–8% simple sugar. It depends on the variety, environmental factors and sowing and harvest dates (*Takacs-Hajos*, 2009; *Sumrah* et al., 2003). Beside sugars the taste of beet root is also determined by geosmin, it is responsible for its characteristic earthy taste. The soil and the variety both take part in the accumulation of this compound (*Guiping* et al., 2003). There are, however, considerable differences among varieties. But unsuitable storage conditions (nylon sacks, 10 °C temperature) can make the situation even worse (*Takácsné-Hájos*, 1997b).

Materials and methods

Tests were set up in the Horticultural Demonstration Garden of the Centre for Agricultural and Applied Economic Sciences of the University Debrecen with 15 table beet root varieties at 3 sowing dates (15 April, 9 July, 19 August). Soil analysis data of the area are given of the Institute for Food Science, Quality Safeguard and Microbiology of the University (*Table 1*).

Table 1. Soil analysis results

Parameters tested / place of sampling	K_A	**Total salt (%)**	pH_{H_2O}	pH_{KCl}	**Humus (%)**	**Total N (%)**	P_2O_5 **(mg/kg)**	K_2O **(mg/kg)**
Under plastic tent	40	0,026	7,75	7,27	5,39	0,313	140,8	230
Open field	35	0,014	7,87	7,29	2,36	0,137	126,2	260

Data reveal that pH values, humus content and K supply of the soil satisfy beet root requirements.

During the growing period productivity and quality parameters of the varieties were observed. *Table 2* lists the tested varieties according to sowing dates.

Figure 1 shows meteorological data. For measurements instruments of the University were used (Institute for Land Utilization, Technics and Area Development).

Table beet root varieties were first sown 15 April 2010 in 3 repetitions with 13 varieties at 30 cm row distance.

During the growing period the usual cultural and weeding methods were used. Plants were thinned at the 2–4 leaf stage 26 May 2010. Only 2 supplemental irrigations (30 mm) were needed as daily temperature and natural precipitations guaranteed optimal growing conditions. Crop was harvested 21 July 2010. Field measurements and sensory evaluation included: leaf length (cm), leaf weight (g), root diameter (cm), root length (cm), root weight (g), inner colour intensity (1–5), white ring (1–3) and taste (1–5). Pigment content (mg/100 g) was measured in the laboratory of the Institute for Food and Science, Quality Safeguard and Microbiology of the University with spectrophotometer at λ=476 nm, λ=538 nm and λ=600 nm

