

Comparison of selected characteristics of root parsley [*Petroselinum crispum* conv. *radicosum* (Alef.) Danert] cultivars

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ABSTRACT: An assortment of 15 cultivars of root parsley was studied in field experiments to evaluate morphological characteristics, market yield, content of selected minerals and nitrate content. Storage ability of roots was also assessed. Mean root weight ranged from 87 g (cv. Bartowich Long) to 129 g (cv. Atika). Root head diameter was from 39 mm (cv. Lange) to 49 mm (cv. Halfflange Omega and Hamburg). Mean root yield amounted to 1.35 kg/m² and the highest value was found in cv. Atika. Nitrate content did not exceed the tolerance limit ranging from 113 to 617 mg/kg of f.m. Mean content of K was 4,690 mg, Ca 124 mg, Mg 509 mg, and Na 425 mg/kg of f.m. Weight losses ranged from 10 to 32%; cv. Jadran showed the lowest value. Newer Czech cultivars (Atika, Jadran, Orbis) had a good commercial and growth potential.

Keywords: parsley; morphological characteristics; yield; nutritional value; storage ability; cultivar

Parsley is a typical root vegetable grown in this country. The area under parsley in the Czech Republic is around 1,500 ha. RUMPEL and KANISZEWSKI (1994) found the mean marketable yield to range from 18.8 to 21.1 t/ha, which is the level corresponding to a range of 15 to 20 t/ha published by MALÝ et al. (1998). Total Czech production ranges from 10 to 18 thousand tons and mean yield level is from 9.9 to 11.8 t/ha. A current Czech list of registered cultivars includes 14 parsley cultivars of inland and foreign origin. The quality of a large portion of domestic production is still below the market demand. Mean annual consumption of parsley is nearly 2 kg per capita.

The nutritional value of parsley roots is characterised by mean content (in mg/kg of fresh matter) of 5.3 mg of beta-carotene, 1.1 mg of thiamine, 1.0 mg of riboflavin, 1.6 mg of pyridoxine, 340 mg of vitamin C (KOPEC 1998). Table 1 shows the content of nitrates and minerals.

Parsley can be stored after a short drying period (directly after harvest at 15°C) at temperatures between -1 and +1°C and relative air humidity around 95% for several months (BAKOWSKI et al. 1994; MALÝ et al. 1998). BAKOWSKI et al. (1994) also found the significant effect of cultivar on storage ability of roots. Mean weight losses were 11–16%.

The aim of this paper was to compare a selected assortment of home and foreign parsley cultivars for their morphological characteristics, yield, storage ability and nutritional value.

MATERIALS AND METHODS

Experiments were conducted in an open field of the Faculty of Horticulture in Lednice. Fifteen cultivars (Table 2) of root parsley were included in the experiment. The culture was sown on April 1st 1997 and April 6th 1998. Final density was 50 plants per square meter. One experimental parcel was 10 m² in size and each cultivar was sown in three replications. Common cultural practices were used during the growing season. Additional irrigation was applied if necessary. A single irrigation dose was 20 mm. Harvest was finished on October 20th 1997 and October 23rd 1998.

Soil analysis showed the following results in 1997 and 1998: 7.3 and 7.4 pH, nutrient content in mg/kg: 2.9 and 3.2 mg of N-NO₃⁻, 199 mg and 193 mg P, 409 and 396 mg K, 4,329 and 4,955 mg Ca, respectively.

The following characteristics were evaluated: root weight, root length, root head diameter (in the thickest part of the root) and market root yield. Nutritional quality analysis consisted in determination of nitrates, potassium, calcium, magnesium and sodium content. Nitrates were analysed by ion-selective electrode Crytur (Crytur, CZ) and content of cations was determined by capillary isotachophoresis on Ionosep (Recman, CZ).

Weight losses were evaluated by determination of root weight decrease during the period from October 23rd 1997 to March 28th 1998 and from November 5th 1998 to April 14th 1999. Root samples were stored at 1.5°C and 90% relative air humidity.