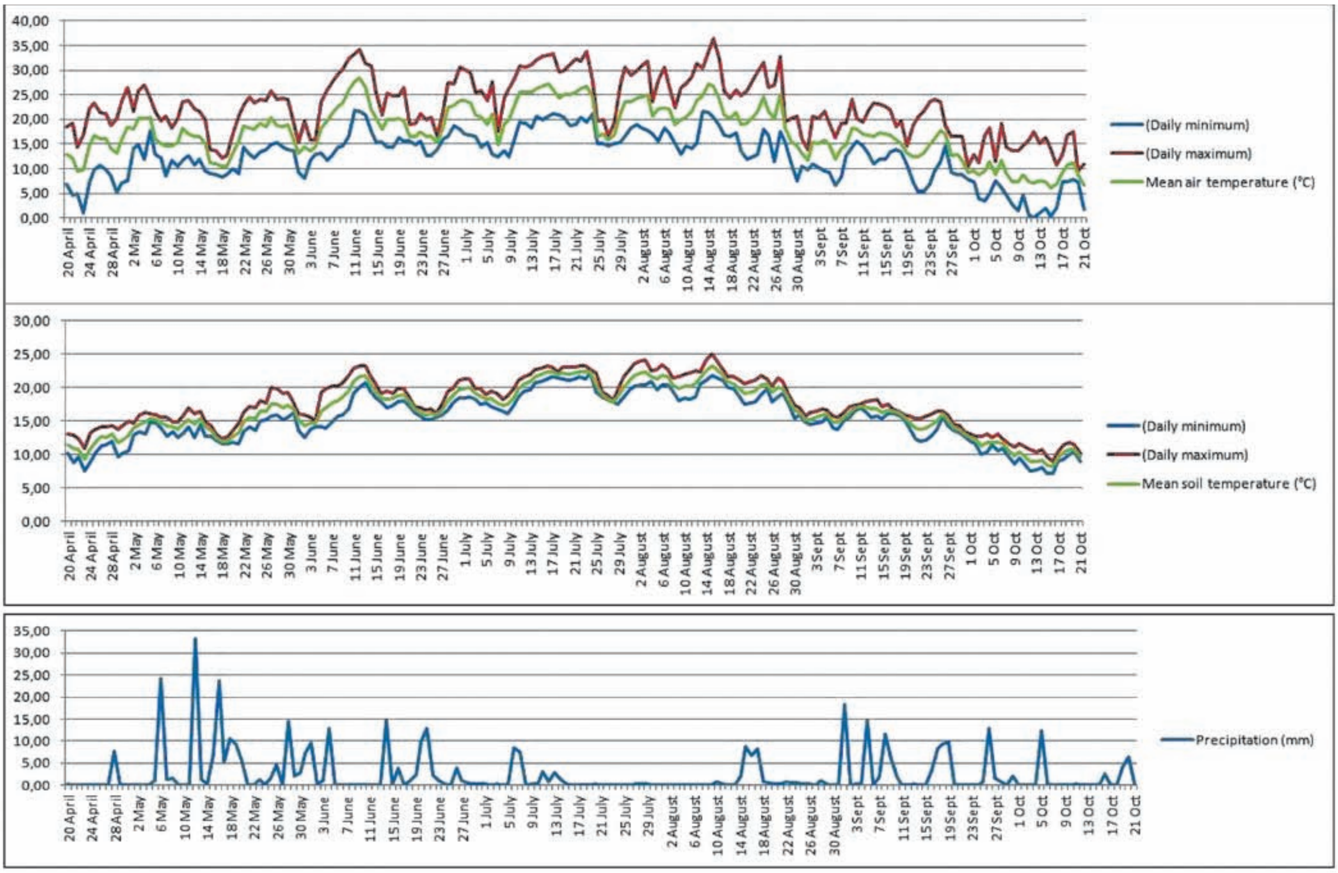

Figure 1. Soil, air and precipitation data in the tested period Debrecen April – October 2010

Table 2. Varieties in the different sowing dates

Series number	Variety	Sowing date		
		15 April	9 July	19 August
1.	Detroit*	X	X	–
2.	Bordó	X	X	–
3.	Favorit	X	X	–
4.	Bonel	X	X	X
5.	Rubin	X	X	–
6.	Little Ball	X	X	–
7.	Akela	X	X	X
8.	Larka	X	X	X
9.	Libero	X	X	X
10.	Mona Lisa	X	X	X
11.	Bikores	X	X	–
12.	Egyiptomi lapos	X	X	–
13.	Konett	X	X	–
14.	Cylindra*	–	X	–
15.	Cvikla podhlovaska*	–	X	–

*due to deficient coming up only some individuals could be evaluated sensorially

wavelength. The pigment content was determined according to *Nilsson* (1970) from the obtained extinction values. Statistical analysis included (*Sváb*, 1981) 2-factor variance analyses and correlation calculations (Microsoft Excel).

The second sowing followed 9 July 2010 in 4 repetitions with 15 varieties using usual cultural methods. Due to the warm, dry weather irrigation had to be applied 6 times (30 mm water dose). Daily mean temperature varied greatly during the growing period morphological and sensory evaluations the methods described above were used.

The third test was sown 19 August 2010 with 5 varieties under unheated plastic (movable) tents in 3 rows for each variety and at 30 cm row distance.

Regular irrigation, soil loosening and weeding methods were applied. Roots were harvested and evaluated 7 December 2010.

Results and evaluation

Root morphology

Quality is affected considerably by the morphological traits. The tested varieties were all of the spherical type except for *Egyiptomi lapos*. The spherical or slightly flatted root shape is responsible for an attractive appearance. Diameter, length and weight of roots were determined at 3 different sowing dates: spring (15 April), second crop (9 July) and late (19 August) (*Table 3*).