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Table 1. Content of nitrates and selected minerals in parsley root (mg/kg of fresh matter)

N-NO ₃ ⁻	Ca	Mg	K	Na	References
79–266 ³					¹ PRUGAR, PRUGAROVÁ (1985)
154–290 ⁴	400 ²	250 ²	4,000 ²		² SOUCI et al. (1991)
40–1,657 ¹	970 ⁶	500 ⁸	5,080 ⁶	300 ⁶	³ BAKOWSKI et al. (1994)
476 ⁷	1,380 ⁸		5,540 ⁸	560 ⁸	⁴ RUMPEL, KANISZEWSKI (1994)
1,224 ⁵		516 ⁶			⁵ LACHMAN et al. (1997)
					⁶ KOPEC (1998)
					⁷ SIOMOS, DOGRAS (1999)
					⁸ US Department (2001)

Table 2. Mean content of nitrates and selected minerals in parsley roots (mg/kg f.m.)

Cultivar	Origin	K	Ca	Mg	Na	N-NO ₃
Atika	Semo (CZ)	5,527	151	542	384	466
Bartowich Long	Johnny's (USA)	5,642	114	430	547	248
Dobra	Seva-Flora (CZ)	4,990	133	616	201	478
Fakir	Küpper (GER)	4,436	120	494	315	343
Halblange	Hild (GER)	4,664	122	529	317	220
Halblange Fakir	Hild (GER)	4,459	125	469	254	617
Halblange Perfekta	Küpper (GER)	4,561	128	438	274	438
Halflange Omega	Royal Sluis (NL)	4,320	127	551	335	432
Hamburg	King's (UK)	5,070	125	584	341	113
Hanácká	Semo (CZ)	4,567	136	439	292	239
Jadran	Semo (CZ)	4,012	104	595	704	380
Lange	Hild (GER)	4,398	97	486	592	462
Lange-glatte KP	Küpper (GER)	5,052	125	506	348	429
Lange-glatte RZ	Rijk Zwaan (NL)	4,542	130	453	841	383
Olomoucká dlouhá	Semo (CZ)	4,214	120	483	549	280
Orbis	Semo (CZ)	4,593	121	532	498	271
Mean		4,690	124	509	425	362
Effects	cultivar	ns	ns	ns	ns	*
	year	**	**	ns	ns	ns

ns – not significant, * – significant difference at $P = 0.05$, ** – significant difference at $P = 0.01$

Mean air temperature recorded during vegetation in 1997 and 1998 was 15.7°C and 17.1°C, temperature sum 2,738°C and 3,047°C, rainfalls 365 mm and 378 mm, respectively.

Statistical analysis (ANOVA, correlation analysis) was performed by statistical software package Unistat version 4.53 (Unistat, USA) at 95% level of probability.

RESULTS

Figs. 1, 2 and 3 show the morphological characteristics of parsley roots. The highest root weight was recorded in cv. Atika (129 g) while the lowest root weight was found in Bartowich Long (87 g). Mean root weight was 108 g and cultivar was confirmed as a significant factor influencing this characteristic.

The mean root head diameter was 45 mm (Fig. 2). Cultivars Halflange Omega and Hamburg resulted with 49 mm and cv. Lange had 39mm root diameter only. Significant effect of cultivar and year was determined.

Root length (Fig. 3) showed the mean value of 162 mm and ranged from 206 mm (cv. Lange-glatte RZ) to 147 mm (cv. Hanácká). The effect of cultivar was found significant, but the effect of year was not confirmed to be significant.

Figure 4 shows yield parameters. The mean yield level ranged from 1.09 to 1.62 kg/m². The highest yield was found in cv. Atika and the lowest value was determined in Bartowich Long. Significant effects of cultivar and year were proved.

The results of nutritional quality evaluation are shown in Table 2. The N-NO₃⁻ average content of roots ranged from about 113 to 617 mg/kg of f.m.

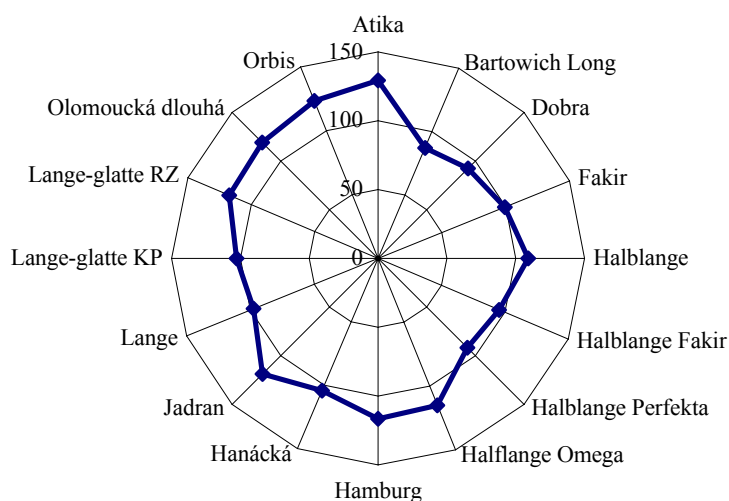


Fig. 1. Mean root weight of parsley cultivars (g)