Table 3. Morphological data of the tested varieties

Variety	Diameter (cm)			Length (cm)			Weight (g)		
	15 April	9 July	19 August	15 April	9 July	19 August	15 April	9 July	19 August
Bordó	6.54	5.88		7.93	6.91		182.40	164.22	
Favorit	6.94	6.10		6.44	6.60		161.00	170.10	
Bonel	6.34	5.20	4.75	7.38	6.35	5.50	141.40	112.50	109.4
Rubin	5.92	5.45		6.09	6.05		131.93	103.30	
Little Ball	6.30	6.18		6.81	6.95		172.93	166.98	
Akela	6.13	6.48	5.20	6.48	7.30	6.38	149.33	187.60	91.73
Larka	5.74	5.20	4.90	6.07	5.53	6.50	93.73	88.93	85.68
Libero	5.94	6.33	5.67	6.47	7.07	7.00	140.67	161.13	156.95
Mona Lisa	5.85	5.20	5.60	5.57	6.00	7.00	143.05	111.10	96.00
Bikores	6.92	5.63		6.71	6.43		185.27	148.17	
Egyiptomi lapos	7.50	7.50		5.22	5.83		207.25	198.67	
Konett	5.84	5.00		6.32	6.60		139.54	127.97	
mean	6.33	5.85	5.22	6.46	6.47	6.48	154.04	145.06	107.95
deviation	0.55	0.72	0.41	0.73	0.54	0.61	29.90	35.45	28.74

Roots sown in April were larger in diameter and heavier in weight than those sown in July which can be explained by the sufficient natural water supply (269.40 mm) of the period between April and July. In the second crop only 230.80 mm precipitation was measured during the 100 day growing period with 27 °C mean temperature in August. In August beet root was sown under an unheated plastic tent to protect it from frosts during the 100 day growing period. In the 5 varieties roots were smaller and weighted less. Shape index of the varieties is shown in *Table 4*.

Table 4. Beet root shape index – diameter (cm)/length (cm)

Variety	15 April	9 July	19 August	Shape index on the mean of sowing dates	Distribution
Bordó	0.82	0.85		0.84	0.02
Favorit	1.08	0.92		1.00	0.11
Bonel	0.86	0.82	0.86	0.84	0.02
Rubin	0.97	0.90		0.94	0.05
Little Ball	0.93	0.89		0.91	0.03
Akela	0.95	0.89	0.82	0.92	0.06
Larka	0.95	0.94	0.75	0.94	0.11
Libero	0.92	0.90	0.81	0.91	0.06
Mona Lisa	1.05	0.87	0.80	0.96	0.13
Bikores	1.03	0.88		0.95	0.11
Egyipt. lapos	1.44	1.29		1.36	0.11
Konett	0.92	0.76		0.84	0.12
Shape index on the varieties	0.99	0.91	0.81		
deviation	0.16	0.13	0.04		

In the spherical type varieties the regular spherical shape with about 1.0 shape index is favourable. Shape is influenced by the uniform water supply of the soil affecting the activity of the bottom root which gets thick in temporary water deficiency making the root shape heart-shaped or oval.

In our tests the regular spherical root shape changed to oval in the late sowing dates. That is, the oval form was typical for most varieties. In the spring sowing *Egyiptomi lapos* had the characteristic flat form while *Favorit*, *Mona Lisa* and *Bikores* excelled in regular spherical shape. On the contrary, in the second crop all beet root varieties were oval except for *Egyiptomi lapos*. The highest elongated shape had *Konett* in the July sowing and *Larka* in the August sowing.

Quality parameters

The raw material value of table beet root is determined principally by the pigment content, its even distribution and the correlation of the red (betacyanin, BC) and yellow (betaxanthin, BX) pigments to each other. The most important pigment component is the betanin, a compound of red betacyanins occurring in the highest ratio. Data are shown in *Figure 2*.

The majority of varieties show higher values in the second crop than in the spring crop. The higher betanin content was promoted, without doubt, by the lower air temperature at the time of root thickening (September, in the second crop). The spring crop was harvested 21 July when temperature above 30 °C were measured. The Fig. shows clearly that the betanin content of root from the late showing date surpassed that of the

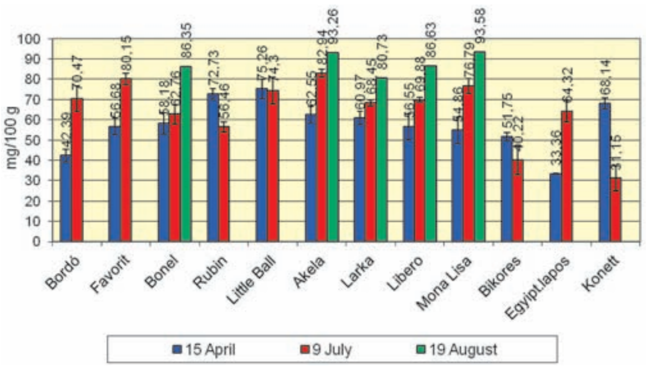

Figure 2. Betanin content (mg/100 g) of beet root varieties at different sowing dates