The minimum and the maximum nitrate level in roots was recorded in cultivars Hamburg and Halblange Fakir, respectively. While no effect of year was found, cultivar was confirmed as a significant factor influencing nitrate content in roots.

The highest potassium content was found in cv. Bartowich Long (5,642 mg/kg) and the lowest value in cv. Jadran (4,012 mg/kg). Mean content of K was 4,690 mg/kg. The effect of growing season on potassium content was found statistically significant.

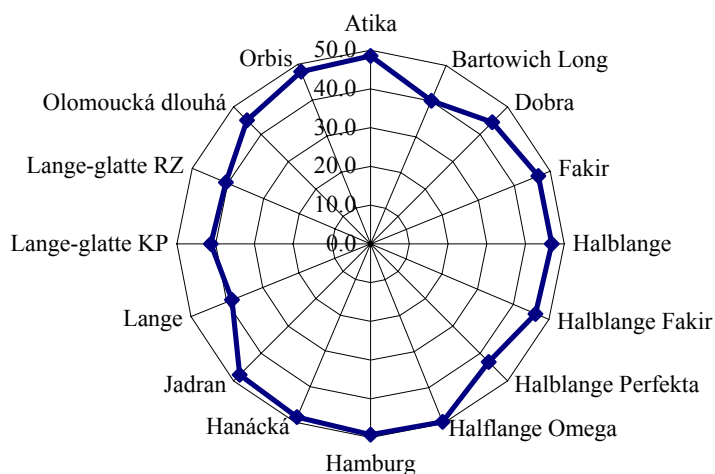


Fig. 2. Mean root head diameter of parsley cultivars (mm)

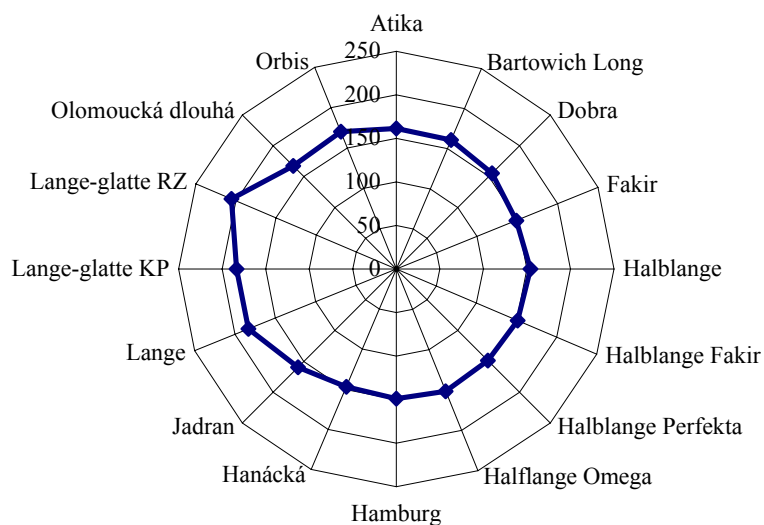


Fig. 3. Mean root length of parsley cultivars (mm)

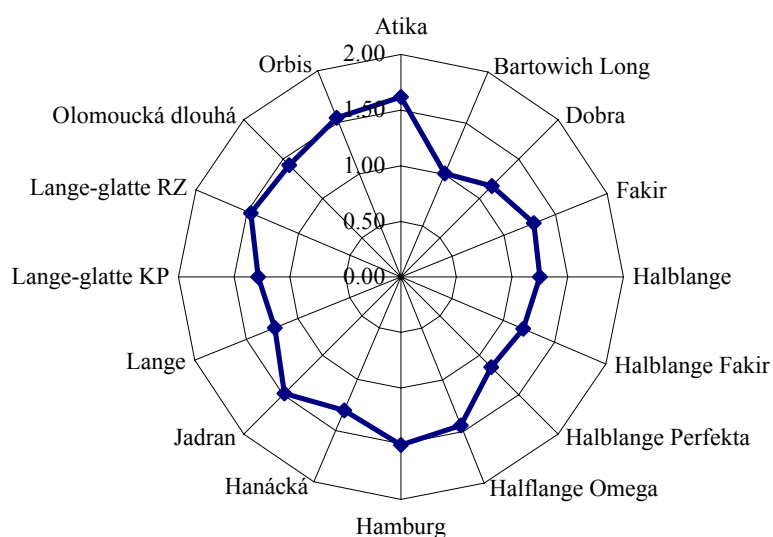


Fig. 4. Mean marketable root yield of parsley cultivars (kg/m²)

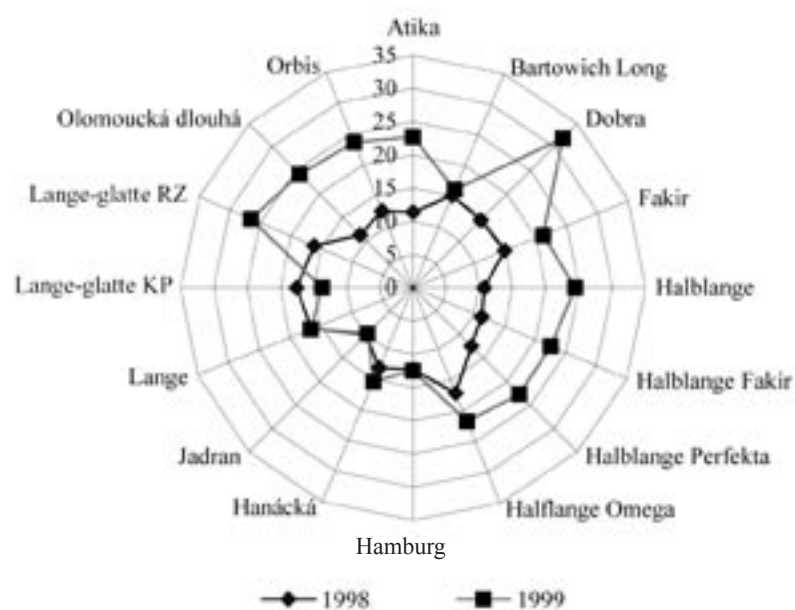


Fig. 5. Losses of root weight of parsley cultivars (%)

Mean calcium content in roots was 124 mg/kg of f.m. Cv. Atika had the highest content (151 mg/kg) and the lowest calcium levels were determined in cv. Lange (97 mg/kg). Year was confirmed as a significant factor influencing calcium content in parsley roots.

The highest magnesium content was recorded in cv. Dobra (616 mg/kg f.m.) while the lowest level was found in cv. Bartowich Long (430 mg/kg f.m.). Mean content of Mg was 509 mg/kg f.m. The effect of cultivar or year was not statistically significant.

Cv. Lange-glatte RZ resulted with the highest sodium content (841 mg/kg) while cv. Dobra showed the value of 201 mg/kg. The effect of cultivar and year was not observed.

The results of storage ability evaluation documented weight losses from 10 to 32% during both years (Fig. 5). Minimum losses were found in cv. Jadran (10%) and maximum ones in cv. Dobra (23%). A significant ef-

fect of cultivar and year on this parameter was confirmed.

DISCUSSION

The results of morphological evaluation brought different values for the chosen parsley assortment. Root diameter was larger than 25 mm in all evaluated cultivars, which is the limit for the first quality market product. The highest root diameter correlates with root weight (Fig. 6). On the other hand, a negative correlation ($r = -0.65$) was found between root diameter and root length (Fig. 7). Figs. 6 and 7 show linear equations and correlation coefficients of analysed data. No other correlation between the morphological characteristics and no correlation with yield were detected.