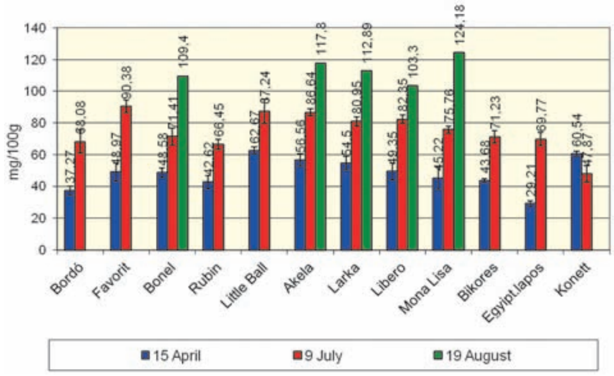

Figure 3. Vulgaxanthin content (mg/100 g) of table beet root varieties at different sowing dates

Table 5. Correlation studies between beet root quality parameters

	BC	**BX**	**BC/BX**	**Water soluble solids**	**Total solids**	**Inner colour (1–5)**	**White ring (1–3)**	**Taste (1–5)**
BC	0	0.823	–0.225	0.317	0.259	0.361	0.282	0.281
BX		0	–0.664	0.51	0.281	0.383	0.452	0.038
BC/BX			0	–0.587	–0.08	–0.151	–0.414	0.197
Water soluble solids				0	0.382	0.098	0.319	–0.169
Total solids					0	–0.133	–0.024	0.336
Inner colour (1-5)						0	0.73	0.047
White ring (1-3)							0	–0.115
Taste (1-5)								0

earlier showings. It means that the cooler temperature affects the pigment synthesis favourably. Tests of this kind could make suggestions as what genotype to choose for given soil and climatic conditions for fresh market and processing production.

Beside the red betanin the second most important pigment component is the yellow vulgaxanthin (*Figure 3*).

Sometimes the yellow pigment content (vulgaxanthin) of the beet root sown in July surpassed by more than 50 % that of the spring crop. In the late (August) sowing very high values were measured similar to the red pigments. This striking increase can also be explained by the cooler autumn weather, it means that the biosynthesis of the two pigment groups runs parallel to each other. The vulgaxanthin content correlation studies showed close correlation in the evolution of yellow and red pigments (r=0.823) in the tested varieties (*Table 5*).

The visible inner colour intensity of the root is determined by the relation of the 2 big pigment groups (betacyanins, betaxanthins) to each other (BC/BX ratio). This ratio is considerably higher in the spring sowing than in the second or late sowings (*Table 6*). The difference between the BC/BX ratios observed in the April and July sowings is statistically proved on the mean of varieties (LSD 0.1 %). It means that the cooler air temperature during the second and late

Table 6. Evolution in betanin and vulgaxanthin (BC/BX) ratio

Variety / sowing date	**BC/BX pigment ratio**		
	15 April	**9 July**	**19 August**
Bordó	1,14	1,03	
Favorit	1,16	0,89	
Bonel	1,20	0,88	0,80
Rubin	1,00	0,85	
Little Ball	1,20	0,85	
Akela	1,11	0,96	0,79
Larka	1,12	0,85	0,71
Libero	1,15	0,85	0,84
Mona Lisa	1,21	1,01	0,75
Bikores	1,18	0,56	
Egyiptomi lapos	1,14	0,92	
Konett	1,13	0,65	
mean	1,15	0,86	0,78
deviation	0,06	0,14	0,05
LSD (0,1%) ***	0,160		
LSD (1%) **	0,119		
LSD (5%) *	0,088		
LSD (1%) **	0,131		
LSD (5 %) *	0,090		

sowings also affected the synthesis of the yellow pigments more favourably. Due to the higher yellow pigment amount lower BC/BX ratio was obtained than in the spring sowing which developed in hot air summer days. The BC/BX ratio of the August sowing continued decreasing proving a higher development rate of the yellow pigments in relation to the red ones. In the late sowing root thickness and pigment accumulation coincided in October when air temperature decreased below 10 °C. Our tests proved statistically significant differences between the July and August crops in the BC/BX ratio (LSD 1%). That is, the BC/BX ratio of the late autumn crop was essentially lower (0.78) than that of the July sown genotypes (0.86).

In the total solids content of plants distinction must be made between water soluble solids (sugars, pigments, etc.) and water insoluble solids (fibres and other compounds). Water soluble solids were determined by a Brix meter. A considerable part of such substances consists of sugars which are in correlation with the sweet taste of the root. Water soluble solids data in the spring and second crops are shown in *Table 7*. On the mean of varieties there was significant difference between the second crop (10.12%) and the spring crop (7.76%). Similar significant difference was found among varieties on the mean of sowing dates (*Table 8*). *Favorit* and *Akela* showed the highest values (10,22% and 9,97%). The lowest water soluble solids content was found in *Larka* and *Libero* (7.46 % and 7.17%) on the mean of the 2 sowing dates. The highest ref. % was measured in almost every variety of the July sowing.

Table 7. Evolution of water soluble solids in beet root

	Water soluble solids (ref.%)		**On the mean of sowing dates**
Variety (A) / Sowing data (B)	15 April	9 July	19 August
Bordó	7,47	10,46	8,97
Favorit	8,07	12,37	10,22
Bonel	8,2	11,09	9,65
Rubin	7,9	10,3	9,10
Little Ball	7,52	10,13	8,83
Akela	9,17	10,76	9,97
Larka	6,83	8,09	7,46
Libero	6,2	8,13	7,17
Mona Lisa	7,7	10,03	8,87
Bikores	8,2	9,87	9,04
Egyiptomi lapos	7,65	10,03	8,84
Konett	8,2	10,17	9,19
On the mean of varieties	7,76	10,12	

Table 8. Variance table for water soluble solids

Variance table (random block) – WATER SOLUBLE SOLIDS				
Factor	**SQ**	**FG**	**MQ**	**F**
Total:	175.09	71		
Repetition:	0.16	2		
Treatment:	162.69	23	7.07	26.58 ***
Factor A:	51.73	11	4.70	17.67 ***
Factor B:	100.25	1	100.25	376.75 ***
Factors A B:	10.70	11	0.97	3.66 ***
Error:	12.24	46	0.27	
**** P=0,1%	*** P=1%		** P=5%	* P=10%
Significant differences:				
Between any 2 combinations (P=5%):				0.85
Between A factor variants on the mean of B (P=5%):				0.60
Between B factor variants on the mean of A (P=5%):				0.24
Between differences (e.g. b1-b2 in different A variants) (P=5%):				1.20

Beside sugars total solids content also comprises considerable amount of fibres which also play part in root texture. The total solids content (partly fibres) of the root is a variety characteristic but it is also influenced by environmental factors. Of the tested varieties significant difference were found in the genotypes *Akela, Larka* and *Konett* between the 2 sowing dates (*Table 9–10*). In this case the raw material of the spring sowing had higher solids content (14.21%, 10.83% and 12.78%) than that of the second crop (10.33%, 9.84% and 9.68%) in the 3 varieties. On the contrary, *Favorit, Bikores* and *Egyiptomi lapos* showed opposite trends. Such evolution of the solids content is certainly genetically fixed but it is also influenced by temperature and soil humidity. The late (August) sowing showed considerable increase in the 5 varieties as compared to the spring and summer crop.

Table 9. Total solids content of beet root at different sowing dates

Variety (A) / Sowing date (B)	**Total solids content (m/m%)**		**On the mean of sowing date**
	15 April	**9 July**	**19 August**
Bordó	12,11	12,3	12,21
Favorit	12,83	14,28	13,56
Bonel	12,79	12,19	12,49
Rubin	12,16	12,5	12,33
Little Ball	12,25	12,62	12,44
Akela	14,21	10,33	12,27
Larka	10,83	9,84	10,34
Libero	9,88	9,68	9,78
Mona Lisa	12,08	12,41	12,25
Bikores	13,33	14,12	13,73
Egyiptomi lapos	11,96	12,9	12,43
Konett	12,78	9,68	11,23
On the mean of varieties	12,27	11,90	