It can be concluded that all tested cultivars have satisfactory morphological characteristics that can com-

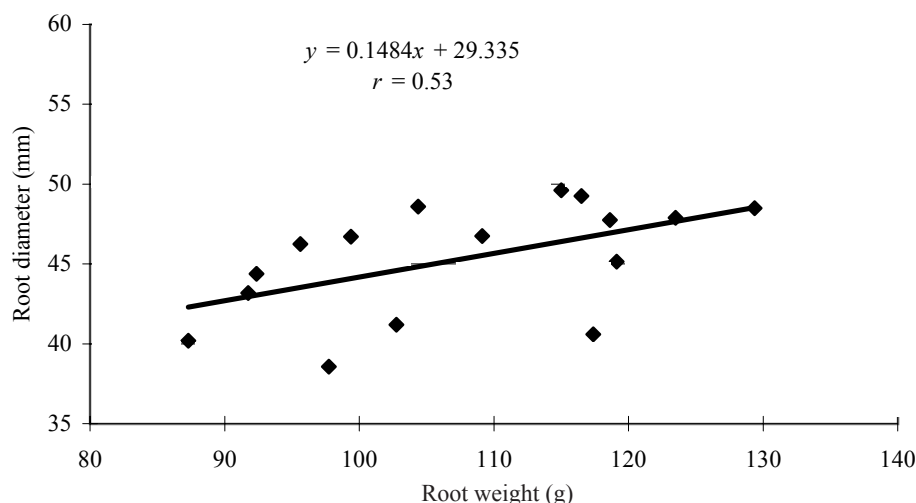


Fig. 6. Correlation of root diameter with root weight

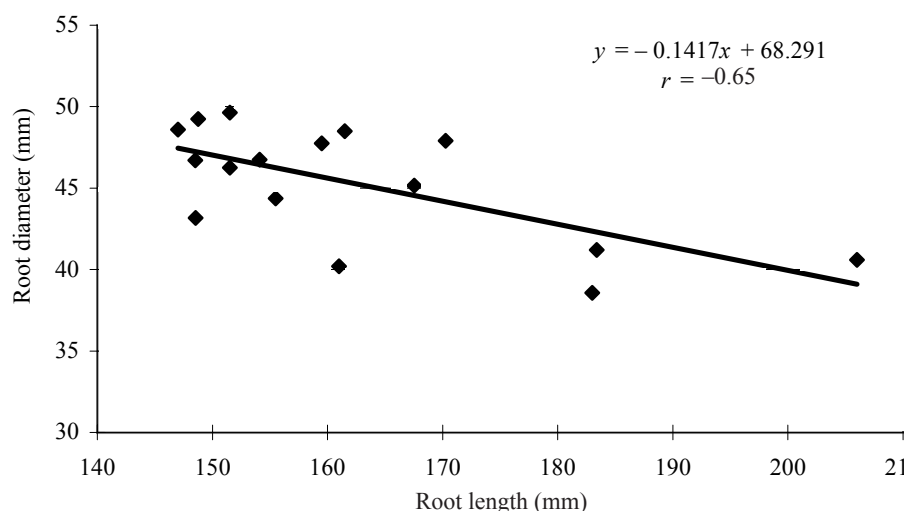


Fig. 7. Correlation of root diameter with root length

ply with Czech quality standards. The thicker the root, the heavier it is. Market demand is for shorter roots that produce less kitchen waste.

The yield levels are in the range of 10 to 16 t/ha. These results correlate more with Czech average parsley yields than with yields achieved in Poland (RUMPEL, KANISZEWSKI 1994). There is still a high potential of parsley genotypes to increase the yield levels. The use of appropriate cultural practices should solve most contemporary problems.

Contents of potassium, magnesium and sodium were similar to data of SOUCI et al. (1991), KOPEC (1998) or other authors. Calcium content was lower if compared with literature data. Many papers describe strong effects of cultivar, weather conditions and growing season on nutritional quality (VULSTEKE et al. 1996; GUTEZEIT, FINK 1999). The effect of cultivar on the content of selected nutrients in roots was not found statistically significant, but weather conditions in the particular years influenced the content of potassium and calcium in roots.

Regulation of the Czech Ministry of Health sets down the maximum tolerable nitrate level 700 mg/kg of f.m. for root vegetables. BAKOWSKI et al. (1993) did not find

any excessive amount of nitrates in parsley roots. This limit was not exceeded in our experiments either, but the value of cv. Halblange Fakir approached the maximum tolerance level. Nitrate content corresponded to the cited data of RUMPEL and KANISZEWSKI (1994) or SIOMOS and DOGRAS (1999).

Storage losses were significant and more important in cultivars represented by the older cv. Dobra, but some of the newer cultivars resulted with quite high losses. Atika, Jadran and Hanácká showed good storage ability. A new breeding programme should focus on this problem together with increasing parsley resistance to diseases.