Table 10. Variance table for total solids content

Variance table (random block) – TOTAL SOLIDS				
Factor	**SQ**	**FG**	**MQ**	**F**
Total:	144.24	71		
Repetition:	0.47	2		
Treatment:	131.99	23	5.74	22.40 ***
Factor A:	86.89	11	7.90	30.83 ***
Factor B:	2.38	1	2.38	9.29 **
Factors A B:	42.72	11	3.88	15.16 ***
Error:	11.79	46	0.26	
**** P=0,1%	*** P=1%		** P=5%	* P=10%
Significant differences:				
Between any 2 combinations (P=5%):				0.83
Between A factor variants on the mean of B (P=5%):				0.59
Between B factor variants on the mean of A (P=5%):				0.24
Between differences (e.g. b1-b2 in different A variants) (P=5%):				1.18

Root quality evaluation

Basic material as used for fresh market and the processing industry were evaluated by simple sensory methods (*Table 11*) to establish inner colour intensity, white ring and taste values. Parameters were evaluated by scores: 1–5 in the case of inner red colour intensity. The competent compounds are mostly found in the rind and less in the xylem causing visible white or light coloured rings (scores: 1–3). Sensory evaluation confirmed that those of the spring sowing. The difference is more pronounced in the late sowing date. There is close correlation between pigment quantities and distribution within the root as shown not only by sensory evaluation but by the correlation value between the 2 parameters (r=0.730) as well (*Table 5*).

Modern diet stresses the importance of fresh vegetable consumption. Raw beet roots were also evaluated sensorially (1–5). In fresh salad dishes the taste of the basic material is decisive, only slightly modified by adding species. On the contrary, in processed food heat treatment and the composition of the brine can quite cover the original taste. Beside the sweet taste the presence of *geosmin* causing an earthy taste could also be evaluated by chewing raw root slices. There is no significant correlation between varieties of high sugar content and their sweet taste.

The earthy taste is due to microorganisms living in symbiosis with table beet roots, to the genetical character of the variety but also to soil factors (compactness, airless soil) which play a part in its development. In our trials values above 4.00 were mostly obtained in varieties of the spring sowing (*Bonel*, *Rubin*, *Little Ball, Akela, Bikores* and *Konett*). Of the 5 varieties in the late (August) sowing *Mona Lisa* excelled in flavour and aroma (5.00).

Table 11. Sensory evaluation results in beet root varieties

Sowing date	**Inner colour (1–5)**			**White ring (1–3)**			**Taste (1–5)**		
Variety	**15 April**	**9 July**	**19 August**	**15 April**	**9 July**	**19 August**	**15 April**	**9 July**	**19 August**
Detroit	3,50			1,00			1,50		
Bordó	4,00	4,54		2,50	2,71		1,70	2,98	
Favorit	5,00	4,65		3,00	2,95		3,00	3,13	
Bonel	4,60	5,00	4,00	2,77	3,00	3,00	4,40	3,25	3,50
Rubin	4,20	4,65		2,50	3,00		4,50	3,13	
Little Ball	3,93	4,35		1,90	2,60		4,50	2,75	
Akela	5,00	4,95	5,00	3,00	3,00	3,00	4,40	3,00	4,00
Larka	4,93	4,93	5,00	2,50	2,93	3,00	3,17	2,77	3,00
Libero	4,97	4,87	5,00	3,00	3,00	3,00	3,90	2,73	4,00
Mona Lisa	4,77	4,70	5,00	3,00	3,00	3,00	3,83	2,88	5,00
Bikores	4,17	4,50		2,33	2,87		4,43	3,23	
Egyipt. lapos	3,87	3,93		2,13	2,00		3,40	2,50	
Konett	4,80	4,33		2,50	2,87		4,27	3,33	
Cylindra		5,00			3,00			3,00	
C. podhlov.		4,07			3,00			2,33	
mean	4,44	4,61	4,80	2,47	2,85	3,00	3,62	2,93	3,90
deviation	0,52	0,34	0,45	0,57	0,27	0,00	1,03	0,29	0,74
scores	1 – red ↓ 5 – deep purple			1 – with white ring ↓ 3 – uniform inner colour			1 – strong earthy taste, tart after-taste ↓ 5 – sweet free of earthy taste		

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