The tested newer Czech cultivars (Atika, Jadran, Orbis) showed good quality characteristics as well as nutritional quality and storage ability. The risk of higher nitrate levels can be neglected in our cultivation system.

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References

- BAKOWSKI J., MICHALIK H., UMIECKA L., 1993. Wpływ odmiany i terminu siewu na przydatność pietruszki korzeniowej do mrożenia. *Biul. Warz.*, 40: 125–133.
- BAKOWSKI J., MICHALIK H., UMIECKA L., 1994. Wpływ terminu siewu i zbioru na jakość pietruszki korzeniowej i jej przechowanie. *Biul. Warz.*, 41: 157–167.
- GUTEZEIT B., FINK M., 1999. Effect of cultivar and harvest date on nitrate content of carrot roots. *J. Hort. Sci. & Biotechnol.*, 74: 297–300.
- KOPEC K., 1998. Tabulky nutriční hodnoty ovoce a zeleniny. Praha, ÚZPI: 72.
- LACHMAN J., PIVEC V., ORSÁK M., 1997. Askorbát-nitrátový a vláknino-nitrátový index – faktory charakterizující kvalitu zeleniny. *Chem. Listy*, 91: 708–709.
- MALÝ I., BARTOŠ J., HLUŠEK J. et al., 1998. *Polní zelinářství*. Praha, Agrospoj: 196.
- PRUGAR J., PRUGAROVÁ A., 1985. *Dusičnany v zelenině*. Bratislava, Příroda: 150.
- RUMPEL J., KANISZEWSKI S., 1994. Influence of nitrogen fertilization on yield and nitrate nitrogen content of turnip-rooted parsley. *Acta Hort.*, 371: 413–419.
- SIOMOS A.S., DOGRAS C.C., 1999. Nitrates in vegetables produced in Greece. *J. Veg. Crop Prod.*, 5: 3–13.
- SOUČI S.W., FACHMANN W., KRAUT H., 1991. Die Zusammensetzung der Lebensmittel. *Nahrungstabellen Wissenschaftliche Verlagsgesellschaft mbH, Stuttgart*. In: VOGEL G., HARTMANN H.D., KRAHNSTÖVER K., 1996. *Handbuch des speziellen Gemüsebaues*. Verlag Eugen Ulmer: 1127.
- U.S. Department of Agriculture 2001. USDA Nutrient Database for Standard Reference, Release 14, Agricultural Research Service, Nutrient data laboratory home page: <http://www.nal.usda.gov/fnic/foodcomp>, 30. 7. 2002.
- VULSTEKE G., DEKEYSER M., DEGRYSE E. et al., 1996. Einfluss von Sorte und Erntezeit auf die chemische Zusammensetzung von Möhren Typ 'Amsterdam Forcing'. *Industrielle Obst und Gemüseverwertung*, 81: 129–134.

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Porovnání vybraných parametrů sortimentu kořenové petržele [*Petroselinum crispum* conv. *radicosum* (Alef.) Danert]

ABSTRAKT: V polních pokusech byl hodnocen sortiment 15 odrůd kořenové petržele. Byly sledovány morfologické vlastnosti, tržní výnos kořenů, obsah vybraných minerálních látek a dusičnanů. Byly také hodnoceny ztráty v průběhu skladování kořenů. Průměrná hmotnost kořenů byla 108 g s rozsahem od 87 g (Bartowich Long) do 129 g (Atika). Průměr hlavy kořene byl od 39 mm (Lange) do 49 mm (Halblange Omega a Hamburg). Výnos se pohyboval na průměrné úrovni 1,35 kg/m², přitom nejlepších výsledků dosahovala odrůda Atika. Obsah nitrátů nepřekročil zdravotní normu a byl v rozsahu od 113 do 617 mg/kg č.h. Podíl draslíku byl v průměru 4 690 mg, vápníku 124 mg, hořčíku 509 mg a sodíku 425 mg/kg č.h. Zjištěné ztráty činily od 10 do 32 %, přitom jako nejlepší se ukázala odrůda Jadran. Novější české odrůdy (Atika, Jadran, Orbis) vykazovaly dobrý ekonomický a pěstitelský potenciál.

Klíčová slova: petržel; morfologické vlastnosti; výnos; nutriční hodnota; skladovatelnost; odrůda

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